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Survey of Ixodid Ticks on Cattle in Borana Pastoral Area, Ethiopia

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Abstract: This study was conducted from September 2011 to May 2012 in Borana pastoral area with the objectives of determining the distribution and relative abundance of Ixodid ticks on cattle in relation to short rain and major dry seasons, cattle age and sex. A total of 8,912 adult ticks belonging to genera of *Rhipicephalus*, *Amblyomma*, *Boophilus* and *Hyalomma* were collected from 768 indigenous cattle. *Rhipicephalus pulchellus* and *Amblyomma gemma* constituted more than 70% of the total collection. Other identified species in order of abundance were *Boophilus decoloratus, Amblyomma variegatum, Hyalomma marginatum rufipes, Hyalomma truncatum, Amblyomma lepidium* and *Amblyomma cohearens*. All species were collected throughout the study period, but showed higher overall mean tick burden (29.39±14.392) during short rain season than major dry (17.14 ±7.294). These variations were statistically significant ($P< 0.05$). The abundance and mean burden of each tick species was high in adult cattle than young and females than males; which also showed statistical significant variation ($P<0.05$) between cattle sex and age groups. The results of this study suggested that the two seasons, cattle age and sex were found to be determinant for dynamics of tick population during the study period. Therefore, strategic control using such seasonal dynamics of ticks, aimed at primarily reducing *Rhipicephalus pulchellus* and *Amblyomma gemma* burden on female and adult cattle, with the objectives of allowing maintenance of endemic stability are recommended.

Key words: Prevalence · Species · Distribution · Risk factors

INTRODUCTION

In Ethiopia, pastoralist areas cover 60% of total landmass of the country and majorities are engaged in extensive livestock herding, which forms the backbone of national economy [1]. The pastoralist groups managed 40% of the national cattle herd; and some 90% of the country's live animals for export. Similarly, Borana rangeland area is among the known pastoralist area of Ethiopia and covered 26% of the livestock population of the country. Though, there is huge livestock resource in pastoral area of Ethiopia [2] and pastoralists of Borana, in exacting [3], due to vary constraints, they are not economically benefited out of it. Among others contagious diseases, ectoparasites (ticks and mange mites) and tick borne diseases are the impediments [4, 5].

In most of Africa including Ethiopia, tick and tick borne diseases (TBDs), together with tsetse and trypanosomosis, are economically very important diseases [6]. Since, studies on tick fauna in Ethiopia begun in early the 19th century [7]; extensive surveys have been carried out on the distribution of ticks on livestock in different regions and more than 60 species of ticks infesting both domestic and wild animal have been recorded. Among these, 30 species are very widespread and important parasites of livestock [1] and causes significant economic losses to livestock industry. The economic losses incurred from downgrading of hides and skins are enormous, export yields foreign earnings of the country, second only to coffee [8].

Rhipicephalus pulchellus and *Amblyomma gemma* are the predominant species in arid and drier land of the country [9] together with arid and drier land of Borana pastoral area [10- 12]. However, the distribution limits of ticks are not fixed and constant, but are determined by a complex interaction of factors (climate, host density, host susceptibility etc) [13]. Therefore, relevant update data on such responsible factors are essential for effective tick and TBDs control strategies [14]. Therefore, the objectives of this study was to determine the distribution

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and mean burden of adult tick dynamics in different age and sex of cattle and in short rain and major dry seasons of Borana pastoral area.

MATERIALS AND METHODS

Description of Study Area: The study was conducted from September 2011 to May 2012 in two districts (Yabello and Dire) of Borana Pastoral area, Southern range lands of Ethiopia. Borana zone, one of the 17 zones of Oromia, is under the administration of Oromia National Regional State. The zone comprises of mainly pastoral area and seldom Agro-pastoral areas. Yabello and Dire districts are among the pastoral areas and located at distance of 570 and 665 kilometers from Addis Ababa, the capital city of Ethiopia, respectively. The region has predominantly a semi-arid climate. The annual temperature varying between 21°C and 38°C with little seasonal variations and the rainfall ranges from 350mm to 900mm, with considerable spatial and temporal variability in quantities and distribution [4]. The study region is characterized by bimodal type rain with 60% occurring in the long rainy season (*Gana*) extending from mid-March to May and erratic short rain season (*Haggaya)* from mid-September through mid-November. The other two seasons are the cool dry season (*Adolessa)* extending from June to August and the major dry season (*Bonna*) from December to February [15] (BZPADO, 2009/10).

Study Animals: The study was carried out on different cattle herds belonging to Yabello and Dire districts. Three hundred eighty four indigenous cattle of different age group and sex were used for adult tick survey during each short rain season and major dry season. For convenience, cattle were divided into two age groups such as young (cattle of ≤ 1.5 years) and adult (cattle of >1.5 years) [16].

Study Design: A cross-sectional study design was used to determine the relative abundance and mean burden of adult tick species on different age groups and sex of cattle and in two seasons of study area. A questionnaire survey of such study design was also included for assessment of pastoralists' perception on cattle tick control options and its methods of applications practiced in the area.

Sample Size and Sampling Methods: To determine ticks species distribution dynamics and adult tick burden in different sex and age groups of cattle and two seasons of the area; the study districts (Yabello and Dire) and three PAs in each district were selected purposively. But the study cattle were sampled using Stratified random sampling by considering equal number of cattle in each district as well as equal number of each sex and age groups during each season of the study area. The sample size was determined using the formula given by Thrusfield [17] based on 50% expected prevalence because as there was no current study conducted on the overall prevalence of tick infestation on cattle in the area. The desired sample size for the study was calculated using 95% confidence interval at 5% absolute precision. Therefore, during each season (short rain, early-October to December; and major dry period, January to mid-March) a total of 384 cattle were sampled. That is, a total of 64 cattle (16 cattle of each sex and 16 cattle of each age group) were sampled every month from each district.

Study Methodology: Ticks were collected in two seasons during the study period: in the short rain season (Mid-Septamber to mid December, 2011) and during the dry period (January to March, 2012). Prior to collection, each cattle was casted and restrained. All adult ticks were collected by hand picking whilst retaining their good condition for identification from eight main tick attachment body sites on alternative sides of the half-body regions of cattle. The eight half body regions for collections were head, dewlap, brisket, belly and back, scrotum/udder, on genital region, leg and tail [18]. The collected ticks were put in separately labeled universal bottle containing 80% ethanol and 15% water with 5% glycerin. Each label includes locality, identification code and attachment site and date of collection [9]. Afterward, ticks were transported to Yabello Regional Veterinary Laboratory. Counting, recording and identification of ticks using hand lens and stereomicroscope took place within one to three weeks of collection. Ticks were identified according to standard taxonomic identification procedures described by [19-21]. All adult tick species identified in each of the season were counted according to their predilection site on cattle half body: hence, the total number of any tick species and mean tick burden present on cattle was estimated. For analysis the half body tick counts were doubled to obtain whole body adult tick burden. The information on meteorology and other climatic conditions of the area were also gathered.

Statistical Data Analysis: All statistical analyses were performed using Statistical Package for Social Science (SPSS)-Version 19 for windows. The difference in the

relative proportion and prevalence of tick species were analyzed using Chi-square test. Whereas, Independent sample t-test was used to examine either differences mean tick burden between seasons, sexes and age groups.

RESULTS

In the survey, a total of 8,912 adult ixodid ticks were collected from half body region of 768 cattle in Yabello and Dire districts of Borana pastoral area. Of totals collected, 4,488 ticks were collected from cattle in Yabello while 4,424 tick from cattle in Dire district. Eight tick species belonging to four genera were collected in both districts (Table 1). The tick genera identified were: *Rhipicephalus* (46.79%), *Amblyomma* (35.28%), *Boophilus* (13.05%) and *Hyalomma* (4.98), but with diverse level of infestation in different age and sex groups of cattle as well as during the short rain and major dry seasons of the area. The overall mean tick burden/cattle were 23.35±12.27 in Yabello and 23.18±13.61 in Dire district; and which showed no statistical significance (P> 0.05).

Rhipicephalus pulchellus was the most abundant tick species identified and having male to female tick sex ratio (M:F) of 4.26:1; and followed by *A.gemma*, having M:F of 3.93:1. Thus, *Rh.pulchellus* and *A.gemma* were the two most prevalent tick species in cattle representing more than 70% of total collected ticks. While, *A.cohearens* was least abundant and having M: F of 5.7:1 (Table 2). The mean burden variation of each tick species between the two districts has not shown statistical significance (P>0.05).

To assess the seasonal distribution of adult tick in cattle of Borana pastoral area, two seasons namely, short rain and major dry periods, were considered. All the identified tick genera and species were collected throughout the period; but highest number of all species was collected in short rain season (Table 3), mainly in October month. The total count of each tick species indicated significant seasonal variation (P< 0.05). An overall M: F of 2.92:1 in short rain and M:F of 4.21:1 in major dry season were collected. During both seasons, *Rh. pulchellus* was found to be the most abundant species and followed by *A.gemma,* with similar peak occurrence in October month. The monthly population dynamics of each tick species on cattle showed on Figure-1. The high mean tick burden of one month coincides with the meteorological information data recorded in the preceding month (s) relatively necessary for development of oviposition female, hatching of eggs, moulting of larvae and nymphs of tick species (Fig.2).

The overall mean adult tick burden has shown statistical significant seasonal variation (P<0.05) and higher during short rain season (29.39±14.392) than major dry period (17.14 ±7.294). During both seasons, maximum mean adult tick burden was observed in case of *Rh.pulchellus,* 12.80±7.818 during short rain and 8.88±3.932 in dry season; and the least was in case of *A.cohearens*, 0.54±1.051 during short rain and 0.16±0.644 in dry period (Table 4).

In the study, the overall mean adult tick burden between adult and young categories showed statistical significant variation (P<0.05) and higher in adults (30.66±12.696) than youngest (15.80±7.945). The mean

Table 1: Relative tick burden in Yabello and Dire district of Borana pastoral area.

Tick Genera	Yabello district	Dire district	% out of total tick
Rhipicephalus	46.2% (2073)	47.22% (2089)	4162 (46.79%)
Amblyomma	35.36% (1587)	35.19% (1557)	3144 (35.28%)
Boophilus	13.41% (602)	12.68% (561)	1163 (13.05)
Hyalomma	5.01% (226)	4.91% (217)	443 (4.98%)

Table 2: Relative abundance, mean count and M: F of tick species on cattle in Yabello and Dire districts, Borana pastoral area of Ethiopia.

	Yabello		Dire				
Tick species	P (%)	Mean±SD	P (%)	Mean±SD	t-value	Overall Prevalence	Overall M:F
A. gemma	23.66	3±2	23.62	3±1	0.405	23.64%	3.93:1
A. variegatum	8.6	1±1	8.1	1±1	0.95	8.35%	3.83:1
A. lepidium	1.8	0	1.81	0±1	-0.072	1.78%	4.28:1
A. cohearens	1.33	0	1.7	0	-1.133	1.5%	5.7:1
B. decoloratus	13.41	2±2	12.68	1±2	-0.178	13.05%	0.93:1
H. truncatum	2.11	0	2.22	0±1	0.78	2.17%	7.39:1
H. m. rufipes	2.9	0±1	2.69	0±1	0.871	2.81%	4.53:1
Rh. pulchellus	46.2	5±3	47.22	5±3	-0.221	46.7%	4.26:1

P (%) = Prevalence, SD= Standard Deviation, M:F=Male to female tick sex ratio

Table 3: Relative abundance and M: F of adult tick species on cattle during short rain and major dry seasons in Borana pastoral area

	Short rain season		Major dry season	
Tick species	% from the season	M:F	% from the season	M:F
Rh. pulchellus	2457 (43.66%)	3.34:1	1705 (51.92%)	6.65:1
A. gemma	1201 (21.34%)	3.72:1	906 (27.6%)	4.24:1
A. variegatum	536 (9.53%)	3.91:1	208 (6.34%)	3.62:1
A. lepidium	118 (2.11%)	5.1:1	41 (1.25%)	2.73:1
A. cohearens	104 (1.85%)	7.67:1	30 (0.92%)	2.75:1
B. decoloratus	159 (16.35%)	0.98:1	91 (7.4%)	0.75:1
H. truncatum	920 (2.83%)	11.1:1	243 (7.63%)	4:1
H. m. rufipes	133 (2.36%)	6.67:1	60 (1.83%)	2.67:1

M:F= male to female tick sex ratio

Table 4: T-test analysis of mean tick burden on cattle between short rain and dry season

Tick species	Season	Mean	SD	SE	t-value	df	95%CI	S
Rh.pulchellus	S/rainy	12.80	7.818	0.399	8.77	766	3.040-4.793	0.000
	Dry	8.88	3.932	0.201				
A. gemma	S/rainy	6.26	3.271	0.167	7.272	766	1.122-1.951	0.000
	Dry	4.72	2.537	0.129				
A. variegatum	S/rainy	2.79	2.339	0.119	12.14	766	1.432-1.984	0.000
	Dry	1.08	1.457	0.074				
A. lepidium	S/rainy	0.61	1.173	0.060	5.695	766	0.263-0.539	0.000
	Dry	0.21	0.727	0.037				
A. cohearens	S/rainy	0.54	1.051	0.054	6.127	766	0.262-0.509	0.000
	Dry	0.16	0.644	0.033				
H. m. rufipes	S/rainy	0.83	1.305	0.067	4.054	766	0.183-0.526	0.000
	Dry	0.47	1.107	0.057				
H. truncatum	S/rainy	0.69	1.057	0.054	5.471	766	0.244-0.517	0.000
	Dry	0.31	0.859	0.044				
Rh.(B.). decoloratus	S/rainy	4.79	3.383	0.173	16.818	766	3.114-3.938	0.000
	Dry	1.27	2.333	0.119				

S/rainy= Short rain season, SD= Standard deviation, SE= Standard error, S= Significance

Table 5: T-test analysis of mean tick burden in adult and young cattle at Borena pastoral area

Tick species	Age	Mean	SD	SE	t-value	df	95% CI	S
A.gemma	Adult	6.94	3.027	0.154	15.244	766	2.541-3.292	0.000
	Young	4.02	2.207	0.113				
A.variegatum	Adult	2.74	2.306	0.117	11.370	766	1.336-1.894	0.000
	Young	1.13	1.554	0.080				
A.lepidium	Adult	0.61	1.223	0.062	5.631	766	0.258-0.535	0.000
	Young	0.21	0.637	0.033				
A.cohearens	Adult	0.50	1.053	0.054	4.868	766	0.184-0.433	0.000
	Young	0.19	0.659	0.034				
Rh.pulchellus	Adult	14.11	7.031	0.358	16.318	766	5.793-7.377	0.000
	Young	7.53	3.592	0.184				
H.m.rufipes	Adult	1.00	1.450	0.074	8.295	766	0.536-0.868	0.000
	Young	0.30	0.797	0.041				
B. decoloratus	Adult	3.83	3.614	0.184	6.796	766	1.152-2.087	0.000
	Young	2.21	2.953	0.151				
H.truncatum	Adult	0.82	1.168	0.059	9.482	766	0.504-0.767	0.000
	Young	0.18	0.596	0.030				

SD= Standard deviation, SE= Standard error, S= Significance

Table 6: Prevalence of tick species infestation by cattle sex at Borana pastoral area

	Male cattle		Female cattle	
Tick species	Number of ticks	% from total	Number of ticks	% from total
A.gemma	867	24.05	1240	23.37
A.variegatum	280	7.8	464	8.74
A.lepidium	62	1.72	97	1.83
A.cohearens	52	1.44	82	1.55
Rh.pulchellus	1654	45.88	2508	47.26
H.m.rufipes	84	2.33	166	3.13
B.decoloratus	534	14.82	629	11.85
H.truncatum	72	2	121	2.28

Table 7: T-test analysis of mean adult tick burden by sex of cattle at Borana pastoral area

Tick species	Sex	Mean	SD	SE	t-value	df	95% CI	S
A. gemma	Male	4.52	2.464	0.126	-9.392	766	-2.349 to -1.537	0.00
	Female	6.46	3.218	0.164				
A. variegatum	Male	1.46	1.746	0.089	-6.405	766	-1.252 to -0.665	0.00
	Female	2.42	2.356	0.120				
A. lepidium	Male	0.32	0.805	0.041	-2.546	766	-0.323 to -0.042	0.00
	Female	0.51	1.149	0.059				
A. cohearens	Male	0.27	0.744	0.038	-2.435	766	-0.282 to -0.030	0.00
	Female	0.43	1.014	0.052				
Rh. pulchellus	Male	8.61	4.260	0.217	-10.11	766	-5.312 to -3.584	0.00
	Female	13.06	7.497	0.383				
H. m. rufipes	Male	0.44	0.999	0.051	-4.913	766	-0.598 to -0.256	0.00
	Female	0.86	1.380	0.070				
B. decoloratus	Male	2.78	3.437	0.175	-2.022	766	-0.975 to -0.014	0.00
	Female	3.28	3.344	0.171				
H. truncatum	Male	0.38	0.821	0.042	-3.634	766	-0.393 to -0.117	0.00
	Female	0.63	1.105	0.056				

SD= Standard deviation, SE= Standard error, S= Significance

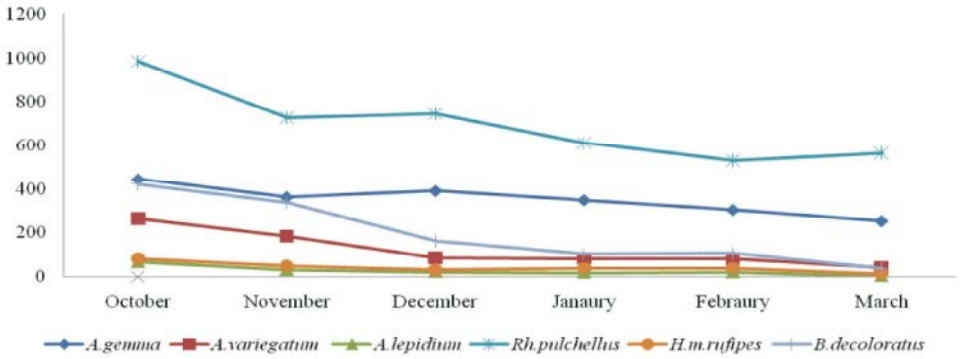

Fig 1: Monthly population dynamics of six tick species on cattle in Borana pastoral area

burden of each species between adult and young cattle has also shown significant variation (P<0.05) (Table 5). *Rhipicephalus pulchellus* was found to be the most abundant in both age categories; comprises 46.19% and 47.77% of total ticks collected from adult and young cattle, respectively. While, *A.cohearens*, of total ticks collected from adults and *H.truncatum*, of total tick collected from young cattle were found as the least. The variation of each tick species between age groups was statistically significant (P<0.05).

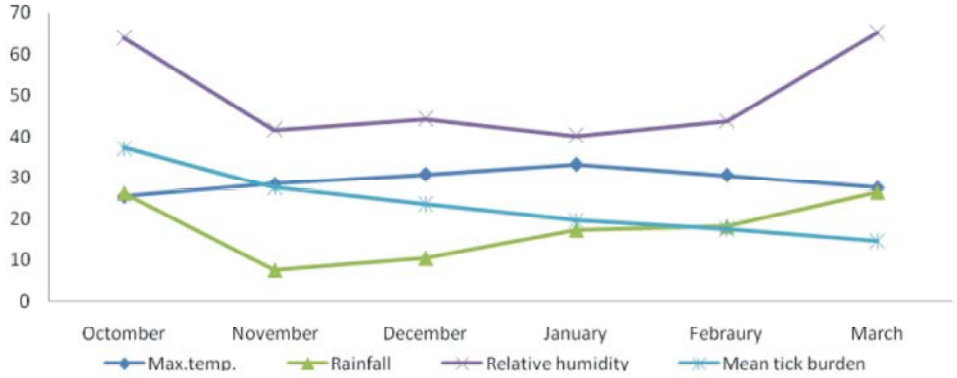

Fig 2: Monthly mean tick burden variation in relation to temperature, relative humidity and rainfall information recorded at Yabello district of Borana pastoral area

Statistically significance variation (P<0.05) in tick abundance (high number of ticks in female cattle, 59.55% and low number of ticks in males, 40.45% of total collected ticks) and overall mean adult tick burden (P< 0.05) between male and female cattle was observed. In both cattle sex groups, the highest proportion was in case of *Rh.pulchellus*, but *A.cohearens* has shown least proportions (Table 6) from the total collected eight tick species.

The overall mean tick was higher, 27.67±14.518 in female cattle and lower, 18.89±9.291in males. The mean burden of each tick species between male and female cattle during the study also showed statistical variation at 5% level of significance (Table 7).

DISCUSSIONS

In this study, a survey was accomplished to determine the dynamics of adult tick distribution and infestation level on cattle in relation to seasonal changes (short rain and major dry) and the host susceptibility (sex and age). The survey was limited to adult ticks. This was due to the fact that adult ticks are more visible, relatively easier to collect and believed to be the most important ectoparasite stage in causing reduced productivity in cattle [11].

During the study period a total of 8,912 ticks belonging to genera of *Rhipicephalus* (46.79%), *Amblyomma* (35.28%), *Boophilus* (13.05%) and *Hyalomma* (4.98%) were found on cattle in both Yabello and Dire districts of Borana pastoral areas, Ethiopia. Previously a closely similar result with greater frequency of *Rhipicephalus* was reported in these areas by Solomon and Kaaya and Regassa [10, 11] as well as in eastern part of Ethiopia by Zeleke and Bekele [22].

The result of this adult tick survey indicated that all the identified species were distributed in both study districts in a closely similar abundance manner. The identified tick species were *Rh. pulchellus*, *Amblyomma gemma*, *A. lepidium, A. variegatum, A. cohearens, B. decoloratus, H. truncatum* and *H. m. rufipes*. This finding was in line with Rahmeto *et al*. [23] investigation, who recorded the distribution of similar eight tick species in two pastoral districts of Somalia regional state. Such closely similar occurrences of tick species in two districts was most likely associated with the fact that similar livestock rearing practice, environmental condition, vegetation coverage and presence of only indigenous cattle breed of the two districts [4]. Hence, these factors are highly determined the distribution, survival and development of ticks. Climatic factors and cattle rearing practices associated with different breeds have a direct influence on the biology and ecology of ticks [23-26] and also robustly agree with the fact that unrestricted livestock movement from area to area in search of water and grazing, which is a common phenomenon in the area, increases and promotes tick-host contact between and/or among districts. Thus, contributes for tick distribution similarities.

All the identified tick genera and species were collected throughout the study period; but the total count of each tick species indicated significant seasonal variation (P< 0.05). Higher numbers of ticks were collected in short rain season, mainly in October. This observation was in consistence with the previous finding in Borana province by Solomon and Kaaya [12], in which higher rate of tick infestation on cattle was observed in October, April, May and June. Moreover, an investigation with similar proportion and seasonal variations for majority of this tick species were indicated by previous studies by

Zeleke and Bekele [22] in Eastern Ethiopia; [27] and Abunna *et al*. [28] in West Harargie of Oromia region and Rahmeto *et al.* [23] in pastoral area of Somalia. This study also agrees with other study conducted in Southern Sudan by Salih *et al*. [29].

During this study period, the abundance of adult tick population in one month depends on the meteorological information recorded on climatic factors (Relative humidity and atmospheric and soil temperature) of the preceding month(s). This might be due to the fact that the number of adult tick annual generation is limited by conditions necessary for development of ovipositing females, hatching of eggs, moulting of larvae and nymphs. Hence, all these necessary conditions are of paramount importance to the future continuation of the tick life cycle [10,30]. For that reason, it is most likely to be that adult female ticks exposed during wet season (March, April and May of the study area) having optimal RH and rainfall could lay large number of eggs with a high level of hatching [30, 31]. Thus, might result the development of more larvae and ultimately a high population on the pasture during the late peak rain season. The larvae that hatched at such wet season, had long survival, high moulting rate and it can remain at an exposed vantage point on the vegetation [32] during the cool dry period; June to August of the present study area. This might attribute to the collection of high adult tick population in October month of the short rain seasons.

However, female ticks those exposed during the major dry and cool months either failed to lay expected normal batch of eggs or produced very few eggs, which did not hatch at all [33]. The climatic condition of these months (December, July and August) most likely attributed to adversely affect egg lying by most ticks, aligned for the collection of small number of adult tick for their respective successive month (s) [9, 12, 24,31] as well observed this variation.

The variation of tick abundance and mean burden during the short rain and major dry season in the present study might also most likely depends on vegetation coverage, immunological response of hosts and livestock keeping practice during short rain season of the area. As vegetation coverage following small rain and seasonal dependant crop production might have great importance to create shades or suitable habitat for ticks [25]. Moreover, a significantly higher mean tick burden was viewed in the area where practice of keeping large herds of cattle together during rainy season, that is when there was no area to area movement in seeking of watering and grazing land, which often tend attributed to ticks to find suitable hosts [23]. Similar analysis was also revealed in Southern Sudan by Salih *et al.* [29]. Minjauw and McLeod [33] have been explained low tick load association with the dry season. It is known that the number of female ticks attached to the host is the most significant indicator of the seasonal activity and population dynamics of ticks [33, 34]. During this study too, low M: F of 2.92:1during short rain and high M: F of 4.21:1during dry season was observed. Similar to this finding the highest collection of ticks combined with a relatively small male/female ratio obtained during rainy season of October by Solomon *et al*. [13]. Salih *et al.* [29] also indicated to rainy season is favorable for the survival and breeding of female ticks in Sudan.

In all cases, except for *B.decoloratus*, males outnumbered females; this is most probably because fully engorged female ticks drop off to the ground to lay eggs while males tend to remain on the host up to several months later to continue feeding and mating with other females on the host before dropping off [10, 33, 24]. Host grooming easily remove semi-engorged or engorged females as compared to males [39]. The females of *B. decoloratus* outnumbered males in this study probably due to the small size of the male which could not be seen. This might be one of the contributory factors for missing males. Similar report was indicated in the country by Solomon *et al*. and Desie and Abebaw and Tamiru [13,26,35].

In this finding, however, each identified tick species was collected from both young and adult cattle; age of cattle was found to be a risk factor for the variation of tick abundance and mean burden. The proportion of the overall tick count was relatively higher in adult cattle (66.18% of total collection) than in youngest (33.82% of total collection). This finding was in agreement with the previous work of Okello-Onen *et al*. [20] in Uganda and with that of Yakhchali [36] in Oshnavich.

This study also revealed the collection of all the identified tick species from both male and female cattle. However, there was abundance and mean tick burden variation in male and female cattle and found high number of tick count in female cattle (59.55% of total collection) than in male cattle (40.45% of total collection). This variation has shown a statistical significance ($P<0.05$). The most probable cause for the high count and burden of tick in female cattle could be hypothesized that some hormonal influences may be associated with this phenomenon.

The predominant tick species during both study seasons was *Rh. pulchellus*, but high total count and mean burden was observed in short rain season (29.39±14.392) than major dry season (17.14 ±7.294). In Ethiopia, *Rh.pulchellus*, "Zebra tick", three host tick species, are the most predominant ticks inhabiting dry, semi-arid and bush land and are found to be most abundant with marked seasonal changes. This finding was inconsistent with the earlier studies accomplished in the present study area [10, 11] and in the Rift Valley and eastwards [21], in the drier lowlands of Harar [37] and in north eastern [38].

It is evident that tick burdens are further exacerbated by the availability of adequate numbers of hosts. Since, each and every family keeps as many as livestock which increases livestock density and promotes tick-host contact [33]. This might be the most probable factor for the high abundance of *Rh. pulchellus* throughout the study period, as both mature and immature stages of *R. pulchellus* feed on a wide variety of domestic and various large wildlife species hosts [21]. Therefore, in an area like Borana pastoral area, where extensive livestock herding practiced, the frequency and intensity of cattle contact with all livestock species is likely high and consequently influence abundance of this species [11]. A similar observation for *Rh.pulchellus* host variability was reported in Somali region [22] and in southern Ethiopia [1].

Amblyomma gemma, was identified as a second predominant species and highest burden was observed during rainy season. The statistical analysis of the result showed significant mean burden variation ($P<0.05$) between short rain and major dry season. A similar wider distribution of *A.gemma* in this study area was reported [11, 21, 39]. Like the present study area which is characterized by lowland and dry types of vegetation, most of the previous studies conducted in the country revealed, as the distribution of *A.gemma* was clearly associated with dry types of vegetation or semi-arid rangelands [7] and in lowland areas [26, 38].

In contrast, [8] reported the decreasing order of Amblyomma species abundance in central Ethiopia as *A. variegatum, A. cohaerens, A. lepidum* and *A. gemma.* This abundance variation is possibly due to the difference in ecological, climatic, animal breed, farming practice etc of these two areas. Moreover, the predominant occurrence of *A. gemma* might be due to its high host seeking properties under the present study area environmental condition, type of animals and management system [21]. The preference of attachment site by *A.gemma* might be also one of important factor for its population abundance and survival [1].

This study has also revealed *B.decoloratus* as the third most abundant species in the area. *Boophilus decoloratus* was collected throughout the study period, but showed high significant variation in mean tick burden ($P<0.05$) during short rain than major dry season. In contrast, [13] at Sebeta; [25] at Alemaya Agriculture University Campus; [24] in southwestern Ethiopia and Desie [26] at Wolayta observed its most abundant occurrence all at with approximately similar altitude and during the dry season. These the above mentioned regions in which *B.decoloratus* reported in high abundance during the dry season; received dry season mean maximum and minimum temperature as well as average dry season humidity of closely similar to that of the present study area short rain season.

According to the previous work done by de Castro (1994) in areas with bimodal rainfall, like Borana pastoralists, female *B. decoloratus* is abundant from end of rainfall peak to the beginning of the next rainy season. That is April-May and September-October of the present study area, respectively. Abebaw [24] has been reported the high dependence of *B.decoloratus* on moist microenvironments because of its great susceptibility to percentage losses of total body water and drop in haemolymph volume at low humidity. This study illustrates that *B.decoloratus* perish rapidly when the humid protection is disrupted. All of this facts possibly justifies the over decreasing of *B. decoloratus* during major dry season.

During this study period, the collections of other tick species were too few too suggest their seasonal proportion and mean abundance variation. They were (in order of abundance) *A. variegatum, H.m. rufipes, H.truncatum, A. lepidium* and *A. cohearens*. All species were collected throughout study period with peak abundance in October of short rain season. The reason for such little abundance of these species might be associated with availability of suitable hosts or the climatic factor in the study area which could not be suitable for survival of unfed ticks or else the behavior of these ticks on finding their hosts might be lesser. The study of tick species on the host population dynamics and their survival in diverse natural habitats might be useful to initiate formulating integrated, suitable,

efficient and economical tick control measures [40]. However, the currently available tool for tick control in many countries relaying on using acaricides, often without understanding of such responsible factors. These leads to environmental pollution, development of resistant tick strains and escalating costs [14].

In conclusion, eight tick species belonging to genera of *Amblyomma*, *Rhipicephalus*, *Boophilus* and *Hyalomma* were identified. *Rhipicephalus pulchellus* and *A. gemma* were the most abundantly distributed species on cattle of Borana pastoral areas and contributed more than 70% of total collected ticks. The seasonal (short rain and major dry seasons) was play great role for tick species distribution and abundance dynamics in the area. Age and sex of cattle were also found to be important determinant for tick population dynamics. Irrespective of the seasons, high total tick count and mean tick burden was found on adult cattle than youngest; and on females than males.

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