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# COMPARATIVE STUDY ON ECTOPARASITIC TICK ABUNDANCE AND DIVERSITY ON GOATS AND COWS

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**ABSTRACT**

**Ectoparasitic infestation is one of the threats to the growth of the livestock industry. Ticks, one of the most notorious groups of ectoparasites on livestock, create issues for cattle rearers by causing a wide range of diseases like babesiosis, theleriosis, anaplasmosis, KFD, CCHF, etc. In addition, conditions like tick worry, metabolic debilitation, secondary infections, and loss of large quantities of blood due to parasitic feeding also pose severe health issues. The current study analyzed the ectoparasitic tick infestation on goats and cows, the common domesticated animals in south India. Gaining from rearing these animals support the economic status of the rural peoples of the region. The study discussed the abundance, diversity, and host selectivity of the ticks recorded from the area. Additionally, the role of each species in transmitting various diseases in animals and humans is also discussed.**

**Key words:** Domestic animals, cows, goats, livestock, ectoparasites, ticks, diversity, abundance, host specificity, tick-borne diseases, seasonal variation, *Haemaphysalis bispinosa, Rhipicephalus (Boophilus) annulatus, Rhipicephalus haemaphysaloides, Hyalomma anatolicum, Boophilus* sp.

In the developing world, domestic animals have their position as the source of energy, food, raw material, and manure mainly for rural farmers. This is especially true for India which is known to be a land of agriculture, where cattle wealth determines the socio-economic status of millions of rural people. Even though cattle farming has not evolved as a major industry in a small state like Kerala, the culture of maintaining a few animals like cows and goats in small stables of the household backyards is still a practice in the rural belts of the state. Low space requirements and maintenance costs, ease in management, and high demand for their products even in urban markets have made these small-scale cattle rearing a major contributor to the economic stability of the middle-class farming community. Ectoparasitism is the major issue faced by the cattle industry all over the world, which severely affects animal health, growth rate, and production (Ajith et al., 2017; Puvarajan, 2017). Among the common ectoparasites on cattle, ticks are one of the major pests causing serious health issues in the host. They cause transmission of tick-borne diseases by bacteria, rickettsiae, protozoa, spirochaetes, and viruses more than any other arthropod vector. Tick-borne diseases like babesiosis, theileriosis, anaplasmosis, and many more are considered major limitations on livestock productivity (Monfared, 2015; Waskel and Gaur, 2015; Riaz, 2017). Tick worry, metabolic debilitation, tick toxicosis, secondary infections, anaemia, weight loss, dermatitis, sweating sickness, and even death due to draining large quantities of blood are the other major deleterious impacts of severe tick infestation (Eyo et al., 2014; Monfared et al., 2015; Soundararajan et al., 2018). From an economic point of view, they are causing a great reduction in milk production and weight gain in cattle (Kumar et al. 2018). The issue of tick infestation is on the high rise hitting the cattle industry of the state. The continued presence of ectoparasites is forcing many small-scale farmers to stop cattle rearing due to increased financial burden, reduced production, and high maintenance costs. The current study aims at analyzing the abundance, diversity, and host specificity of common tick species infesting cows and goats in the Palakkad district of Kerala state in India.

## MATERIALS AND METHODS

A survey of tick species infesting cows and goats was carried out for a period of six months from September 2019 to February 2020, from Pallatheri, a rural village in Elappulli panchayat, Palakkad district (Latitude 10.7570°N, 76.7134°E). The study period includes two seasons, post-monsoon and pre-summer. Random sampling was done from cows (*Bos taurus*) and goats (*Capra aegagrus hircus*) above two years of age, reared in the residential backyards

of the study area. Collections were made by hand picking method (Debbarma et al., 2018). Collected specimens were transferred into Tarsons vials (PVC) containing 70% alcohol. The specimens were taken to the laboratory at St. Josephs College (Autonomous), Devagiri, and identified up to the species level with the identification keys provided by (Sen, 1938; Trapido, 1964; Geevarghese, 1997). The monthly data of tick species obtained were subjected to statistical analysis by using PAST software. The tick abundance, diversity, and evenness concerning the hosts were analysed. Variation in the abundance of tick species on the two hosts was done with one factor ANOVA and variation in season-wise abundance in the two hosts was analysed with the Kruskal Wallis test followed by Wilcoxon- Mann Whitney test.

## RESULTS AND DISCUSSION

The study recorded a total of 202 ticks from 80 cows and 369 ticks from 80 goats. The ticks identified are *Haemaphysalis bispinosa, Boophilus sp., Rhipicephalus (Boophilus) annulatus, Rhipicephalus haemaphysaloides, Hyalomma anatolicum,* and one unidentified species. Out of the five identified species, all species were found to infest cows, whereas only two species were recorded on goats namely, *H. bispinosa* and *R. haemaphysaloides*. The percentage of tick infestation in cows was 35.38% and in goats was 64.62%. Regarding the overall species-wise abundance of the ticks in the locality, *H. bispinosa* (67.08%) was recorded as the prevalent species followed by *R. haemaphysaloides* (13.66%), *Boophilus* sp. (11%) and *R.(B) annulatus* (6.13%) respectively. *H. anatolicum* was recorded as the least abundant species in the area (1.04%). While considering the percentage of infestation in different animal hosts *H. bispinosa* was the abundant species in cows (47%) followed by *Boophilus* sp. (31%) and *R. (B) annulatus* (17%). *H. anatolicum* (3.9%) and *R. haemaphysaloides* (0.5%) recorded low abundance. In goats, *H. bispinosa* (78%) was the most abundant species followed by *R. haemaphysaloides* (20.87%). *Boophilus* sp., *R. (B) annulatus*, and *H. anatolicum* were completely absent in goats. Rhipicephalus was the predominant genus recorded from the locality, with three species followed by Haemaphysalis genus with a single species.

Species diversity and evenness of ticks were high for cows. Statistical analysis showed that overall tick abundance on the host varied between the two hosts namely goat and cow (p= 0.002308, F=10.17), and was recorded to be highest on goats than on cows. Significant variation was observed in the abundance of individual tick species that were present on both hosts. *H. bispinosa* (p=0.00, F=21.14) and *R. haemaphysaloides* (p=0.00, F=28.44, Table 1) recorded the highest abundance in goats than in cows. Despite the low diversity of tick species, overall tick abundance was high in goats compared to cows. Goats with longer hairs and thicker coats create a microclimate that favours tick survival (Fraga et al., 2003) which supported the high abundance of individual tick species on goats. Cows with comparatively shorter hairs and thinner fur coats are intensively maintained in the region with a practice of regular bathing and grooming, daily cleaning of cow sheds, and use of plant-based or chemical compounds to regulate the ectoparasitic population. Such practices lead to the continuous removal of ticks from the animal body resulting in a low abundance of pest species (Shyma et al., 2013). The absence of hygienic measures along with favourable habitat conditions supported the population build-up of the ticks on goats. The higher tick diversity in cows indicates the ability of the host to maintain multiple populations of ectoparasites on them.

*Haemaphysalis bispinosa* being the most abundant species on both hosts marks its importance as the predominant ectoparasitic tick in the region. *H. bispinosa* is one of the prevalent tick species in Kerala (Prakasan and Ramani, 2007; Shyma et al., 2013; Balasubramanian et al., 2019). It is a three-host hard tick attributed with lower host specificity and ability to infest a wide range of animals including all domestic animals (Prakasan and Ramani, 2007; Geevarghese and Mishra, 2011). This provides *H. bispinosa* with higher chances of existence on different hosts widely in the region. All life stages have been found to inhabit the grooves and crevices in the cattle shed for about 3 to 8 feet above the floor, and they can reproduce quickly and occur in clusters on the walls of the cattle shed (Chhabra, 1992; Geevarghese and Mishra, 2011). This phenomenon helps them escape from the regular tick control measures practiced by the farmers providing higher survival rates. *Haemaphysalis bispinosa* transmits diseases like Theleriosis and Bartonellosis in cattle by transmitting pathogens like *Theleria orientalis* and *Bartonella bovis* respectively. (Kho et al., 2015; Kakati et al., 2015). Additionally reports on the presence of *H. bispinosa* in areas endemic to the Kyasanur Forest Disease (KFD) outbreak and the ability of the animal to act as a reservoir for the virus (Balasubramanian et al., 2019; Prakasan, 2015) show that the tick species have a role in

the transmission of this disease. Hence the prevalence of the species in the region is of great concern, as they can affect the health status of the host animals and humans associated with cattle rearing.

*Rhipicephalus haemaphysaloides* is a common tick species of south India that shows comparatively low host specificity and can infest a wide range of animals including domestic and wild animals (Prakasan and Ramani, 2007). It was recorded as the second most abundant species in goats whereas in cows it showed less abundance. They act as a vector of benign *Theleria ovis* (Chhabra, 1992). KFD virus was isolated from the wild-caught species of *R. haemaphysaloides* (Kumar et al., 2014) which shows its potency to spread the pathogen. Ticks under the *Rhipicephalus* (*Boophilus*) genus including *Rhipicephalus (Boophilus) annulatus* act as vectors of *Babesia bigemina* and *Babesia bovis* causing babesiosis in a wide range of animals and humans (Antunes et al., 2012) they also transmit *Anaplasma marginale* causing rickettsia (Bovine anaplasmosis or gall sickness). Nair et al., 2013 reported *Anaplasma marginale* in samples collected from cows in Palakkad and other Malabar districts. The absence of subgenus *R. (Boophilus)* in goats is notable despite its occurrence as the second major pest in cows. The exclusion of goats as a host is suspected not due to their high host specificity on cattle as the species have been reported earlier from goats from Kerala (Prakasan and Ramani, 2007). Additionally, the members of this subgenus are reported to be able to complete their life cycle on goats (Nyangiwe and Horak, 2007). According to Daemon et al., 1998 and Nyangiwe and Horak, 2007, goats act as alternative hosts for many species, playing a role in maintaining infestations of ticks on other animals. Hence it is concluded that goats might be acting as an alternative host for the species in the region. The abundance of the preferred hosts like cows might have caused the reduction in the population of *Rhipicephalus* (*Boophilus*) sp. on alternative hosts like goats. *Hyalomma anatolicum* is a multi-host hard tick that is a common member of the genus in India (Shyma et al., 2012). Even though a lower abundance of *H. anatolicum* in cows and its complete absence in goats were recorded in the region, the tick species have been reported from both these hosts in other regions (Islam et al., 2006; Choubdar et al., 2019). Hence *H. anatolicum* remains as a minor ectoparasitic tick on cows.

While looking into the relationship with tick abundance and seasonality, Kruskal-Wallis test showed a significant variation in the season-wise abundance of ticks on goats (Table 1). Tick abundance in goats during post-monsoon (15.87± 7.87) is higher than in pre-summer (8.73± 6.69). Among the two tick species recorded on goats, only *H. bispinosa* showed significant variation in season-wise abundance where the highest abundance was recorded in post-monsoon (12.40± 7.40) than in the pre-summer (6.80± 5.85) season. No

Table 1. Diversity of the ticks on two hosts- goat and cow

| Abundance and infestation | | | | |
|---|---|---|---|---|
| Tick species recorded | % of infestation | | Abundance (Mean± SD) | |
| | Goat | Cow | Goat | Cow |
| *H. bispinosa* | 78.05% | 47.03% | 9.60± 7.15 | 3.17± 2.78 |
| *Boophilus* sp. | 0.00% | 31.19% | 0.00± 0.00 | 2.10± 2.06 |
| *R. (B) annulatus* | 0.00% | 17.33% | 0.00± 0.00 | 1.17± 2.05 |
| *R. haemaphysaloides* | 20.87% | 0.50% | 2.57± 2.60 | 0.03± 0.18 |
| *Hyalomma anatolicum* | 0.00% | 3.96% | 0.00± 0.00 | 0.27± 1.01 |
| Unidentified species | 1.08% | 0.00 | 0.13± 0.51 | 0.00± 0.00 |

| Diversity analyses | | |
|---|---|---|
| | Cows | Goats |
| Dominance_D | 0.3501 | 0.6528 |
| Shannon_H | 1.176 | 0.5695 |
| Evenness_e^H/S | 0.6483 | 0.5891 |

| Seasonal variation | | | |
|---|---|---|---|
| Host | Kruskal Wallis test | | Significant variation in abundance between the two seasons (Mann Whitney test) |
| | P | H | |
| Cow | 0.2306 | 1.427 | ……. |
| Goat | 0.01347 | 6.091 | 0.01428 |

(Kruskal Wallis test, followed by Mann Whitney test for parameters showing significant variation)

significant variation was noted in the overall abundance of ticks on cows. Among the three tick species on cows, only *Boophilus* sp. showed significant variation in season-wise abundance. Here the abundance is higher in pre-summer (2.93± 2.34) than in post-monsoon (1.27± 1.33). The higher abundance of *H. bispinosa* in the post-monsoon season than during pre-summer, which is also the prevalent species on goats, is the major contributor to the overall tick abundance in goats during the post-monsoon season. Of the three species reported on cows, only *Boophilus* sp., the second prevalent species, showed significant variation in seasonal abundance which is more abundant during pre-summer than in post-monsoon. Hence it is thought that the seasonal variation in tick abundance is directly proportional to the seasonal abundance of the prevalent tick species.

The recorded high tick abundance on goats and high tick diversity on cows in the study confirms the role of cows and goats as important hosts of the ixodid ticks in the region. The occurrence of *H. bispinosa* and *R. haemaphysaloides* as the dominant ectoparasitic tick pest on both the hosts and their ability to serve as a vector in transmitting several tick-borne pathogens is a clear indicator of the possibility of the spread of various tick-borne diseases in the hosts of the region. The prevalence of the vectors of KFD in the study area on the domesticated hosts further show the risks posed by these ectoparasites to animals and humans.

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## AUTHOR CONTRIBUTION STATEMENT

Princy and Aswathi conceived and designed research. Sample collection and preliminary sorting done by Nandakrishnan. Species level Identification done by Princy. Data analysis, interpretation and writing part done by Princy and Aswathi. All authors read and approved the manuscript.

## CONFLICT OF INTERST

No conflict of interest.

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