Research Article:

MORPHOLOGICAL CHARACTERIZATION OF ECTOPARASITES INFESTATING DOGS FROM AN ANIMAL BIRTH CONTROL CAMPAIGN IN KHOTANG, NEPAL

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ABSTRACT

Dogs are an integral part of human civilization as companion animal species. But free-roaming dogs create major veterinary and public health concerns due to their role as reservoirs of ectoparasites and vector-borne pathogens. In Nepal, Himalayan Sheepdogs (*Bhote Kukur*) are culturally significant but poorly studied regarding ectoparasitic infestations. This study was conducted during an animal birth control campaign for dogs (N = 105) in July 2025 at Diktel Rupakot Majhuwagadhi Municipality, Khotang District. Ticks were collected by hand-picking/forceps, preserved in 70% ethanol, and identified morphologically under a stereo zoom dissecting microscope using standard taxonomic keys. Morphometric analyses were based on diagnostic features of ticks (capitulum, scutum, spiracles), fleas (combs), and flies (wing venations). Overall, 147 ectoparasites recovered where ticks were most prevalent (25.71%), followed by fleas (2.85%), and flies (0.95%) in dogs, with occasional mixed infestations. Identified species included brown ticks (*Rhipicephalus sanguineus* and *R. haemophysaloides*), flea (*Ctenocephalides canis*), and louse fly (*Hippobosca longipennis*). The predominance of ticks, particularly females, underscores their role as vectors of pathogens such as *Ehrlichia*, *Babesia*, and *Anaplasma*. This study provides the first baseline on ectoparasites of Himalayan Sheepdogs in rural Nepal and emphasizes the need for integrated conventional and advanced molecular diagnosis and control strategies for strengthening One Health approach.

सारांश

मानव समाजको विकासक्रम संगै कुकुर प्रजातिले महत्वपूर्ण भूमिका निर्बाह गर्दै आईरहेको छ । संक्रमित छाडा–फिरन्ते कुकुरहरू पशु तथा जनस्वास्थ्यका लागि चुनौतीपूर्ण छन्, किनभने तिनीहरूमा पाइने बाह्य परजीवीहरूले रोग सार्न महत्वपूर्ण भूमिका खेल्छन् । नेपालमा हिमालयन शीपडग अर्थात् भोटे कुकुर सांस्कृतिक रुपमा महत्वपूर्ण भए तापनि बाह्य परजीवी सम्बन्धी अध्ययनहरू अत्यन्तै न्यून छन् । बाह्य परजीवीहरूको पहिचान गर्ने उदेश्यका साथ यो अध्ययन २०२५ जुलाईमा खोटाङ जिल्ला, दिक्तेल रुपाकोट मजुवागढी नगरपालिकामा आयोजना गरिएको कुकुर बन्ध्याकरण शिविरमा ल्याइएका १०५ वटा कुकुरहरूमा गरिएको हो । बिभिन्न बाह्य परजीवीहरू सङ्कलन गरी ७०% इथानोलमा संरक्षण गरी मापदण्ड अनुसारको ट्याक्सोनोमिक कुञ्जी प्रयोग गरी स्टेरियो जुम डिसेक्टिङ्ग माइक्रोस्कोपमा आकृति–आधारित पहिचान गरियो । किर्ना, उपियाँ र झिंगाका अंगहरू को विशिष्ट संरचना का आधारमा तिनीहरूको प्रजातीहरू पत्ता लगाईयो । यसरी संकलित बाह्य परजीवीहरू (१४७) जसमा किर्नाले (२५.७१%), उपियाँले (२.८५%) र झिंगाले (०.९५%) कुकुरहरू संक्रमण हुनुका साथै केही कुकुरमा मात्र मिश्रित संक्रमण भएका थिए । पहिचान गरिएका प्रजातिहरूमा कुकुरमा पाउने खैरो किर्ना समूह (*Rhipicephalus sanguineus* र *R. haemophysaloides*), उपियाँ (*Ctenocephalides canis*), र जुम्रे-झिंगा (*Hippobosca longipennis*) समावेश थिए । विशेषगरी पोथी किर्नाको उच्च प्रादुर्भावले *Ehrlichia*, *Babesia* र *Anaplasma*

जस्ता रक्त परजीवी वाहकको रूपमा तिनीहरूको महत्व देखाउँछ । यस अध्ययनले ग्रामीण नेपालका भोटे कुकुरमा बाह्य परजीवीहरूको पहिलो आधारभूत विवरण प्रदान गर्दै एक स्वास्थ्य दृष्टिकोणलाई सुदृढ गर्न परम्परागत तथा मोलेकुलर स्तरको निदान र नियन्त्रण रणनीतिहरू आवश्यक रहेकोमा जोड दिन्छ ।

Keywords: Bhote Kukur, One Health, Vector-Borne Pathogens, Zoonoses

INTRODUCTION

Dogs are one of the most widespread domestic animals globally and play an integral role in both rural and urban communities as companions, guards, and working animals (Bergström et al., 2020; Sepúlveda et al., 2014). In Nepal, many local settings, including Khotang District, most dogs are free roaming rather than strictly owned or confined (O'Meara, 2025). Such free roaming behavior not only contributes to nuisance problems, especially at night due to barking and aggression, but also increases the risk of dog bites and transmission of fatal diseases to humans and livestock (Rahaman, 2017). Free-roaming dogs often share common shelters and feeding sources, creating an environment favorable to the spread of vectors and vectors transmitting parasitic diseases.

Among the health concerns, ectoparasites represent a major challenge. Free-roaming dogs frequently harbor a variety of ectoparasites, such as ticks, mites, fleas, flies, and lice, which have significant veterinary, environmental, and public health implications (B. Kelly et al., 2024). These external parasites not only affect animal welfare and productivity but also act as pathogens of zoonotic importance (Giannelli et al., 2024). These ectoparasites negatively impact canine health by causing irritation, anemia, hypersensitivity, and secondary infections (Bhusal et al., 2025; Hurtado et al., 2018; Zineldar et al., 2023). More importantly, ectoparasites provide a crucial role in transmitting bacterial, protozoal, helminthic, and viral diseases to both humans and animals (Esch & Petersen, 2013). Biological or mechanical way numerous zoonotic pathogens, including *Ehrlichia* spp., *Babesia* spp., *Anaplasma* spp., and *Rickettsia* spp. transmitted from infected to healthy host animals (Díaz-Regañón et al., 2020; Pandey et al., 2025; Pennisi et al., 2017). Therefore, the role of dogs as reservoirs and ectoparasites as vectors underscores the need for careful surveillance and management.

Despite their importance, the handling and clinical examination of free-roaming dogs poses significant challenges. These dogs are often unfamiliar to human restraint and may display aggressive behaviors (Luescher & Reisner, 2008). Safe handling for diagnostic purposes is usually possible only during animal birth control (ABC) and vaccination campaigns, or under anesthetic conditions (Yoak et al., 2014). These logistical limitations contribute to a lack of systematic parasitological surveys in rural Nepal, resulting in critical gaps regarding the diversity and distribution of ectoparasites in local dog populations. Accurate identification of ectoparasites is essential for understanding epidemiological risks (Devleesschauwer et al., 2014; Massei et al., 2017; Wells et al., 2012). Morphological identification provides baseline taxonomic information and facilitates the recognition of species complexes. However, morphology alone may be insufficient to distinguish cryptic species within groups such as *Rhipicephalus sanguineus* (brown ticks), which vary in their ecological adaptations and vector competence (Kazim et al., 2022). Molecular characterization, therefore, provides an advanced tool for resolving taxonomic ambiguities and detecting pathogen carriage within populations (Nava et al., 2018; Šlapeta et al., 2022).

The present study focuses on the ectoparasites of local dogs (*Bhote Kukur*) in Khotang, Nepal. These large mountain dogs are culturally significant and commonly free roaming in rural areas, making them potential reservoirs and transmitting sources of parasites. The present research aims to document the diversity of ectoparasites infesting *Bhote Kukur*, provide morphological identification of collected specimens, and highlight the implications for veterinary, environment and public health. Furthermore, the findings provide an avenue for further molecular characterization of ectoparasites and their associated pathogens.

RESEARCH METHODS

Study site

Ectoparasites were collected from a total of 105 dogs admitted in the animal birth control camp organized at Diktel Rupakot Majhuwagadhi Municipality in July 2025. Dogs were brought from different spots of Municipality (Fig. 1). There were 75 male and 30 female dogs representing the four different wards (1, 2, 3, and 5) of the Municipality (sampling details in Table 1). Diktel (Diktel Rupakot Majhuwagadhi Municipality) located at (27°12′50″N and 86°47′52″E) an elevation of 700 - 2250 m above sea level with subtropical to temperate climate (AccuWeather, 2025). The average temperature was recorded 24 °C during the time of sampling.

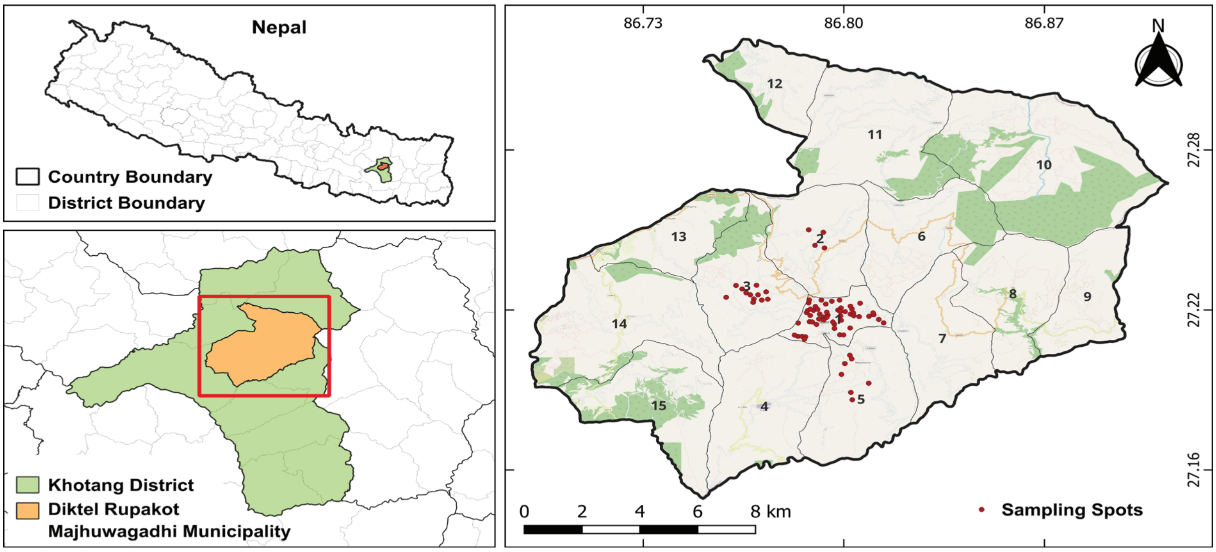

Fig. 1. Research area representing the locations of dogs included in the animal birth control (ABC) campaign and for ectoparasitic specimens' collection at Diktel Rupakot Majhuwagadhi Municipality Khotang District, Nepal (27°12′50″N to 86°47′52″E)

Table 1. Sampling details for the collection of ectoparasitic specimens from a total of (N = 105) dogs

Sampling dogs	Categories	Number (%)
Gender	Male	75 (71.42)
	Female	30 (28.58)
	Total	105 (100)
Age	≤ 1 yr	25 (23.80)
	>1 to ≤ 3 yrs	61 (58.09)
	>3 yrs	19 (18.09)
	Total	105 (100)

Sample collection and preparation

Individual dogs were examined thoroughly for the presence of ectoparasites. Then the ectoparasites like tick flea and fly were collected using the hand picking or forceps so that the mouth part remained intact with the body of specimens. The collected ectoparasites were kept in the 70 % ethanol and transported to the laboratory at the Department of Microbiology and Parasitology, Agriculture and Forestry University. In laboratory samples were thoroughly washed with distilled water for 5 min. The specific ectoparasites were then examined under the stereo zoom dissecting microscope. Identification was performed using keys provided by Walker et al. (2014) for ticks Pratt & Wiseman (n.d.) for fleas, and Rani et al. (2011) for fly of dogs.

Morphometric analyses

Based on the specific structures like basis capitulum, palp, scutum, eyes, hypostomal teeth, spiracles, coxae, anal groove, adanal plates, and genital openings ticks were identified and characterized into different stages (larval: three pair of legs, nymphal: undifferentiated body parts), sexes (male: small sized and scutum covering entire dorsal; female: large sized and small scutum covering at front part), and species (ixodids). Similarly, structures like shape of head, thorax, antennae, genal and pronotal combs, fleas were characterized. Flies were characterized by using specific key features including mouth parts, wing venation and legs. The measurements observed were taken using a measuring scale of least division of 1 mm (Fig. 2). The measurements were noted for individual samples.

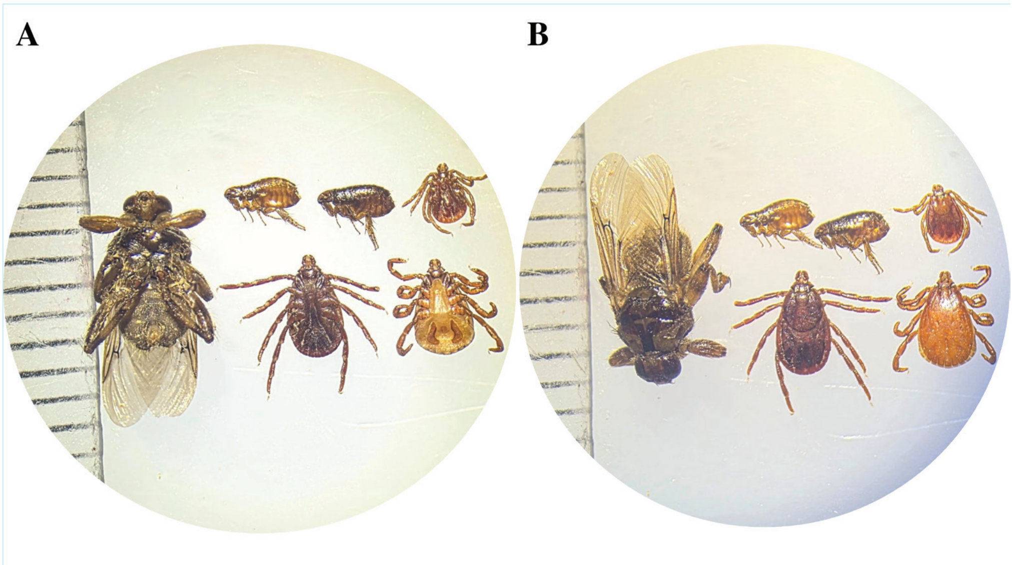

Fig. 2. Morphological characterization of different ectoparasites of dogs. Measurement of parasites under the Stereo-zoom dissecting microscope. A = Ventral view, and B = dorsal view of fly, fleas, and ticks. Single division of scale = 1 mm

Data management

The images were captured using mobile photography (Samsung Galaxy s25 Ultra) and organized in Microsoft PowerPoint [Microsoft® PowerPoint® for Microsoft 365 MSO (Version 2507)]. Comparison of images was performed using previously published research reports for key components. The study map was prepared by using QGIS software (Version 3.42.0).

RESULTS AND DISCUSSION

This study provides the first documentation of ectoparasites infesting the indigenous Bhote Kurkur. While numerous studies in Nepal have been mapped tick species in livestock across different agro-climatic regions, information on ectoparasites of native dog breeds has remained largely unexplored (Dahal et al., 2011; Shrestha et al., 2020) Given the potential for tick species displacement driven by climatic changes, this study provides a baseline for future insights into the tick fauna of Khotang District (Shrestha et al., 2011). In addition, previous studies have reported a diversity of ectoparasites- ticks, mites and fleas across Nepal's varied agro-climatic regions (B.C., 2011; Biswakarma & Aryal, 2023)

The Himalayan Sheepdogs of Nepal are large breeds having thick, double coats, often in black and tan or solid black are also known as *Bhote Kukur* in Nepalese local community (International Kennel Club, 2025). Since morphological characterizations are considered crucial pre-requisites for advanced molecular research, this study attempts to document the ectoparasites in those community dogs for the foundation of future studies on the potential vector borne parasitic diseases of one health importance.

Ectoparasitic infestations in dogs

All three different groups of ectoparasites were presented on the body of dogs. Ticks were present in 25.71% (27/105) of dogs followed by fleas, 2.85% (3/105), and at least by flies 0.95% (1/105). The mixed infestation of (ticks and fleas) and (ticks and flies) was found in 0.95% (1/105) in each combination. These data are consistent with the findings (Saru et al., 2022)

Distribution of ectoparasitic species

Ticks were distributed in different stages (adult and nymph) and representing male and female (Table 1). When categorized by ectoparasitic groups, tics were the most prevalent, with 135 specimens recorded, comprising 54 (40%) males and 81 (60%) females. Fleas were less common, with 9 individual fleas were identified, including 6 (75%) males and 3 (25%) females. Flies were the least represented group, with only 3 specimens, all of which were females. Overall ticks were the dominant ectoparasites infesting dogs in Khotang, followed by fleas and flies.

Table 2. Distribution of ectoparasites (ticks, fleas, and flies) collected from dogs in Khotang district, Nepal

Ectoparasitic groups	Number of males	Number of females	Total
Ticks	54 (40)	81 (60)	135
Fleas	6 (75)	3 (25)	9
Flies	0 (0)	3 (100)	3

Note: Figures in the brackets represent the corresponding percentage.

The predominance of ticks observed in this study highlights their major role as ectoparasites of dogs in Khotang district. The higher proportion of female ticks compared to males is consistent with previous reports, as engorged females typically remain on the host for longer periods, increasing their likelihood of being collected. Similarly, the presence of fleas, although comparatively lower, is noteworthy since they contribute to dermatological issues and act as vectors of zoonotic agents. In addition, flies were the least common ectoparasites encountered, with only females recorded. This fly species could act as a mechanical vector for pathogens.

Morphological characterization of tick species

Male

The oval but slightly tapering anterior portions of the male tick were noticed. Male ticks with an average of (2.8 – 3.4) mm in length and (2.5 – 3.1) mm in breadth [Fig. 3(A–D)]. The scutum, or dorsal cover, was red (Fig. 3A), brown (Fig. 3B), and yellowish; it had tiny punctations scattered throughout it. The dorsal side has deep marginal grooves that extend to the first festoons. Scapular rounding, eye flatness, and posteromedian groove. The variable size of the festoon had width and length almost similar (Fig. 3D) except for the middle festoon (width greater than length) (Fig. 3C). Plates on the ventral surface are long adanal plates, subtriangular to sickle shaped (Fig. 3A), posterior end is wider (Fig. 3A) or narrower (Fig. 3B) than the width of the adjacent festoon. The inner margin of adanal plates were clearly concave. Spiracle plates were comma or elongated; dorsal prolongation narrow and visible dorsally (Fig. 3A) but their ultra-structures and shape were indistinct clearly. Basis capitulum hexagonal in shape. Coxa I with bifurcations (internal spur wider than external spur), coxae II-III had only external spur; coxae IV with two-minute spur; the size of coxae increasing order from first to fourth [Fig. 3(A-D)]. posterior margin at the central point there was also a bulging structure observed in some instances (Fig. 3D). The male genital opening at the level of second coxae.

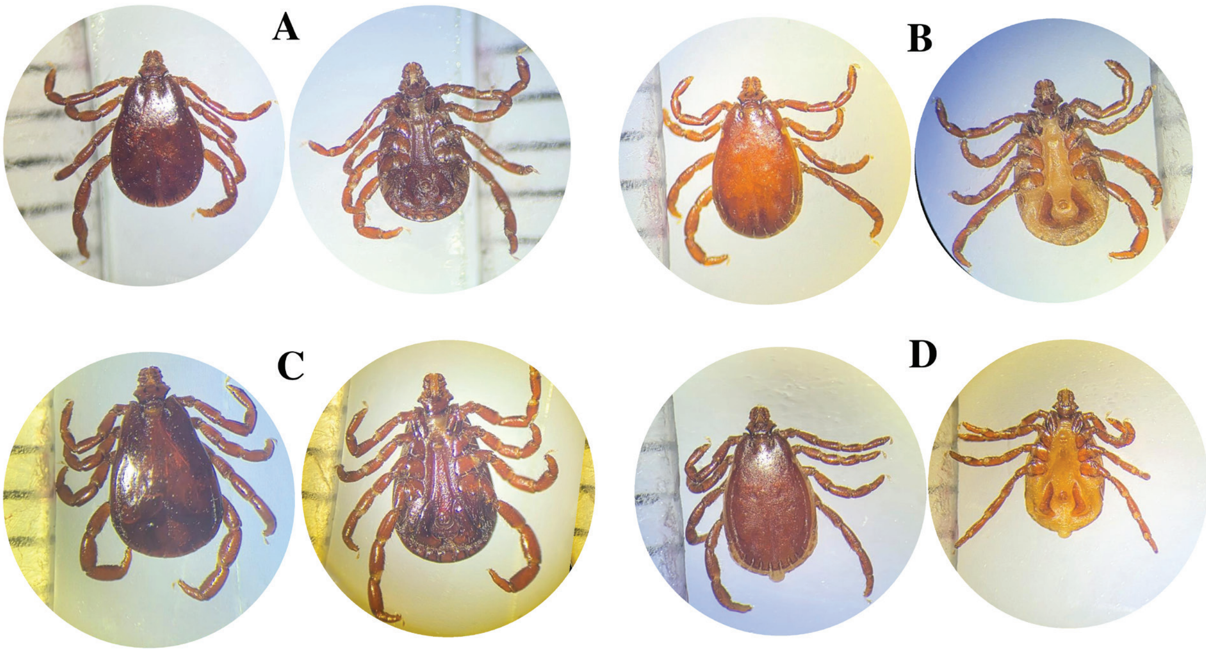

Fig. 3. Morphological characteristics of *Rhipicephalus* ticks collected from dogs in Khotang District, Nepal. A, B, C, and D; Dorsal and ventral view of engorged male *R. sanguineus* and *R. haemophysaloides,* Images captured under stereomicroscope showing key diagnostic features including scutum, spiracular plates, coxae, and spurs. Side measuring scale: each division = 1 mm

The morphological characteristics of observed male are unique to the male of either *Rhipicephalus sanguineus* or *Rhipicephalus haemophysaloides* as we observed in the combinations. Elongated spiracle plate subtriangular visible from the dorsal side. The width of prolongation of spiracle on the dorsal is narrower than the festoon next to it. Dots (punctations) on the dorsal scutum of unequal and moderately distributed. Marginal groove (conspicuous), distinct posteromedian groove (sub-circular), adanal plate (long, subtriangular sickle shaped, concave inner margins). Comparative analysis of morphological key provided by different researchers the identified species are brown ticks of dogs (*Rhipicephalus sanguineus* groups) and most probably *R. sanguineus* and *R. hamophysaloides* (Fig. 3 and Table 3)

Female

The body is broad and oval measuring about 3.4 – 8.2 mm long (total body length). Female ticks were inornate; reddish brown [Fig. 4(A, B)] or reddish yellow [Fig. 4(C, D)]. Cervical grooves diverged posteriorly; small punctuations of unequal sizes distributed sporadically over the dorsal surface of scutum. Alloscutum showed three vertical grooves [Fig. 4(A, C, D)], inconspicuous in highly engorged females (Fig. 4B). Spiracle plates were oval, or comma shaped without elongation (Fig. 4B) but failed distinctions in all images. Basis capitulum hexagonal dorsally; wider than the length. Hypostome showed the dental formula of 3+3 (Fig. 4A). Coxae I spurs were unequal (internal broader than external) and slightly parallel (Fig. 4A). The sizes of coxae increase from anterior to posterior (I-IV) showing a short external spur on each. Genital opening in female on ventral surface at the level and in between coxae II in U-shaped [Fig. 4 (A, C)]. The narrowing of the U-shaped opening was not clearly observed due to lack of high magnifications and focus for microscopic structures.

Fig. 4. Morphological characteristics of *Rhipicephalus* ticks collected from dogs in Khotang District, Nepal. A. Dorsal and ventral view of engorged female *R. haemophysaloides,* B. Dorsal and ventral view of engorged female *R. sanguineus*, C. Dorsal and ventral view of normal *R. haemophysaloides*, and D. Dorsal and ventral view of normal *R. sanguineus*. Images captured under stereomicroscope showing key diagnostic features including scutum, spiracular plates, coxae, and spurs. Scale: each division = 1 mm

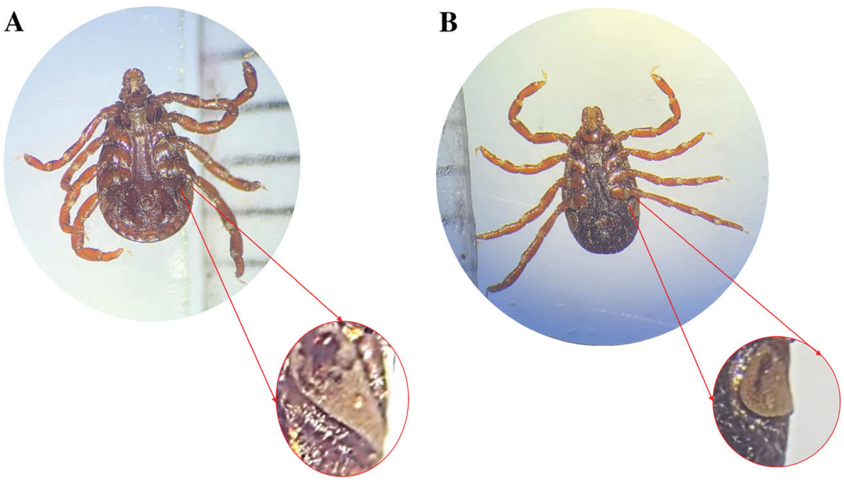

Fig. 5. Ventral view of Rhipicephalus sanguineus group of ticks highlighting the spiracular plates. A. Male and B. Female. Side measuring scale: each division = 1 mm

The morphological characteristics of observed females are also unique to *Rhipicephalus sanguineus* groups. The shape of genital aperture (U-shaped), spiracle plates (narrow dorsal prolongation), basis capitulum (hexagonal and blunt laterally), scutum (length > breadth) and other structures (grooves, punctations, and porose area). Comparative analysis of morphological key for female ticks provided by different researchers; identified species are brown ticks of dogs (*Rhipicephalus sanguineus* groups) and most probably *Rhipicephalus sanguineus* and *Rhipicephalus haemophysaloides* (Table. 3). These findings are also consistent with previous findings (Morel & Vassiliades, 1962; Nava et al., 2018; Šlapeta et al., 2022; Walker et al., 2014). This study is supported by the fact that *Rhipicephalus* (*Boophilus*) *microplus* as a predominant species among livestock and pets, with *R. (Boophilus) microplus* and *R. haemophysaloides* showing prevalences of 32.67% and 37.33% in the Kathmandu Valley (B.C., 2011). However, *R. sanguinus* has been documented as predominantly in canines in some reports (Biswakarma & Aryal, 2023).

Table 3. Key morphological differences between *Rhipicephalus sanguineus* and closely related Rhipicephalus species (males and females)

Species	Key characteristics (Male vs *R. sanguineus*)	Key characteristics (Female vs *R. sanguineus*)
R. haemophysaloides	Scutum smooth, adanal plates sickle like, spiracles comma shaped	Genital aperture narrowly U-shaped; scutum punctuations less
R. guilhoni	Spiracular plate = width of adjacent festoon (narrower in *R. sanguineus*)	Genital aperture truncated V-shaped with distinct hyaline flaps (vs broadly U-shaped)
R. turanicus	Spiracular plate = width of adjacent festoon; cusp on adanal plates (absent in *R. sanguineus*)	Genital aperture U-shaped (vs broadly U-shaped); scutum with more and larger punctations
R. rossicus	Fewer and less conspicuous punctations on scutum (more numerous in *R. sanguineus*)	Scutum relatively impunctate (vs punctate in *R. sanguineus*).
R. sulcatus	Scutum with more numerous and denser punctations (less dense in *R. sanguineus*).	Similar scutum; more densely punctate.
R. pusillus	Shorter marginal groove; overall body size smaller.	Smaller scutum; more densely punctation.
R. leporis	Shorter marginal groove; overall body size smaller	Smaller scutum; larger punctations on cervical fields.

Note: comparative descriptions based on findings and figures provided in different studies (Morel & Vassiliades, 1962; Nava et al., 2018; Šlapeta et al., 2022; Walker et al., 2014).

R. sanguineus, or the brown dog tick, has potential to transmit diseases like canine ehrlichiosis (*Ehrlichia canis*) and canine babesiosis (*Babesia vogeli*) (Eamudomkarn et al., 2022; Gallego et al., 2023a, 2023b). It can also spread Rocky Mountain Spotted Fever (*Rickettsia rickettsii*) and Mediterran Spoted Fever (*Rickettsia conorii*) to humans (Lineberry et al., 2022). In addition, ticks also act as the vector for Canine *Hepatozoon canis*, and *Anaplasma platys* (canine anaplasmosis (Eamudomkarn et al., 2022). Similarly, *R. haemophysaloides* has also potential to transmit the several diseases to both humans and animals, including Babesiosis, Ehrlichiosis, Rickettsiosis (like Kyasanur Forest Disease virus), Anaplasmosis, and the pathogen responsible for Canine Monocytic Ehrlichiosis (*Ehrlichia canis*) (Harrus & Waner, 2011; P. J. Kelly et al., 2013). This species of tick is prevalent in the South and Southeast Asia and is responsible for significant vectors for diseases of livestock and companion animals like dogs (Díaz-Regañón et al., 2020; Pandey et al., 2025; Pennisi et al., 2017).

Morphological characterization of flea species

The total body length of the tick identified was 2.2 – 3.1 mm; the whole body laterally compressed. The anterior was a rounded head consisting of pronotal and genal combs. The first spines of pronotal comb were shorter than the second. The posterior margin of the hind tibia; short, club-shaped dorsal incrassation (Fig. 6).

Fig. 6. Morphological characteristics features of dog fleas (*Ctenocephalides canis*) collected from Khotang District. Upper left and lower one = male flea and upper right one = female flea. Side measuring scale: each division = 1 mm

Based on the above morphological key, the observed species has unique characteristics to *Ctenocephalides canis* and is supported by previous reports (Hii et al., 2015; Pratt & Wiseman, 2010). *C. canis* (dog flea), the potential ectoparasite responsible for flea induced- dermatitis followed by hypersensitivity on the skin (Michael, 2024). In addition, they have crucial role in the transmission of tapeworms (*Dipylidium caninum*), and filarial nematodes (*Acanthocheilonema reconditum*) (Traversa, 2013). There has been evidence of infections of *D. caninum* in humans by the ingestion of such infected fleas (Jeon & Eom, 2023).

Morphological characterization of fly species

The body of fly was dorsoventrally flattened, giving it a louse like appearance. The total body length measured 5.5 mm (head, thorax, and abdomen) and width about 2 mm. The fly had powerful mouthparts, large compound eyes, short antennae, robust legs tipped with large, strong, claw-like structures on the tarsus. Wing veins were concentrated in the leading half (Fig. 7).

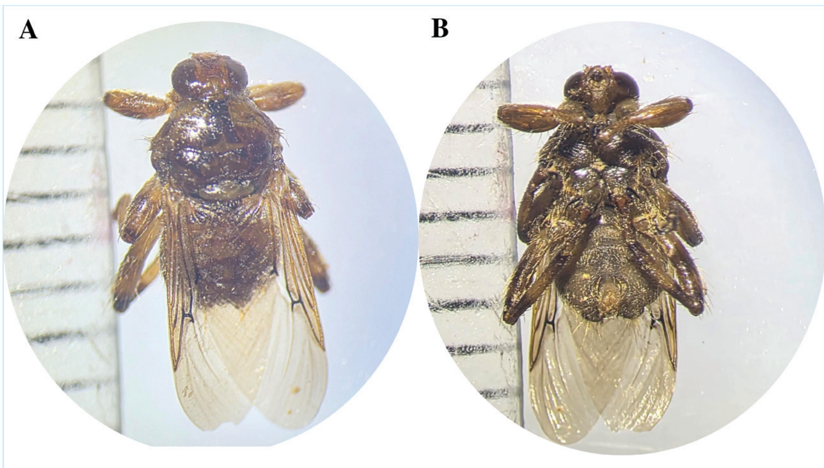

Fig. 7. Morphological characteristics features of dog fly (*Hippobosca longipennis*) collected from Khotang District. A = dorsal view and B = ventral view. Scale; each division = 1 mm

Based on the above morphological key, the observed species has unique characteristics to *Hippobosca longipennis* and is supported by previous reports (Rani et al., 2011). *H. longipennis* (dog louse fly); mainly responsible for transmission of *Acanthocheilonema dracunculoides* (filarial nematode)(Rani et al., 2011). In addition, it acts as a mechanical transport host for *Cheyletiella yasguri* (mites)(Rani et al., 2011). Some reports have indicated that it can be a vector for other pathogens like *Anaplasma phagocytophilum* and *Borrelia burgdorferi* (Peña-Espinoza et al., 2023).

CONCLUSION

This study provides the first detailed documentation of ectoparasites infesting Himalalyan Sheepdogs (*Bhote Kukur*) of Nepal, highlighting the predominance of ticks, particularly species within the *Rhipicephalus sanguineus* group (Brown ticks of dog), followed by fleas (*Ctenophalides canis*) and louse fly (*Hippobosca longipennis*). The higher prevalence of ticks, especially females, emphasizes their role as the significant ectoparasites of dogs in Khotang, consistent with their extended host attachment and vector potential for a wide range of pathogens affecting both humans and animals. The presence of fleas and flies, though comparatively lower, remains of epidemiological importance given their association with dermatological disorders, zoonotic parasites, and vector-borne pathogens. Morphological identification revealed species capable of transmitting serious diseases, including canine ehrlichiosis, babesiosis, hepatozoonosis, rickettsioses, and dipylidiasis. Collectively, these findings establish a baseline for ectoparasitic infestations in Himalayan Sheepdogs and underline the need for integrated surveillance and control strategies, bridging veterinary and public health within the framework of One Health.

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CONFLICT OF INTEREST

The author declares no conflict of interest regarding this publication.

ETHICS APPROVAL

Sampling procedure involved the collection ticks under anesthetic condition without harming the dogs and following the standard protocol with animal welfare considerations.

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