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ORIGINAL ARTICLE

# Ectoparasites of goats in three agroecologies in central Oromia, Ethiopia

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**Abstract** A cross-sectional study was conducted to determine the prevalence and risk factors for ectoparasites infestation in 979 goats in three agroecologies in central Oromia, Ethiopia from October 2009 through April 2010. The results of the study showed that of the total goats examined 487 (49.7 %) of them were infested with one or more ectoparasites. The ectoparasites identified were (16.5 %) *Linognathus* spp., 8.8 % *Sarcoptes*, 5 % *Ctenocephalides* spp. 11.8 % *Amblyomma variegatum*, 5.9 % *Rhipicephalus evertsi evertsi*, 4.3 % *Rhipicephalus pravus*, 1.6 % *Boophilus decoloratus*, 1.8 % *Rhipicephalus sanguineus*, 1.3 % *Rhipicephalus praetextatus*, and 0.4 % *Hyalomma truncatum*. Statistically significant (OR=0.477, $p$=0.000) difference was observed in prevalence of *Linognathus stenopsis* among highland, lowland and midland. Significantly higher prevalence of tick infestation in the lowland than both the midland and highland agroecology was recorded. The risk of tick infestations in lowland and midland was 2.841 and 5.635 times, respectively, higher than in highlands. Age-related variation was not observed in the prevalence of both *Linognathus* and tick infestations in examined goats. Significantly (OR=7.864, $p$=0.000) higher prevalence of sarcoptic mange in the lowland than the midland was observed. Goats in lowland were 7.864 times at higher risk for sarcoptic mange than those in the midlands. Sex-related variation in the prevalence of ectoparasites was never recorded in goats. Significantly higher prevalence of sarcoptic mange (OR=0.266, $p$=0.000) and *Ctenocephalides* spp. (OR=2.430, $p$=0.005) on young than adult goats was recorded. The logistic regression results showed statistically significant difference in prevalence of tick infestations (OR=0.565, $p$=0.000) and sarcoptic mange (OR=0.582, $p$=0.003) between goats with poor and good body condition. Further studies on role of ectoparasites in transmission of diseases to goats, comparative prevalence and load, and the importance of goats as alternative hosts in different agroecology and management systems in Ethiopia are recommended so as to design applicable control program in the country. Furthermore, the threat of ectoparasites on overall productivity of goats and the tanning industry warrants detail studies and urgent control intervention.

**Keywords** Agroecology · Fleas · Lice · Mites · Oromia · Prevalence · Goat · Ticks

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## Introduction

Ethiopia is home to 21.7 million goats (CSA 2008); however, the immense potential this huge population represents is yet to be realized due to a multitude of factors. Ectoparasites are widely distributed in all agroecologies in Ethiopia and particularly affect larger number of goats of the country (Pegram et al. 1981). Ectoparasites including ticks, lice, fleas, and mange mites are incriminated to cause a wide range of health

problems such as mechanical tissue damage, irritation, inflammation, hypersensitivity, abscesses, and lameness; and when present in large numbers may cause anemia and reduced productivity of goats (Fthenakis et al. 2001; Nyangiwe and Horak 2007; De Matos et al. 2009). Furthermore, ticks, lice, fleas, and mange mites are reported to cause great preslaughter defects responsible for downgrading and rejection of goat skins. Bayou (1998) reported that 56 % of goat and 35 % of sheep skin rejections in Ethiopia is attributed to ectoparasites. All these imply ectoparasites pose serious economic losses to the resource poor farmers, the tanning factories and the national economy (Amsalu et al. 2000; Sertse and Wossene 2007a, b; Chanie et al. 2010).

In Oromia Regional State, 7,685,529 goats are estimated to be found (CSA 2008), which represents 36.6 % of the national goat population. The skin supply to the central market of the country from the Oromia region is estimated to be 26.4 % of goat skins. The export of processed and semiprocessed skins constitutes Ethiopian's second largest commodity. However, recent surveys indicate that over the last 10 years, the quality of raw materials has deteriorated with increasing number of reject grades and growing problems of skin diseases associated with lice, ticks, and mange mites infestations. Ectoparasites are reported to play a key role for this continuously declining quality of goat skins (Ermias 2000; Haffize 2001; Molu 2002; Sertse and Wossene 2007b; Chanie et al. 2010; Berhanu et al. 2011). In spite of their great importance, so far, only few studies have been conducted on ectoparasites of goats in Oromia. There is paucity of information in different agro-ecologies of the region. Thus, the present study was undertaken with the objectives to identify and determine the prevalence of ectoparasites of goats in three agro-ecologies in Oromia regional state and to assess the effects of risk factors on the prevalence and distribution of ectoparasites of goats in the study districts.

## Materials and methods

### Study area

A study on ectoparasites of goats was conducted in three agroecologies of Oromia regional state, Ethiopia from October 2009 to April 2010. The selected study districts were Adami Tulu-Jiddo-Kombolcha, Akaki, and Sululta representing lowland, midland, and highland agro-ecological zones, respectively. The farming systems in these districts are characterized by mixed crop–livestock production system. The livestock in study areas are traditionally managed under extensive production system.

Adami Tulu-Jiddo-Kombolcha is one of the districts of East Showa zone of Oromia region which is found in the mid Rift Valley at 7° 52′N latitude and 38° 42′E longitude. The area is located 163 km Southeast of Addis Ababa with an average altitude of 1,650 m above sea level (asl). It experiences a bimodal unevenly distributed pattern of rainfall with long rainy season extending from July to September and a short rainy season from February to April, and with an average annual rainfall of 760.9 mm. The average minimum and maximum temperatures are 16.6 and 29.4 °C, respectively. The livestock populations of the area are estimated to be 212,415 of cattle, 34,899 of sheep, 116,585 of goats, 25,619 of equines, and 130,247 of poultry.

Akaki district, the second study area, is located at an average altitude of 1,900 m asl southeast of Addis Ababa. It is one of the districts found in Eastern Showa administrative Zone of Oromia. Akaki district lies between 8° 44′N latitude and 35° 58′E longitude location. The area experiences an annual rainfall ranges from 800 to 1,000 mm with two rainy seasons; the short rainy season occurs between March and May, while the main rainy season is between June and September. The average minimum and maximum temperatures are 13.5 and 25.8 °C, respectively. The livestock population of the area is 69,107 cattle, 18,970 sheep, 23,409 goats, 23,937 equines, and 126,865 poultry.

Sululta district, the third study area representing a highland altitude, is found in Central highlands of Ethiopia with location between 9° 13′–10° 57′N latitude and 37° 57′–39° 33′E longitude. It is located 40 km North of Addis Ababa at an average altitude of 2,550 m asl. Sululta district is one of the districts of North Showa Zone of Oromia region. The area receives a mean annual rainfall of a minimum of 834 mm and a maximum of 1,447 mm. The mean minimum and maximum temperatures of the area are 4.4 and 22.5 °C, respectively. The district's livestock population is estimated to be 210,210 of cattle, 80,900 of sheep, 16,491 of goats, 32,862 of equines, and 75,936 of poultry.

### Study animals

The study on ectoparasites was carried out on indigenous goats that were managed under extensive production system.

### Study design

A cross-sectional type of study was used to investigate ectoparasites of goats in three agroecologies in Oromia. Simple and systematic random sampling methods were used. The study districts were selected purposively based on their representation of different agroecologies. Five, seven, and six peasant associations from Adami Tulu-Jiddo-Kombolcha, Akaki, and Suluta districts, respectively, were randomly selected representing lowland, midland, and highland agro-ecological zones, respectively, using a lottery system. The study animals were randomly selected using systematic sampling technique

from traditionally managed goat population in the respective areas.

### Sample size determination

The sample size for the current study was determined as per the method described by Thrusfield (2005). Accordingly, 50 % expected prevalence of ectoparasites infestations in each study agro-ecology, 5 % acceptable error, and 95 % confidence level were applied to determine the sample size of study goats in each study agroecology. Based on this and considering the livestock population of each study agro-ecology, 469, 404, and 106 goats from lowland, midland, and highland, respectively, were studied for ectoparasites.

### Clinical examination

A total of 979 study goats from three agro-ecological zones were clinically examined for the presence of ectoparasites and gross skin lesions. The sex, age, and body conditions of each selected study goat were recorded during clinical examination. The study goats were categorized into two age groups as young (up to 1 year) and adult (older than 1 year) as described by Steele (1996) for goats, age was determined as indicated by owners and judged by dentition methods. The body condition scores were determined by modifying the system described in Steele (1996) for goats as poor and good. Poor body condition score was given for goats which were extremely thin and those having smooth and less prominent spinous and transverse processes in which finger can be pushed and had moderate depth of loin muscle. The good body condition score was given for goats in which the spinous process only stickup very slightly and those having smooth, rounded and well covered transverse processes, and full loin muscle.

Clinical examination for ectoparasites of each study goats was performed by multiple fleeces parting in the direction opposite to that in which hair normally rests and followed by physical examination of skin, inspection and palpation of the skin across all parts of the animal for the presence of parasites, and gross lesions indicating the clinical form of infestation by ectoparasites. Goats found infested were considered as positive for ectoparasites. The ectoparasites were identified on the basis of their morphological structure as described by Wall and Shearer (1997) and Walker et al. (2003).

### Ectoparasite collection and identification

Ectoparasites including ticks, lice, and fleas were collected manually from their sites of attachment. The ticks were removed from the host skins while retaining their mouth parts for identification using forceps. The coat-brushing technique was used for collection of lice. Ectoparasites were placed in labeled universal bottles containing 70 % ethanol. All collected samples were properly labeled with all relevant and required information and taken to the Parasitology Department of the National Animal Health Diagnostic and Identification Center located at Sebeta town. Ectoparasites were identified under a stereomicroscope according to their key morphological structures as described by Okello-Onen et al. (1999) and Walker et al. (2003) for ticks, Urquhart et al. (1996) and Wall and Shearer (1997) for lice and fleas.

In addition, skin scrapings were taken from goats clinically suspected with cases of mange. This was done by clipping the hair around affected areas, scrapping the edges of the lesion with scalpel blade until capillary oozing was evident in such a way that the blade was being held at an angle so that the materials scrapped fell on a paper held underneath. Then, the scrapped materials were transferred to a container and were taken for laboratory examination. Skin scrapings were processed according to the method described in Urquhart et al. (1996). The sample was treated with a few drops of 10 % potassium hydroxide, allowed to stand for 30 min and was examined under light microscope at ×40 magnification. The mange mites were identified according to the morphological keys described in Wall and Shearer (1997).

### Data analysis

Microsoft Excel was used for data management. Statistical software SPSS version 15.5 for windows was used for data analysis. Descriptive statistics such as percentages and 95 % confidence intervals were used to summarize the proportions of infested and non-infested goats. The effects of different epidemiological risk factors on the prevalence and distribution of ectoparasites were analyzed using binary logistic regression method. Statistical significance was set at $p<0.05$.

**Table 1** Overall prevalence of ectoparasites in goats ($n$=979)

| Ectoparasites | Goat ($n$=979) | |
|---|---|---|
| | Prevalence (%) | 95 % CI |
| *Linognathus* spp. | 16.5 | 14.2–18.8 |
| *Sarcoptes* spp. | 8.8 | 7.0–25.9 |
| *B. decoloratus* | 1.6 | 0.8–2.4 |
| *A. variegatum* | 11.8 | 9.8–13.8 |
| *R. evertsi evertsi* | 5.9 | 4.4–7.4 |
| *R. praetextatus* | 1.3 | 0.6–2.0 |
| *R. pravus* | 4.3 | 3.0–5.6 |
| *R. sanguineus* | 1.8 | 1.0–2.6 |
| *H. truncatum* | 0.4 | 0.1–0.7 |
| *Ctenocephalides* spp. | 5.1 | 3.7–6.5 |
| Overall | 49.7 | 46.5–52.8 |

**Table 2** Prevalence of ectoparasites in goats by agroecology ($n$=979)

| Ectoparasite | Agroecology | | |
|---|---|---|---|
| | Lowland ($n$=469; %) | Midland ($n$=404; %) | Highland ($n$=106; %) |
| *L. stenopsis* | 55 (11.7) | 89 (22.0) | 106 (100) |
| Sarcoptic mange | 73 (15.6) | 13 (3.2) | 0 (0) |
| *B. decoloratus* | 3 (0.6) | 10 (2.5) | 3 (2.8) |
| *A. variegatum* | 30 (6.4) | 80 (19.8) | 6 (5.7) |
| *R. evertsi evertsi* | 17 (3.6) | 41 (10.1) | 0 (0) |
| *R. praetextatus* | 8 (1.7) | 5 (1.2) | 0 (0) |
| *R. pravus* | 23 (4.9) | 19 (4.7) | 0 (0) |
| *R. sanguineus* | 12 (2.5) | 6 (1.5) | 0 (0) |
| *H. truncatum* | 3 (0.6) | 1 (0.2) | 0 (0) |
| *Ctenocephalides* spp. | 20 (4.3) | 21 (5.2) | 9 (8.5) |
| Overall | 232 (49.5) | 220 (54.5) | 35 (33.0) |

## Results

### Overall prevalence

During the study period, a total of 979 goats from the three agro-ecological zones were examined for the presence of ectoparasites. Results of the study showed that an overall prevalence of 49.7 % of ectoparasites was recorded on goats of the study areas (Table 1). The ectoparasites identified on goats were *Linognathus* spp., *Sarcoptes*, ticks, and *Ctenocephalides* spp. *Linognathus stenopsis* was identified as the most common ectoparasite of goats. Seven species of ixodid ticks were identified, viz: *Amblyomma variegatum*, *Rhipicephalus evertsi evertsi*, *Rhipicephalus pravus*, *Boophilus decoloratus*, *Rhipicephalus sanguineus*, *Rhipicephalus praetextatus*, and *Hyalomma truncatum* (Table 1).

The preferred feeding sites by ticks were head/ears, scrotal/udder, ano-vulva, tail, brisket, dewlap, neck and leg. For *Linognathus* species, sites of infestation were shoulder (71.4 %), neck (66.7 %), and the sides (38.4 %). Head/ears and the groin areas were observed as the main sites for sarcoptic mange. The two common sites of *Ctenocephalides* species infestations were the belly and sternum regions.

### Prevalence of ectoparasites by agroecology

A total of 979 goats were examined for the presence of ectoparasites of which 469 were from lowland, 404 from midland, and 106 from highland. The overall prevalence of ectoparasites on goats of lowland, midland and highland was 49.5, 54.5, and 33.0 %, respectively (Table 2). The binary logistic regression analysis result of the effect of agroecology on prevalence of ectoparasites of goats is presented on Tables 4, 5, 6, and 7. Statistically significant difference was observed in prevalence of *L. stenopsis* among highland, lowland and midland (OR=0.477, $p$=0.000; Table 4). The prevalence of tick infestation was significantly (OR=2.841, $p$=0.005) higher in the lowland than the highland, significantly (OR=5.635, $p$=0.000) higher in midland than the highland and significantly (OR=0.504, $p$=0.000) higher in the lowland than the midland agroecology (Table 5). Significant difference was also observed in the prevalence of sarcoptic mange between the lowland and midland agroecologies (OR=7.864, $p$=0.000; Table 6). However, statistically significant difference was never observed in the prevalence of *Ctenocephalides* infestation among the three agroecologies ($p$>0.05; Table 7).

**Table 3** Prevalence of ectoparasites of goats by sex, age, and body condition ($n$=979)

| *Ectoparasite* | Sex | | Age | | Body condition | |
|---|---|---|---|---|---|---|
| | Male ($n$=319; %) | Female ($n$=660; %) | Young ($n$=444; %) | Adult ($n$=535; %) | Poor ($n$=271; %) | Good ($n$=708; %) |
| *L. stenopsis* | 67 (21.0) | 114 (17.3) | 75 (16.9) | 86 (16.1) | 45 (16.6) | 116 (16.4) |
| Sarcoptic mange | 22 (0.07) | 64 (9.7) | 26 (5.8) | 60 (11.2) | 55 (20.3) | 116 (16.4) |
| Ticks | 77 (24.1) | 164 (24.8) | 101 (22.7) | 140 (26.2) | 49 (18.1) | 192 (27.1) |
| *Ctenocephalides* spp. | 22 (6.9) | 28 (4.2) | 33 (7.4) | 17 (3.2) | 12 (4.4) | 38 (5.4) |
| Overall | 164 (51.4) | 323 (48.9) | 214 (48.2) | 273 (51.0) | 145 (53.5) | 342 (48.3) |

**Table 4** Summary results of binary logistic regression for *Linognathus* species in goats

| Risk factors | | Coefficients | SE | *P* values | OR | 95 % CI for OR | |
|---|---|---|---|---|---|---|---|
| | | | | | | Lower | Upper |
| Agroecology | Highland[a] | 1 | 1 | 1 | 1 | 1 | 1 |
| | Lowland | −0.343 | 0.302 | 0.256 | 0.710 | 0.392 | 1.283 |
| | Midland | 0.396 | 0.292 | 0.174 | 1.486 | 0.839 | 2.632 |
| | Lowland | −0.739 | 0.190 | 0.000 | 0.477 | 0.329 | 0.693 |
| Sex | Female[a] | 1 | 1 | 1 | 1 | 1 | 1 |
| | Male | 0.206 | 0.184 | 0.262 | 1.229 | 0.857 | 1.762 |
| Age | Adult[a] | 1 | 1 | 1 | 1 | 1 | 1 |
| | Young | 0.101 | 0.179 | 0.572 | 1.106 | 0.780 | 1.570 |
| Body condition | Good[a] | 1 | 1 | 1 | 1 | 1 | 1 |
| | Poor | 0.101 | 0.179 | 0.572 | 1.106 | 0.780 | 1.570 |

*SE* standard error, *OR* odds ratio
[a]Reference category

Prevalence of ectoparasites by sex, age, and body conditions

The overall prevalence of ectoparasites in male and female goats was 51.4 and 48.9 %, respectively (Table 3). Statistically significant variation in the prevalence of ectoparasites was never recoded between male and female goats ($p>0.05$). The overall prevalence of ectoparasites in young and adult goats was 48.2 and 51.0 %, respectively (Table 3). Statistically significant difference in prevalence of both sarcoptic mange (OR=0.266, $p=0.000$) and *Ctenocephalides* infestation (OR=2.430, $p=0.005$) was observed between young and adults goats as shown on Tables 6 and 7. But statistically significant difference was never recorded ($p>0.05$) in the prevalence of *Linognathus* and tick infestations between male and female, and young and adult goats (Tables 4 and 5).

The overall prevalence of ectoparasites in goats with poor and good body condition was 53.5 and 48.3 %, respectively (Table 3). The logistic regression results (Tables 5 and 6) showed statistically significance difference in prevalence of tick infestations (OR=0.582, $p=0.003$) and sarcoptic mange (OR=0.565, $p=0.000$) between goats with poor and good body condition. However, significant variations ($p>0.05$) were never observed in the prevalence of *Linognathus* and *Ctenocephalid*es infestations between goats with poor and good body condition (Tables 4 and 7).

## Discussion

Results presented in this study revealed an overall prevalence of 49.7 % of ectoparasites in goats. This finding suggests the great importance of ectoparasites in goats of the study areas. The absence of improved husbandry practices and inadequate veterinary services, favorable climatic conditions, low input of feeds, and poor awareness of goat owners on the effects of ectoparasites might have strongly contributed for wide occurrence of infestation by ectoparasites. The findings of the current study are in agreement with the previous reports from Ethiopia (Haffize 2001; Teshome 2002; Kassa 2006; Chanie et al. 2010; Mulugeta et al. 2010; Abunna et al. 2009; Bekele et al. 2011) and other countries of the world (Madeira et al. 2000; Mohammed and

**Table 5** Summary results of binary logistic regression for tick infestation in goats

| Risk factors | | Coefficients | SE | *P* values | OR | 95 % CI for OR | |
|---|---|---|---|---|---|---|---|
| | | | | | | Lower | Upper |
| Agroecology | Highland[a] | 1 | 1 | 1 | 1 | 1 | 1 |
| | Lowland | 1.044 | 0.368 | 0.005 | 2.841 | 1.381 | 5.846 |
| | Midland | 1.729 | 0.365 | 0.000 | 5.635 | 2.754 | 11.530 |
| | Lowland | −0.685 | 0.159 | 0.000 | 0.504 | 0.369 | 0.689 |
| Sex | Female[a] | 1 | 1 | 1 | 1 | 1 | 1 |
| | Male | −0.081 | 0.167 | 0.629 | 0.923 | 0.665 | 1.280 |
| Age | Adult[a] | 1 | 1 | 1 | 1 | 1 | 1 |
| | Young | −0.057 | 0.157 | 0.717 | 0.945 | 0.695 | 1.285 |
| Body condition | Good[a] | 1 | 1 | 1 | 1 | 1 | 1 |
| | Poor | -0.542 | 0.183 | 0.003 | 0.582 | 0.406 | 0.833 |

*SE* standard error, *OR* odds ratio
[a]Reference category

**Table 6** Summary results of binary logistic regression for sarcoptic mange in goats

| Risk factors | | Coefficients | SE | *P* values | OR | 95 % CI for OR | |
|---|---|---|---|---|---|---|---|
| | | | | | | Lower | Upper |
| Agroecology | Highland[a] | 1 | 1 | 1 | 1 | 1 | 1 |
| | Lowland | 19.546 | 3,654.077 | 0.996 | 308,272,364.274 | 0.000 | |
| | Midland | 17.484 | 3,654.077 | 0.996 | 39,199,480.596 | 0.000 | |
| | Lowland | 2.062 | 0.336 | 0.000 | 7.864 | 4.067 | 15.206 |
| Sex | Female[a] | 1 | 1 | 1 | 1 | 1 | 1 |
| | Male | 0.229 | 0.291 | 0.432 | 1.257 | 0.710 | 2.226 |
| Age | Adult[a] | 1 | 1 | 1 | 1 | 1 | 1 |
| | Young | −1.325 | 0.287 | 0.000 | 0.266 | 0.152 | 0.466 |
| Body condition | Good[a] | 1 | 1 | 1 | 1 | 1 | 1 |
| | Poor | 2.024 | 0.263 | 0.000 | 7.565 | 4.520 | 12.662 |

*SE* standard error, *OR* odds ratio

[a] Reference category

Ali 2006) who reported high prevalence and great importance of ectoparasites in small ruminants.

Tick infestations with an overall prevalence of 24.6 % was the highest and most common ectoparasites identified from goats of the study area. This findings is in line with the previous observations reported by Pegram et al. (1981), Wallaga (1997), Mekonnen et al. (2001, 2007), and Sertse and Wossene (2007a) who reported that tick species are one of the most common ectoparasites of goats in different parts of Ethiopia. In the current study, significantly higher prevalence of tick infestations was recorded in goats from the midland (33.7 %) and lowland (20.5 %) than those goats from the highland (8.5 %). The risk of tick infestations in lowland and midland was 2.841 and 5.635 times, respectively, higher than in highlands. This finding coincides with the previous reports of Sertse and Wossene (2007a) and Mulugeta et al. (2010). This may be attributed to higher temperature, relative humidity, and prolonged sunlight in both lowland and midland that favors the survival and reproduction of ticks (Pegram et al. 1981) than the highland. Goats with poor body condition score were 0.585 times higher at risk of infestation by ticks than those goats with good condition.

The results of the present study indicated that lice infestations were encountered as the second most prevalent ectoparasites on goats with overall prevalence of 16.5 % (Table 1). The prevalence of lice recorded in the present study is higher than the findings of Haffize (2001; 1.5 % in goat in Central Ethiopia), Numery (2001; 14.5 % in goats in Kombolcha), and Molu (2002; 1.5 % in goats in Southern rangelands of Oromia). But this prevalence is lower than those recorded in the eastern part of Amhara region of 29.2 % in goats (Sertse and Wossene 2007a) and the southeastern parts of Tigray of 26.7 % in goats (Mulugeta et al. 2010). Such differences in prevalence might arise from differences in agroecology, season during which the study was conducted, variations in

**Table 7** Summary results of binary logistic regression for *Ctenocephalides* in goats

| Risk factors | | Coefficients | SE | *P* values | OR | 95 % CI for OR | |
|---|---|---|---|---|---|---|---|
| | | | | | | Lower | Upper |
| Agroecology | Highland[a] | 1 | 1 | 1 | 1 | 1 | 1 |
| | Lowland | −0.714 | 0.421 | 0.090 | 0.490 | 0.215 | 1.118 |
| | Midland | −0.453 | 0.419 | 0.279 | 0.636 | 0.280 | 1.444 |
| | Lowland | −0.261 | 0.326 | 0.423 | 0.770 | 0.407 | 1.458 |
| Sex | Female[a] | 1 | 1 | 1 | 1 | 1 | 1 |
| | Male | 0.352 | 0.300 | 0.241 | 1.422 | 0.790 | 2.562 |
| Age | Adult[a] | 1 | 1 | 1 | 1 | 1 | 1 |
| | Young | 0.888 | 0.313 | 0.005 | 2.430 | 1.315 | 4.490 |
| Body condition | Good[a] | 1 | 1 | 1 | 1 | 1 | 1 |
| | Poor | −0.308 | 0.343 | −0.308 | 0.343 | −0.308 | 0.343 |

*SE* standard error, *OR* odds ratio

[a] Reference category

management, breed and health care of goats in the study areas, and the sensitivity of the diagnostic method used. Lice infestation may reflect some other underlying problems such as malnutrition and chronic diseases (Wall and Shearer 1997). The possible reasons for such high prevalence of lice in the study area include management problems, poor feeding, and inadequate veterinary services. Significantly ($p<0.05$) lower prevalence of *Linognathus* spp. was recorded in midland and lowland than the highland goats. The risk of infestations in highland was 0.477 times higher than the infestation in the lowland and midland. This may be attributed to suitable temperature and humidity range required for reproduction of this spp. of lice (Wall and Shearer 1997).

The findings of an overall prevalence of 8.8 % sarcoptic mange in goats of this study is in agreement with previous observations made in other parts of the country by Chalachew (2001; 6.9 % in goats from Wolayta), Worku (2002; 4.3 % in goats from Sidama Zone), Sertse and Wossene (2007a; 6.1 % in goats from Eastern part of Amhara), and 5.8 % of mange mites in goats of Wolita in southern Ethiopia by Sheferaw et al. (2010). Significantly higher prevalence of sarcoptic mange in goats of lowland (15.6 %) than those goats from the midland (3.2 %) agroecology was recorded. Goats in lowland were 7.864 times at higher risk for sarcoptic mange than those in the midlands. The higher temperature, humidity, and sunlight which prevail in lowlands and midland may have accounted for the differences in prevalence as has been reported by Pangui (1994). Significantly higher prevalence of sarcoptic mange in goats with poor body condition than those goats with good was recorded. These findings are in agreement with the previous works of Molu (2002) and Sertse and Wossene (2007a).

*Ctenocephalides* species was encountered as one of the ectoparasites of goats of the present study. This observation is similar to previous reports of Mulugeta et al. (2010) and Bekele et al. (2011) in Ethiopia. It is a well-established fact that ruminants including goats do not have their own flea species (Urquhart et al. 1996) but they can be infested when they get in contact with infested dogs, cats or any other animals (Cole 1986; Wall and Shearer 1997). Significantly higher prevalence of *Ctenocephalides* species was recorded in young than in adults goats. The observed odds indicated that young goats were 2.430 times more at risk than adults goats. This finding agrees with the previous works of Sertse and Wossene (2007a).

## References


Abunna F, Kasasa D, Shelima B, Megersa B, Regassa A, Amenu K (2009) Survey of tick infestation in small ruminants of Miesso district, West Harergie, Oromia Region, Ethiopia. Trop Anim Heal Prod 41:969–972

Amsalu D, Bewket S, Kassa T, Tefera T, Gezahgne M, Dagne M, Shihun S (2000) Mange: A disease of growing threat for the production of small ruminants in Amhara National Regional State. The opportunities and challenges of enhancing goat production in Ethiopia, November 10–12

Bayou K (1998) Control of sheep and goatskin diseases. In: Ian BC, Bayou B (eds) Proceedings of control of sheep and goatskin diseases for improved quality of hides and skin, FAO, Addis Ababa, 13–14 February 1998

Bekele J, Tariku M, Abebe R (2011) External parasites infestation in small ruminants in Wolmera district of Oromia region, central Ethiopia. J Anim Vet Adv 10(4):518–532

Berhanu W, Negussie H, Alemu S, Mazengia H (2011) Assessment on major factors that cause skin rejection at Modjo export tannery, Ethiopia. Trop Anim Heal Prod 43:989–993

Chalachew N (2001) Study on the skin diseases in cattle, sheep and goats in and around Wolayta Soddo, Southern Ethiopia. DVM Thesis. Addis Ababa University, Debre Zeit

Chanie M, Negash T, Sirak A (2010) Ectoparasites are the major causes of various types of skin lesions in small ruminants in Ethiopia. Trop Anim Heal Prod 42:1103–1109

Cole HE (1986) Veterinary Clinical Pathology, 4th edn. W.B. Saunders Company, Philadelphia, p 391–403

CSA (2008) Ethiopian agricultural sample survey report on livestock and livestock characteristics, vol II. Addis Ababa, Ethiopia

De Matos M, Sitoe C, Neves L, Nöthling JO, Horak IG (2009) The comparative prevalence of five ixodid tick species infesting cattle and goats in Maputo Province, Mozambique. Onderstepoort J Vet Res 76:201–208

Ermias Y (2000) A Study on Ectoparasites of fresh sheep pelts and assessment of pickled skin defects processed at Sebeta Tannery. DVM Thesis, Addis Ababa University, Debre Zeit

Fthenakis GC, Karagiannidis A, Alexopoulos C, Brozos C, Papadopoulos E (2001) Effects of sarcoptic mange on the reproductive performance of ewes and transmission of *Sarcoptes scabiei* to newborn lambs. Vet Parasitol 95:63–71

Haffize M (2001) Study on skin diseases of small ruminant in Central Ethiopia. DVM Thesis, Addis Ababa University, Debre Zeit

Kassa B (2006) Cockle, mange and pox: major threats to the leather industry in Ethiopia. Ethiopian leather industry: perseverance towards value addition. Proceedings of the National Workshop, December 14–15, 2006, Addis Ababa, Ethiopia, p 71–92

Madeira NG, Amarante AFT, Padovani CR (2000) Diversity of ectoparasites in sheep flocks in Sao Paulo, Brazil. Trop Anim Health Prod 32:225–232

Mekonnen S, Hussein I, Bedane B (2001) The distribution of ixodid ticks (Acari: Ixodidae) in central Ethiopia. Onderstepoort J Vet Res 66:243–251

Mekonnen S, Pegram RG, Gebre S, Mekonnen A, Jobre Y, Zewde M (2007) A synthesis of ixodid (Acari: Ixodidae) and argasid (Acari: Argasidae) ticks in Ethiopian and their possible roles in disease transmission. Ethiop Vet J 11:1–17

Mohammed Y (2006) Prevalence of ectoparasites of sheep and goat flock in Urmia Subrub, Iran. Vet Parasit 76:431–442

Molu N (2002) Epidemiological study on skin diseases of small ruminants in the southern rangelands of Oromia, Ethiopia. DVM Thesis, Addis Ababa University, Debre Zeit

Mulugeta Y, Yacob HT, Ashenafi A (2010) Ectoparasites of small ruminants in three selected agro-ecological sites of Tigray Region, Ethiopia. Trop Anim Heal Prod 42:1219–1224

Numery A (2001) Prevalence and effect of ectoparasites in goats and fresh goat pelts and assessment of wet-blue skin defects at Kombolcha Tannery, South Wollo. DVM Thesis, Addis Ababa University, Debre Zeit

Nyangiwe N, Horak IG (2007) Goats as alternative hosts of cattle ticks. Onderstepoort J Vet Res 74:1–7

Okello-Onen J, Hussar SM, Essuman S (1999) Taxonomy of African ticks. Identification manual. ICIPE Science Press, Nairobi, pp 124–125

Pangui LJ (1994) Mange in domestic animals and methods of control. Rev Sci Tech Off Int Epiz 13(4):1227–1243

Pegram RG, Hoogstral H, Wassef HY (1981) Ticks (Ixodidae) of Ethiopia: distribution, ecology and host relationship of tick species affecting livestock. Bull Entomol Res 71:339–359

Sertse T, Wossene A (2007a) A study on ectoparasites of sheep and goats in eastern part of Amhara region, Northeast Ethiopia. Small Ruminant Res 69:62–67

Sertse T, Wossene A (2007b) Effect of ectoparasites on quality of pickled skins and their impact on the tanning industries in Amhara regional state, Ethiopia. Small Ruminant Res 69:55–61

Sheferaw D, Degefu H, Banteyirgu D (2010) Epidemiological study of small ruminant mange mites in three agro-ecological zones of Wolaita, Southern Ethiopia. Ethiop Vet J 14(1):31–38

Steele M (1996) Sheep. In: Coste R, Smith JA (eds) The tropical agriculturalist. Macmillan, CTA, London,Wageningen, p 79–80

Teshome W (2002) Study on skin diseases of small ruminant in sidama zone, Southern Ethiopia. DVM Thesis, Addis Ababa University, Debre Zeit

Thrusfield M (2005) Veterinary Epidemiology, 3rd edn. Blackwell Science Ltd., UK, p 229–245

Urquhart GM, Armour JL, Dunn AM, Jennings FW (1996) Veterinary parasitology, 2nd edn. Blackwell, London, pp 89–205

Walker AR, Bouattour A, Camicas JL, Estrada-Pena A, Horak IG, Latif AA, Pegram RG and Preston PM (2003) Ticks of domestic animals in Africa. A guide to identification of species, ICTTD-2, Bioscience reports, London, pp 1–219.

Wall R, Shearer D (1997) Veterinary entomology, 1st edn. Chapman and Hall, London, pp 1–438

Wallaga D (1997) Survey of ticks and tick-borne diseases in eight domestic animals in and around Debre Zeit, Eastern Showa Zone, Ethiopia. DVM Thesis, Addis Ababa University, Debre Zeit