

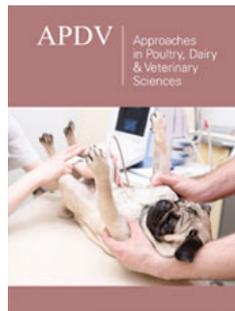
Ixodidae Ticks of Bovine; Prevalence and Major Species Identification in Soddo Zuria Districts of Wolaita Zone, Ethiopia

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ISSN: 2576-9162



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Submission:  May 08, 2019

Published:  June 19, 2019

Volume 6 - Issue 2

How to cite this article: Mulugeta A, Beredu Y, Biruk A. Ixodidae Ticks of Bovine; Prevalence and Major Species Identification in Soddo Zuria Districts of Wolaita Zone, Ethiopia. *Appro Poultry Dairy & Vet Sci* 6(2). APDV.000632.2019. DOI: [10.31031/APDV.2019.06.000632](https://doi.org/10.31031/APDV.2019.06.000632)

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Abstract

The distribution and abundance of cattle tick species in Soddo Zuria woreda, Wolaita zone, was studied over a period from November 2016 to April 2017. Adult ticks were collected from seven main body regions of 501 cattle which were under an extensive management system. Out of the total of 501 cattle examined, 327 (65.27%) were found to be infested by one or more tick species. In this study, 3290 adult ticks were collected from the animal body parts and identified to genera and species level. Four tick species of three genera (*Amblyomma*, *Boophilus*, and *Rhipicephalus*) were identified. The relative prevalence of each species was *Boophilus decoloratus* (45%), *Amblyomma variegatum* (23%), *A. cohaerence* (17%), and *Rhipicephalus evertsi-evertsi* (13%). The risk factor like sex of cattle did not show significant association with the infestation rate but there was an association with age, breeds and body conditions. The prevalence of tick infestation in poor body condition (75%), medium body condition (61%) and good body condition (55%) were found to be statistically significant ($p < 0.05$) among the three groups of body conditions.

The prevalence of tick infestation was found to be statistically significant ($p < 0.05$) among the three breeds, with the highest prevalence in local breeds (70%) than both exotic (62%) and cross breeds (54%). The result indicated that the favorable predilection sites of *Amblyomma* species were ventral body and perineum. *B. decoloratus* preferred dewlap, udder/scrotum, belly, leg/tail, head, and perineum. *R. evertsi-evertsi* had strong predilection sites for perineum, dewlap, udder/scrotum, and ears. The sex ratio of all tick species identified during this study periods was skewed towards male except for *B. decoloratus*. Considering the economic importance of tick and tick-borne diseases (TBDs) in the Soddo Zuria district, also in the country, there should be country wide control strategy, taking into account acaricide residues in products.

Keywords: Attachment site; Cattle; Ixodidae; Prevalence, Soddo zuria woreda; Tick burden

Introduction

Ticks are obligate, blood-feeding ectoparasites of vertebrates, particularly mammals and birds. It has been estimated that about 80% of the world population of cattle is infested with ticks. The lifecycle of ticks (both Ixodids and Argasids) undergo moulting stages in their development; eggs, 6-legged larva, 8-legged nymph and adult [1]. According to the numbers of hosts, Ixodids ticks are classified as one-host ticks, two-host ticks, three-host ticks and Argasids classified as multi-host ticks. In one-host ticks, all the parasitic stages (larva, nymph, and adult) are on the same hosts; in two-host ticks, larva attach to one host, feed and moult to nymphal stage and engorged, after which they detach and moult on the ground to adult; and in three-host ticks, the larva, nymph, and adult attach to different hosts and all detach from the host after engorging, and molt on the ground. In multi-host ticks (Argasids), a large number of hosts are involved, and it is common to have five molts, each completed after engorging and detaching from the hosts [2].

Ticks are most numerous, particularly in tropical and sub-tropical regions, and their impact on animal health and production is greatest in these regions [3]. Ticks are usually relatively large and long-lived, compared to mites, surviving for up to several years [4]. Ticks belong to the phylum Arthropod, class Arachnid, and order Acari. The families of ticks parasitizing livestock are categorized into two, the Ixodidae (hard ticks) and Argasidae (soft ticks). Though sharing certain basic prosperities, they differed in many structures, behavioral,

physiological, feeding, and reproduction pattern [5]. Ticks that are considered to be most important to domestic animals' health in Africa comprise about seven genera and forty species. Among these tick genera, the main ticks found in Ethiopia are *Amblyomma* (40%), *Boophilus* (21%), *Haemaphysalis* (0.5%), *Haylomma* (1.5%), and *Rhipicephalus* (37%) [1]. Among these, *A. varigatum* and *B. decoloratus* are the most important and widely distributed [6].

A. coherence, *A. gemma*, *A. lepidium*, *Haylomma marginatum rufipes*, *H. truncatum*, and *R. evertsi* are also commonly found in Ethiopia [7,8]. Even though there were a number of studies on ticks and tick-borne diseases (TBDs) in many parts of Ethiopia, in some location, there was no previous study on tick and TBDs. Therefore, the objectives of this study were to estimate the prevalence of tick infestation of cattle in Soddo Zuria district and to identify the common tick species in Soddo Zuria district.

Materials and Methods

Description of study area

The tick survey was conducted in South Nation Nationalities and Peoples Region, Wolaita zone particularly, in Soddo Zuria woreda from November 2016 to March 2017. The town is located 380 km Southwest of Addis Ababa on the way to Arbaminch town and it has a latitude and longitude of 6°54'N 37°45'E with an elevation between 1650 and 2980 meters above sea level. The town is bounded with Damot Gale Woreda to the North, Humbo Woreda to the South, Damot Woide Woreda to East and Damot Sore Woreda to the West. The annual rainfall of the area is 1000-1200mm. The dry season extends from September to February and the rain season stays from March to August. The livestock population of the area comprised about 1,097,710 cattle; 150,383 sheep; 185,250 goats; 60,055 equines and 734,924 poultry [9].

Study population

The cattle population found in Soddo Zuria woreda was considered as a study population. The study populations were constituted in all breeds that are known as local, cross and exotic breeds depending on their respective blood level. Therefore, local breeds have pure indigenous traits, cross breeds have both indigenous and exotic traits about less than 75% and exotic breeds are considered having more than 75% of the exotic trait.

Study methodology

The selected study animal was properly restrained, and all tick samples were collected from half the body regions. Ticks were removed carefully and gently in a horizontal pull to the body surface. The collected ticks were preserved in universal bottles containing 70% ethanol and labeled with respect to predilection site, age, sex and date of collection, then transported to Wolaita Sodo Regional Veterinary Laboratory for counting and identification. The ticks were counted and subsequently identified to genus and species level by using stereomicroscope, according to standard identification keys as given by [10].

Sampling design and technique

A cross-sectional study was conducted to determine the prevalence of ticks, and identification of species of ticks collected and labeled according to predilection site. All the animals selected as sampling unit were checked for any tick infestation based upon the numbers of ticks found on the animal and the study record period. Ticks were collected from ears, heads, dewlaps, belly/flank, udder/scrotum, perineum and legs/tails in the separated sample bottles with 70% ethanol. In addition to the attachment site of tick in different body regions, the burden of ticks based on age, sex, body condition, and breeds of animals were determined.

Sampling methods and determination of sample size

The cattle to be examined were selected by simple random sampling method, and multistage sampling strategy was used to determine appropriate sample size. The sample size was determined by using the formula given by Thrustfield [11]. The expected prevalence of Ixodidae ticks of cattle in Soddo Zuria woreda was assumed as 50%. The parameters used were 95% confidence interval and 5% desired level of precision. By substituting these values in the formula, the sample size was calculated to be 384 as shown below but, 501 animals were included in the study to increase precision.

$$N = \frac{1.962 P_{exp}(1 - P_{exp})}{d^2}$$

Where,

n=Sample size;

P_{exp}=Expected prevalence;

d²=Expected precision which is usually 5% (0.05)

Data analysis

The data collected were entered and managed in Microsoft-excel. An intercooled SPSS 20 version software [12] statistical program was employed for the data analysis. The overall prevalence of tick was determined by dividing the number of positive animals by total sample size and was expressed as a percentage. Chi-square (X²) test was used to assess if there was a statistically significant association in tick infestation between ages, sex, breeds and body conditions.

Result

In the current survey, a total of 501 animals were included with breed distribution of local (n=308), cross (n=137), and exotic (n=56). Out of the 501 animals examined, ticks were found on 327 animals yielding an overall prevalence of 65.27%. The distribution of tick genera was identified and located in Table 1 below. The statistical analysis was done for the prevalence of tick infestation with hypothesized risk factors (age, sex, breed and body condition). There were statistically significant association with breeds (x²=11.9698, P=0.003), body conditions (x²=14.2337, P=0.001) and age (x²=9.8475, P=0.0) (Table 2). Higher tick infestation rate was seen on both poor body condition and local breeds. There were no

statistical significances ($P > 0.05$) associated with the sex of animals (Table 2). Of the total 3290 Ixodid ticks collected from seven body region of 327 cattle, four different species in three genera were identified. The tick species identified were *B. decoloratus* (45.47%), *R. evertsi* subspecies *evertsi* (13.98%), *A. varigatum*

(23.04%) and *A. cohaerence* (17.5%) (Table 3). By considering the relative abundance of each tick species identified in the study area, *B. decoloratus* was the most abundant (45.47%) and *R. evertsi* subspecies *evertsi* were the least abundant (13.98%).

Table 1: Distribution of tick genera of cattle in the study area.

Kebeles	Tick Genera							
	Amblyomma		Boophilus	Rhipicephalus		Total		
	No.	%	No.	%	No.	%	No.	%
Buge manicha	194	39.04	213	42.85	90	18.11	497	15.11
Dalbo Atiwaro	172	33.26	270	52.22	75	14.5	517	15.72
Gulgula	262	40.74	300	46.65	81	12.59	643	19.54
Offa Gandaba	245	44.95	221	40.55	79	14.49	545	16.56
Wachiga Busha	249	42.13	273	46.19	69	11.67	591	17.966
Waraza Lashu	212	42.65	219	44.06	66	13.27	497	15.11
Total	1334	40.55	1496	45.47	460	13.98	3290	100

Table 2: Prevalence of tick in relation to body conditions breeds, sex and age of animals.

Parameter	Body condition			Breed			Sex		Age	
	Good	Medium	Poor	Local	Cross	Exotic	Male	Female	≤4 years	>4 years
No. of animals examined	118	206	177	308	137	56	222	279	206	295
No. of animals infested	66	127	134	218	74	35	144	183	118	209
Prevalence (%)	55.93	61.65	75.7	70.77	54.01	62.5	64.9	65.6	57.3	70.8
Chi square (χ^2)	14.2337			11.9698			0.0288		9.8475	
P-value	0.001			0.003			0.865		0	

Table 3: Number of tick Species identified in half body region of cattle.

Tick Species	Body Regions						
	Head	Ear	Dewlap	Legs/Tail	Udder/Scotum	Perineum	Belly
<i>A. varigatum</i>	30	-	283	32	273	123	18
<i>A. coherence</i>	5	-	59	20	249	161	82
<i>B. decoloratus</i>	62	64	545	159	359	79	228
<i>R. evertsi-evertsi</i>	13	41	124	5	89	165	23
Total	110	105	1011	216	969	528	351

The observed proportion of tick species of *Amblyomma* identified during the study preferred udder/scrotum, dewlap/brisket, perineum, belly/back, legs/tail, and head regions. The *B. decoloratus* preferred the attachment site such as dewlap/brisket, udder/scrotum, belly/back, legs/tail, perineum, ears, and heads regions. The *Rhipicephalus* species were encountered mainly in the

perineum, dewlap, udder/scrotum, ears, belly/back, and head and legs/tail regions (Table 3). The numbers of ticks collected from the cattle dominated by males, but an exception was found in one host tick (*B. decoloratus*) in which females' collection was higher than the males' (Table 4).

Table 4: The distribution and sex ratio of adult tick species in the study area.

Tick Species	Total Count	Prevalence (%)	Sex Ratio		
			Male	Female	(Male: Female)
<i>B. decoloratus</i>	1496	45.47	13	1483	0.008:1
<i>A. varigatum</i>	758	23.04	648	110	5.891:1
<i>A. coherence</i>	576	17.5	520	56	9.285:1
<i>R. evertsi-evertsi</i>	460	13.99	405	55	7.363:1
Total	3290	100	1586	1704	0.931:1

Discussion

The prevalence and distribution of the most common tick species infesting cattle are different from one area to another. In the present study, a detailed investigation was carried out to identify and determine the type of species and predilection site of ticks infesting cattle in Soddo Zuria district. Although there are different species of ticks, only four species of ticks, *B. decoloratus*, *A. varigatum*, *A. coherence*, and *R. evertsi evertsi* were identified. *B. decoloratus* were found to be the most abundant tick species in Soddo Zuria district with a rate of 45.47%. This finding was in agreement with the report of Sileshi et al. [13] who described that *B. decoloratus* was the commonest and most widespread tick in Ethiopia, collected in all administrative regions except in the Afar region.

The current finding was also in line with the report of Tamru [14] in Asela et al. [15] in Ethiopia, who reported the highest prevalence of *B. decoloratus* (80%) in the study areas. According to Shiferaw [16], *B. decoloratus* had the highest frequency in the observed area during dry seasons (January, February, and early March) in Wolaita zone. This result disagreed with the findings of Alekaw [17] at Metekel Ranch, Ethiopia showing the prevalence of 5.7%. This may be due to the geographical location and altitude factors which are 1,500 to 1,600m above sea level of Metekel Ranch. The females were abundant from September to April and transmitted *Babesia bigemina* to cattle, and a severe infestation can lead to tick worry, anorexia, and anemia [18]. The one-host ticks of the genus *Boophilus* that parasitize ruminants represent a hindrance to livestock farming in tropical and sub-tropical countries. They transmit the causative agents of Anaplasmosis ("Gall Sickness") and Babesiosis ("Red Water") in cattle [10].

A. varigatum was the second widespread tick species of the cattle in the current study area with a rate of 23.04%. This result disagreed with different reports done by other authors in different parts of Ethiopia such as Tessema & Gashaw [19] in Asela, Belew & Mekonnen [20] in Holeta, Seyoum [18], Mehair [21] in Awassa who as described *A. varigatum* as the first most abundant tick species in their study areas. The difference in result was due to the geographical location where *A. varigatum* was found in highest number in the highland and high rainfall, and also due to its being relatively active throughout the year in most part of Ethiopia.

A. varigatum is a widely distributed cattle tick in Ethiopia [22], and it is a potential vector of diseases caused by *Cowdria ruminantium*, *Theileria mutan*, *T. velifera* ("Benign Bovine

Theileriosis") and viral diseases, Nairobi sheep disease, and also aggravates the situation of bovine dermatophilosis (*Dermatophilus congolense*) [13]. The study conducted in Wolaita zone by Dessie & Getachew [23] agreed with this study that shows *A. varigatum* was the second abundant tick species at Highland and Midland, and the first abundant in the lowland during the wet period. This variation may be due to the change in environmental conditions, with the result of global warming that highly affects the ecology of ticks. Change in temperature and rainfall have been reported to affect the distribution of diseases of vectors and tick-borne diseases [2].

A. coherence was the third abundant tick species with a rate of 17.5% in the study area. *Amblyomma coherence* is the most prevalent and abundant tick on cattle [24]. According to [25], *A. coherence* was also the third abundant tick species in the Bench Maji zone with a prevalence of 4.2% in the area. The prevalence of *A. coherence* is alarmingly important as this tick has been reported as a vector for *C. ruminantium* which is the causative agent of cowdriosis ("Heartwater") [13]. Moreover, *Amblyomma coherence* transmits Ehrlichiosis, but less important vector than *A. varigatum*. Another report indicated a spontaneous infection of *Amblyomma coherence* by *Rickettsia conorii* in Ethiopia [25,26].

R. evertsi-evertsi was found to be the least abundant with a rate of 13.98% tick species in this study area. The native distribution of *R. evertsi-evertsi* in Ethiopia seems to be connected with middle height dry Savannas and steppes, in association with zebra and ruminant and it is widely distributed throughout Ethiopia [20]. This tick species shows no apparent preference for particular altitude, rainfall zone or seasons [24]. According to Sileshi et al. [13], *R. evertsi-evertsi* was collected throughout their study period, with the peak of abundance in January coinciding with the beginning of the rainy season and they also described that the discovery of this tick in that area was in line with its widespread occurrence in most parts of the country. The occurrence of this species in and around the Wolaita zone was also reported by Dessie & Getachew [23]. *R. evertsi-evertsi* has short mouthparts with which to feed on a soft area. As a result, it is a possible vector of *Babesia*, *Rickettsia*, and *Theileria* [27].

Ticks are known to be distributed in different parts of the host's body. In this study, the main infestation site of ticks in the body of hosts was dewlap, udder/scrotum, perineum, and belly. A variety of factors such as host density, the interaction between tick species, time and season, and inaccessibility for grooming determined the attachment site of the ticks on the skins [28]. The predilection sites found in this study were in line with those reported by Seyoum [29]

and Behailu [30] in their study conducted in North Wollo zone and Asela, respectively.

In the current study, different animal-related risk factors were studied to determine whether there was a significant variation in tick infestation between and among different groups of animals with suspected risk factors. The proportion of tick infestation was higher in adult animals as compared to young animals. As a result, there was a statistically significant association ($p < 0.05$), and the higher proportion may be due to outdoor management and long-distance movement of adult animals to search for food and water compared to younger animals, so the chance of exposure was higher. This finding was also in agreement with the finding of Feseha [31], Tessema & Gashaw [19] and Belew & Mekonnen [20] who stated a higher proportion in adult cattle.

There was a statistically non-significant association ($p > 0.05$) in the infestation rate among different sex groups, where the higher infestation was recorded in female animals compared to their counterparts. Higher infestation in the female might be due to seasonal variation in some hormones like prolactin and progesterone at a higher level and stressors of production (such as pregnancy and lactation) that make female animals more susceptible than male [32,33]. It may also be found that immune-compromised animals acquire high tick infestation in more over the stress of production such as pregnancy and lactation make the females more susceptible to such infestation. This result disagreed with the previous work done by Hussien [34] in Bako.

The proportion of tick infestation was higher in poor body conditioned (75.7%) as compared to medium body conditioned (61.65%) and good body conditioned animals (55.93%). This was due to the fact that poor body conditioned animals having reduced immunity and are exposed to any kind of disease when grazing on the field. The result of the current study agrees with Okelly & Seifert [35] who reported that the dietary deficiencies that influence the breakdown of tick resistance. The observation indicates that poor body conditioned animals are less resistant to tick infestation and lack enough body potential to build resistance with age advancement. Several authors have reported that high infestation of tick results in poor body condition due to the consumption of the high amount of blood and fluids by those ticks [36].

According to Aerts & Neshem [37] who reported the British cattle breeds having the lowest body condition score under tropical conditions had the highest infestation of ticks. Seid [38], Southerst [36] and Bianchi et al. [39] reported that tick load on the animal might be affected by breed and nutritional stress. Ultimately, these factors affect general body condition, which in turn affects blood composition, respiratory rate, appetite and eventually leads to poorer body condition score. However, the well-fed animals were very resistant to any kind of diseases when they grazed in the field or are kept at home. The fact that more tick burden was recorded in both local and exotic breeds compared to cross cattle.

The current finding agrees with the report by Belew & Mekonnen [20] that revealed the presence of tick infestation in local breeds were very high with the prevalence of 44.96% ($n=223$),

while in cross breeds and Jersey, the prevalence were 15.83% ($n=57$), and 8.50% ($n=30$) respectively. The significant variation in tick infestation of cattle of different breeds may be attributed to the different management system, lack of supplementary feeding for local breeds, or lack of control measures against tick on local breeds. Furthermore, it can be assumed that it might be due to the lack of interest of farmers for local breeds as well as taking more care to cross and exotic breeds than local breeds.

The male to female ratios of *B. decoloratus*, *A. varigatum*, *R. evertsi-evertsi*, and *A. cohaer* were similar to previous reports of Seyoum [29] and Solomon et al. [28]. Except for *B. decoloratus*, all other species tick's males outnumbered females because males normally remain on the host longer than females. Fully engorged female tick drops off to the ground to lay eggs while males tend to remain on the host up to several months to continue feeding and mating with other females on the host before dropping off [28]. The females of *B. decoloratus* outnumbered males in this study might be probably due to the small size of the male which may not be seen during collection [19].

Conclusion and Recommendation

Variable information on tick species distribution and dynamics are very essential to assess the economic loss encountered due to tick infestation and also to identify the appropriate measure of tick control. Among ectoparasites, ticks cause the greatest economic loss in livestock population either by transmitting a wide variety of TBDs or by affecting the health of animals as well as the quality of hiding and skins. The important and abundant tick species investigated in the study area were *B. decoloratus*, *A. varigatum*, *A. cohaerence*, and *R. evertsi-evertsi*. The study indicated that there was a high burden of ticks in the area. However, the attention given to controlling the infestation had not been sufficient.

The control methods necessary for tick and TBDs were a selection of tick resistance cattle, acaricides treatment, appropriate livestock management, evaluation and incorporation of traditional practices or remedies that appear to be of value. In general, the distribution of ticks are not fixed but are determined by a complex interaction of factors such as climate, host density, host susceptibility, grazing habits, and pasture-herd management. Therefore, an effective tick control program should be formulated and implemented based on the distribution pattern of ticks and factors responsible for their distribution.

In light of the above conclusion the following recommendations are forwarded:

- A. Tick control program (Application of Acaricide) should be continued with an increasing frequency of application in wet months.
- B. Detection of acaricide resistance tick species which are economically important since limited types of acaricide was used in the area.
- C. More attention should be given to the selection of resistant cattle breeds and types, and good performance with regards to the production of local breeds.

Appropriate pasture management in communal grazing area is recommended.

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