Quest Journals
Journal of Research in Environmental and Earth Sciences
Volume 12 ~ Issue 4 (April 2026) pp: 07-14
ISSN(Online) :2348-2532
www.questjournals.org

Research Paper

Tick infestation in urban dogs in the Democratic Republic of the Congo

Ali Twaha[1,2], Steve Ngoy [1,2], Onesime Mubenga[2,3], Pionus Katuala[1], Casimir Nebese[1], Guy-Crispin Gembu[1,2].

[1] *Faculty of Science, University of Kisangani, Democratic Republic of the Congo*
[2] *Centre de Surveillance de la Biodiversité, University of Kisangani, Democratic Republic of the Congo*
[3] *Faculty of Natural and Renewable Resource Management, University of Kisangani, Democratic Republic of the Congo*

Abstract
Ticks pose a significant public health threat worldwide due to their role in transmitting various vector-borne pathogens. This study aimed to assess the prevalence of tick infestations and the diversity of ticks infesting dogs in several municipalities within the city of Kisangani, in the Democratic Republic of the Congo.
A total of 207 dogs were examined over 50 days in five months (April, May, August, September, and October) of 2024. Of the dogs examined, 168 (81.2%). A total of 5,875 ixodids were collected. The examination of the parasite load distribution reveals major heterogeneity within the sample, characterized by an overdispersion typical of tick populations in natural environments. Parasite burdens were generally low (median = 8), yet the marked right-skewness of the distribution revealed aggregation in a limited number of heavily infested hosts. The prevalence of infestation varied between municipalities, with the highest percentage of infested dogs in Kabondo (91%), Kisangani (90%), and Makiso (89%), and the lowest in Mangobo (68%) and Tshopo (56%).
There was a significant disparity in the prevalence of infestation, with females dogs showing a higher infestation rate (102 out of 128 dogs examined) compared to males (39 out of 79 dogs examined). Mature canids also had a higher infestation rate than younger animals. Rhipicephalus sanguineus was found in 92% of cases, confirming its strong adaptation to the urban environment and its potential role in the transmission of canine and zoonotic pathogens. These results highlight the need for enhanced surveillance and integrated tick control measures in urban areas in Kisangani.

Keywords: *Ectoparasites, Rhipicephalus sanguineus, Haemaphysalis leachi, municipalities, vector-borne diseases, dog parasites.*

*Received 28 Mar., 2026; **R**evised 06 Apr., 2026; **A**ccepted 08 Apr., 2026 © The author(s) 2026.*
P**ublished with open access at **www.questjournals.org

I. Introduction

Ticks, as obligatory hematophagous ectoparasites, are of substantial importance for both animal and human health. These arthropods parasitize a diverse array of mammals, avian species, and reptiles [1]. Globally, almost 900 species of ticks have been identified and categorized into three families: Ixodidae, Argasidae, and Nutalliellidae [2]. Ixodid ticks, commonly known as hard ticks, are of primary interest to public health due to their capacity to transmit various pathogenic organisms, including *Babesia*, *Theileria*, *Anaplasma*, and the Crimean-Congo haemorrhagic fever virus [3]. They are recognized as the principal vectors of disease in animal populations worldwide, and their impact on human welfare is surpassed only by that of mosquitoes[4].

Parasitic infestations in domestic canines merit considerable attention due to their capacity to facilitate the propagation of a diverse array of pathogenic agents. These include bacterial diseases such as borreliosis (caused by *Borrelia spp.*), rickettsiosis, tularemia, and bartonellosis, alongside parasitic conditions like babesiosis and anaplasmosis [5,6]. This underscores the imperative for conducting epidemiological studies on parasitic loads within urban canine populations, given their potential role as reservoirs and transmission vectors for zoonotic diseases affecting human health. The probability of disease transmission is further augmented by the escalating interface among human, domestic animal, and wildlife populations, a trend that inherently promotes the broader dissemination of zoonotic pathogens[7].

The ecological adaptability and range expansion of ticks are largely due to their capacity to adapt to varied environments and host assemblages. Influences such as climatic shifts, alterations in land utilization, and host relocation are contributing to their dispersal into novel areas, including regions previously free of infestation [8]. In Africa, for example, *Rhipicephalus microplus* has shown rapid geographic expansion, displacing indigenous tick species [9] and predictive models suggest distributional increases of up to 100% for several *Rhipicephalu*s species [10].

This investigation aimed to determine the prevalence and intensity of tick infestation on canine hosts within five districts of Kisangani, with a focus on identifying geographical differences and considering their possible relevance to public health. Furthermore, host-specific attributes, including sex and age, were to be examined to evaluate their impact on the probability of infestation.

II. Materials and Methods

2.1. Study environment

The study was conducted in the city of Kisangani, the capital of Tshopo Province in the Democratic Republic of the Congo (DRC). Climatically, Kisangani belongs to the Af category according to the Köppen-Geiger classification (equatorial climate). This climate is characterized by stable temperatures, with an annual average of approximately 25.3 °C, and abundant rainfall averaging 1,724 mm per year (based on records spanning from 1956 to 2005). Monthly precipitation consistently exceeds 60 mm, although it is unevenly distributed over two seasons throughout the year [11, 12].

Covering a total area of 2,947.9 km², the city is administratively subdivided into six municipalities, five of which are located on the right bank of the Congo River and one on the left bank (Fig. 1). The specific scope of the research focused on five urban municipalities: Kabondo, Kisangani, Makiso, Mangobo, and Tshopo. These areas are characterized by rapid recent population growth and an urban environment marked by a high density of domestic and stray dogs.

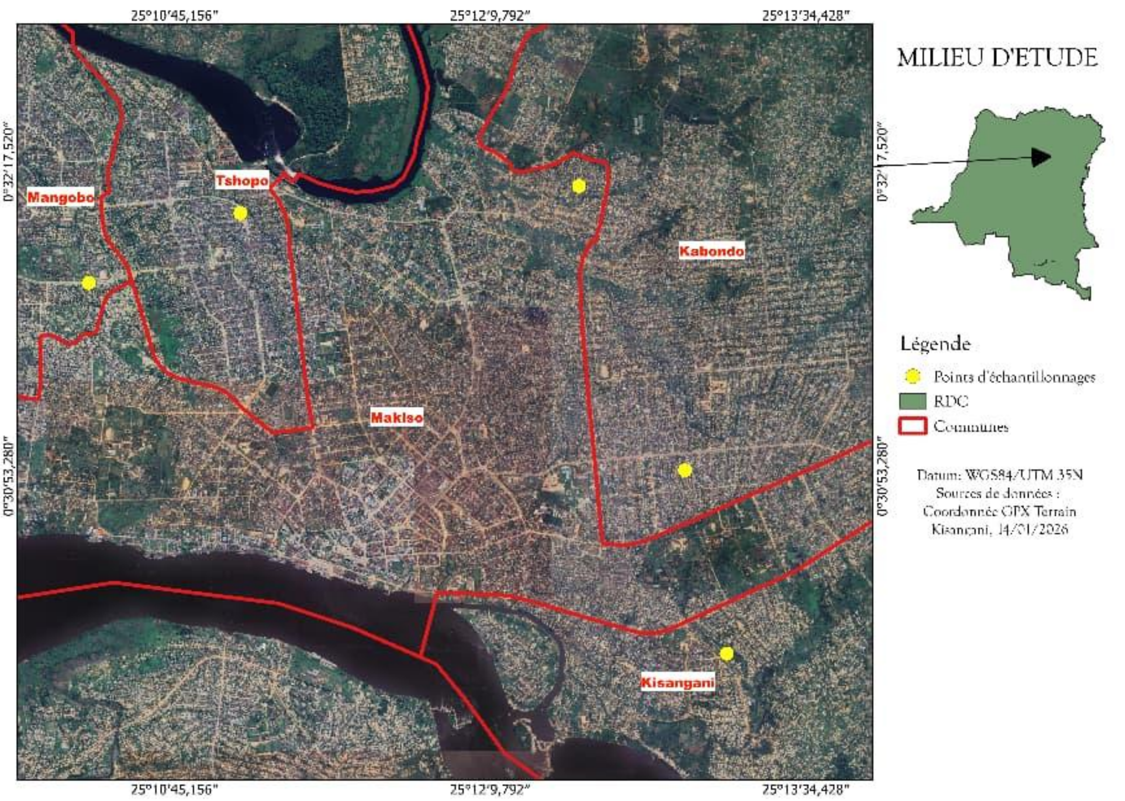

Figure 1: Map showing the location of sampling points in the five municipalities of the city of Kisangani, Tshopo Province (DRC).

2.2. Data collection

Dogs of all ages and both sexes were included. Sampling was conducted using a non-probabilistic snowball approach. Snowball sampling involves a non-probabilistic and non-random sampling method, such as snowball sampling [13], is particularly relevant for investigations targeting specific or hard-to-reach populations in the absence of a comprehensive sampling frame. This approach is therefore suitable for studying groups such as pet owners in urban areas[14].

Operationally, this strategy involves asking the subjects initially included in the study for example, dog owners who have agreed to participate, to identify and recommend other individuals within their social network (neighbours, friends, acquaintances) who might also agree to participate in a study concerning their pet. This referral mechanism allows for a gradual expansion of the study cohort by capitalizing on the social connections of the initial participants [15].

In applying this approach, in each municipality, an initial dog was identified with the assistance of residents. The dogs included in this study were not all strays; most were owned, and their owners or caretakers facilitated sampling and referred us to other dog owners in the neighbourhood. This process was repeated until the pre-determined study period of 10 days per municipality was completed. The snowball method is commonly applied when the target population is difficult to access through conventional sampling techniques [13,15]. A stratified sampling approach based on geographic location was implemented in five of the six municipalities in Kisangani: Makiso, Kabondo, Kisangani, Tshopo and Mangobo. The municipality of Lubunga was omitted from the investigation due to safety concerns arising from prevalent inter-ethnic violence in the area. This stratification by municipality also enabled the examination of potential spatial variations in infestation prevalence associated with variables such as municipal area, sanitation levels, and environmental attributes. The ticks were collected manually using entomological forceps (Fig. 1), delicately removed from their host so as not to damage the gnathosoma, which was used for identification. Ticks were preserved in 70% ethanol for identification in the laboratory. Before each examination, verbal consent was systematically obtained from the owners or guardians of the dogs. For examination, dogs were muzzled (Fig. 2) to prevent any risk of bites when handling them.

Fig 2. Dogs fitted with a muzzle by the owner (a) and tick removal using entomological tweezers (b).

2.3. Identification of ticks

The hard ticks collected were identified and processed at the Biodiversity Monitoring Center (CSB) laboratory in Kisangani. Identification was based on observation of morpho-anatomical characteristics under a binocular microscope (Leica EZ4, Leica Microsystems, Wetzlar, Germany; manufactured in China and OPTIKA S.r.l., Ponteranica, Bergamo, Italy) and using the specific dichotomous keys to determine the genera and species of the specimens collected of [16,17 ,18].

2.4. Data analysis

The differences in infestation associated with host characteristics such as sex were tested using chi-square tests. Given the non-normal distribution of tick abundance data, a Kruskal-Wallis test, a non-parametric alternative, was employed to evaluate variations between host groups. In instances where notable differences were identified, Dunn's post hoc test was subsequently utilized to conduct pairwise comparisons. Before statistical analysis, data were tested for normality using the Shapiro–Wilk test. Since the distribution of infestation data deviated significantly from normality ($p < 0.05$), non-parametric tests were deemed appropriate. Accordingly, the Kruskal–Wallis test was applied for group comparisons, followed by Dunn’s post hoc test where relevant. We considered two key parameters to explain the variations observed in tick abundance: the sex of the host and the age of the host. By accounting for host sex and age, along with the capture location's municipality, we could evaluate the impact of these variables on tick abundance.

III. Results

A total of 5,875 ixodids were collected from a sample of 207 canids inspected. The examination of the parasite load distribution reveals major heterogeneity within the sample, characterized by an overdispersion typical of tick populations in natural environments. While the majority of subjects exhibit low infestation (median = 8), the pronounced positive skewness of the histogram highlights a "long tail" of extreme values. Although 75% of the observations fall below 33 ticks, the presence of isolated individuals carrying exceptional loads (up to 400) highlights the existence of hyper-receptive hosts.

Table 1: The number of canine hosts examined of each sex, the number infested by ticks and the percentage prevalence of tick infestation and the statistical test (X^2), stratified by municipality in five administrative entities of Kisangani, Democratic Republic of the Congo.

Municipalities	Hosts examined		Hosts infested		Prevalence (%)	
	M	F	M	F	M	F
KABONDO	19	26	19	22	100	84,6
KISANGANI	8	32	7	29	87,5	90,6
MAKISO	28	28	25	25	89,3	89,3
MANGOBO	11	23	7	16	63,6	69,6
TSHOPO	13	19	10	8	76,9	42,1
Total	**79**	**128**	**68**	**100**	**86,1**	**78,1**

F	128	102
M	79	39
Total	207	141
Chi^2	17.9	

The prevalence of infestation varied according to the locations studied, with very high values observed in Kabondo (91%), Kisangani (90%), and Makiso (89%). In contrast, lower prevalences were found in Mangobo (68%) and Tshopo (56%), suggesting spatial heterogeneity of infestation. The overall prevalence (81%) shows widespread distribution of the parasites in the host population studied, highlighting their health and ecological importance in the region.

A chi-square test of independence was conducted to examine the relationship between host sex and tick infestation status. The analysis revealed a statistically significant association between these two variables (χ^2 = 17.9, df = 1, $p < 0.001$). Specifically, a greater proportion of female canines exhibited tick infestations (79.7%) relative to their male counterparts (49.4%). Chi-square analysis revealed a significant association between infestation prevalence and host sex as well as geographic location (χ^2 = 9.80, df = 4, p = 0.044). Specifically, a higher proportion of females were infested compared to their male counterparts, and infestation levels varied from one location to another. These results suggest that host-related factors, such as sex, and environmental variables related to distinct geographic areas play a role in the distribution and frequency of tick infestations within the canine population of the study area.

Table 2: The number of dogs examined, the number of ticks found and the percentage infested stratified by host age class.

Age	Number examined	Number of Ticks	PrI (%)
Adult (over one year old)	117	96	82,1
Young (under one year)	90	72	80
Total	207	168	81,2

The study reveals a state of hyperendemicity regarding tick infestation within the canine population studied. Out of a sample of 207 hosts, 168 were infested, i.e. an infestation prevalence of 81.2%.
Analysis by age group reveals an infestation prevalence of 82.1% in adult dogs (one year or older) and 80.0% in young dogs (less than one year old). The small difference observed between these groups (2.1 percentage points) suggests that the age of the host does not significantly influence the presence of the parasite.
In terms of the ticks identified, these were predominantly of *Rhipicephalus sanguineus*, followed by *Rhipicephalus sp* and *Haemaphysalis leachi* (Fig. 1) The municipalities of Makiso and Kabondo, which had high infestation levels, appear to be major hotspots for tick infestation, unlike other areas such as Mangobo and the other sector

of Tshopo, which have significantly lower infestation rates. These observations suggest significant geographical variations in tick prevalence within the city.

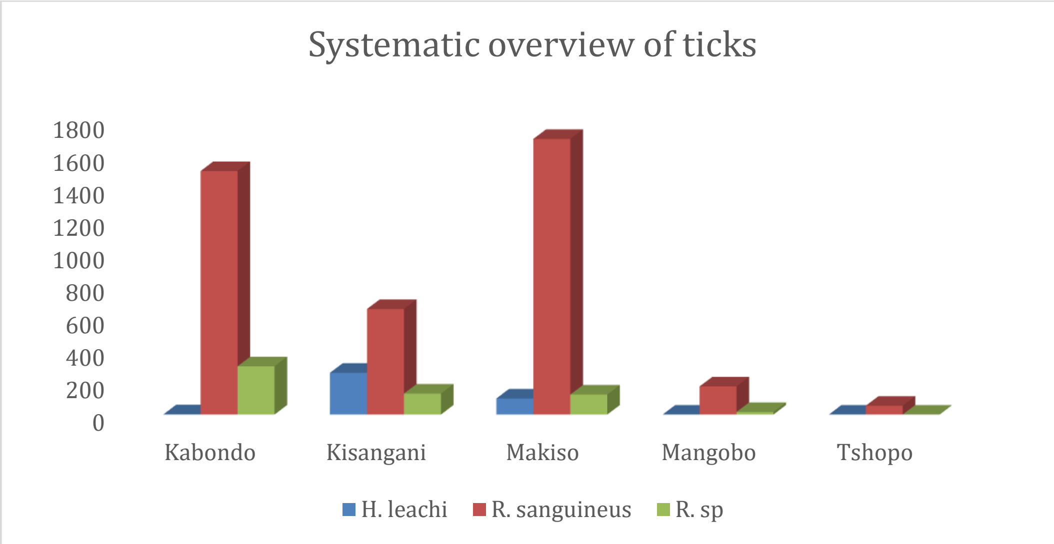

Figure 3: The systematic overview of ticks of different species collected from dogs in five different municipalities in the city of Kisangani

IV. Discussion

4.1. Epidemiological status and spatial distribution of infestation

This study revealed an exceptionally high infestation prevalence of 81.2% among dogs in Kisangani, reflecting a state of hyperendemicity. This rate far exceeds those reported in other tropical or subtropical contexts, such as Cameroon 63% [19], Burkina Faso 43,7% [20] and even temperate zones such as Romania 38.3% [21]. These differences can be explained by the tropical climate stability of the Kisangani region, which favors continuous tick activity, unlike temperate zones subject to marked seasonality.

Significant spatial heterogeneity was observed between the five municipalities studied: Kabondo (91.1%), Kisangani (90%), and Makiso (89.3%) had the highest rates, while Mangobo (67.7%) and Tshopo (56.3%) had the lowest. These disparities reflect a micro-ecological gradient linked to vegetation cover, dog density, dog owner availability, waste management, and the proximity of residential areas to wooded plots. As highlighted by [22] point out, these factors shape the dynamics of tick populations in urban areas and reinforce the need for a control approach tailored to each locality.

4.2. Parasite load and factors of variation

The examination of the parasite load distribution reveals major heterogeneity within the sample, characterized by an overdispersion typical of tick populations in natural environments. While the majority of subjects exhibit low infestation (median = 8), the pronounced positive skewness of the histogram highlights a "long tail" of extreme values. indicate a high ectoparasite load, which is likely to cause physiological stress and vector-borne diseases. Statistical analysis revealed a significant interaction between location and sex of the dogs ($p = 0.044$), indicating that the distribution of ticks depends simultaneously on environmental and behavioral factors.

This dynamic suggests that the parasite's persistence in the ecosystem is maintained by a small minority of highly infested reservoirs, a crucial finding for targeting vector control interventions and community health development.

Females were significantly more infested than males, a result consistent with the work of [23] and [24] who attribute this trend to hormonal factors modulating the immune response or to reproductive behaviors increasing exposure time to infested habitats. Nevertheless, [25] observed a predominance of males in livestock infestations in Tunisia, emphasizing that sex differences are contextual, influenced by behavior, ecological conditions, and management practices.

With regard to age, the prevalence of infestation was slightly higher in adults (82.1%) than in young animals (80.0%), with no significant difference. This result is consistent with [26] and [27] who showed that older animals, exposed for longer periods to infested environments, are at increased risk of infestation.

4.3. Biogeography and species diversity of ticks

Taxonomic analysis identified three main species: *Rhipicephalus sanguineus*, *Haemaphysalis leachi*, and *Rhipicephalus sp*., with a marked predominance of *R. sanguineus*. This composition is consistent with the observations of [25, 26] and [29], who report a global predominance of this species, often referred to as the brown dog tick.

R. sanguineus is distinguished by its endophilic life cycle, tolerance to domestic microclimates, and high reproductive capacity indoors, which explains its dominance in tropical and subtropical urban areas. Studies conducted in various ecological contexts, such as those by [30] in Romania and [31] in Pakistan, confirm this universal ecological plasticity.

The simultaneous presence of *H. leachi* and *Rhipicephalus sp*. in Kisangani illustrates local species diversity and highlights the possibility of co-infections or simultaneous transmission of pathogens, increasing the health risk.

4.4. Epidemiological implications and public health perspectives

The hyperendemicity observed in Kisangani reveals considerable parasitic pressure and a potential epidemiological threat to animal and human populations. The species identified, notably *R. sanguineus* and *H. leachi*, are established vectors of pathogens such as *Ehrlichia canis*, *Babesia canis*, and *Rickettsia spp*. [32].

The lack of systematic tick control programs, combined with limited veterinary infrastructure and close human-dog cohabitation, increases the risk of zoonotic transmission. It is therefore imperative to promote integrated ectoparasite management strategies based on community awareness among dog owners, regular application of appropriate acaricides, and improved environmental hygiene.

In addition, it would be relevant to develop molecular surveillance approaches to detect pathogens associated with local ticks and more accurately assess the zoonotic potential in the Congolese urban context.

4.5. Summary and scientific significance

This study is the first quantitative and ecological contribution to understanding urban canine parasitism in the Democratic Republic of Congo.

It demonstrates: the existence of urban hyperendemicity of ticks in Kisangani; marked spatial variability modulated by environmental and behavioral factors; the global dominance of *Rhipicephalus sanguineus* in anthropized environments; and the emergence of an underestimated zoonotic risk.

These results call for a multidisciplinary approach, combining ecology, veterinary medicine, and public health, in order to develop sustainable control policies for ticks and the diseases they carry in tropical urban environments.

V. Conclusion

This investigation reveals substantial epidemiological observations concerning mite parasitism in canine populations in Kisangani, confirming a pronounced parasitic endemicity. The findings indicate an overall infestation prevalence of 81.2%, with a statistically relevant median ectoparasite load of median ([= 8; Q1 = 1; Q3= 33]) parasites per affected host.

These quantitative epidemiological data, which enrich the previously limited body of research on ticks in urban areas of the Democratic Republic of Congo, highlight a growing public health issue. The increase in the prevalence and diversity of tick species observed in this urban environment, combined with the predominance of *Rhipicephalus sanguineus* in its endophilic biotopes and the inadequacy of existing veterinary infrastructure in Kisangani, leads to increased vulnerability to the spread of vector-borne diseases among animal and human populations.

These results underscore the imperative need for strategic action. It is crucial to implement integrated management programs and effective preventive and control measures in the geographical area concerned, taking into account the spatial variability of risk and the need for active epidemiological surveillance for vector-borne diseases.

Acknowledgements

The authors would like to express their sincere gratitude to dog owners in the city of Kisangani for their cooperation and time during the sampling sessions. We would also like to thank the field assistants and local veterinary technicians for their invaluable assistance in collecting ticks and handling animals.

Our thanks also go to the Faculty of Sciences of the University of Kisangani (UNIKIS) and the Centre de Surveillance de la Biodiversité (CSB) for providing access to their laboratories and logistical support. Finally, we would like to express our gratitude to the VLIR-UOS project for its technical and financial support, as well as to our colleagues Viktor Van De Velde for his fruitful guidance during the writing process, Jeremy Kasereka for his assistance in data analysis, and Professor Richard Wall for his expert advice and critical review of the manuscript on parasitology-related aspects.

Authors' contributions
HT, SN conceived and designed the study. HT performed the fieldwork in the municipalities of Kabondo, Kisangani, Makiso, Mangobo, and Tshopo. HT analysed data on ticks in urban dogs. HT, SN, OK, NA, GC and PK drafted the manuscript. All authors read and approved the final manuscript.
Funding
Funding This study was supported by a VLIR-UOS grant. The funders had no role in study design, data collection and analysis, decision to publish, or preparation of the manuscript.

Availability of data and materials
Recommended statement for your study: The datasets generated and/or analyzed during the current study are available from the corresponding author on reasonable request.

Ethics approval and consent to participate
Ethical approval: The study protocol was reviewed and approved by Ethics Committee of the Biodiversity Monitoring Center at the University of Kisangani (Approval No CSB/UNIKIS/108/KIS/2024). All procedures involving dogs were conducted in strict accordance with the national guidelines for animal welfare in the Democratic Republic of the Congo and international standards for veterinary practice.
Consent to participate: For domestic dogs, the purpose and procedures of the study were explained to the owners in their local language (Lingala or Swahili). Verbal informed consent was obtained from all owners prior to any data collection or handling of the animals.
Consent for publication
Not applicable.
Competing interests
The authors declare that they have no competing interests.

References

[1]. Dantas-Torres F, Chomel BB, Otranto D. Ticks and tick-borne diseases: a One Health perspective. Trends Parasitol. 2012;28:437–46. https://doi.org/10.1016/j.pt.2012.07.003
[2]. Guglielmone AA, Robbins RG, Apanaskevich DA, Petney TN, Estrada-Peña A, Horak IG, et al. The Argasidae, Ixodidae and Nuttalliellidae (Acari: Ixodida) of the world: a list of valid species names. Zootaxa [Internet]. 2010 [cited 2026 Jan 18];2528. https://doi.org/10.11646/zootaxa.2528.1.1
[3]. Boulanger N, Boyer P, Talagrand-Reboul E, Hansmann Y. Ticks and tick-borne diseases. Médecine et Maladies Infectieuses [Internet]. 2019 [cited 2026 Jan 13];49:87–97. https://doi.org/10.1016/j.medmal.2019.01.007
[4]. Habib J, Zenner L, Garel M, Mercier A, Poirel M-T, Itty C, et al. Prevalence of tick-borne pathogens in ticks collected from the wild mountain ungulates mouflon and chamois in 4 regions of France. Parasite [Internet]. 2024 [cited 2026 Jan 18];31:21. https://doi.org/10.1051/parasite/2024011
[5]. Gray J, Kahl O, Lane RS, Stanek G. Lyme Borreliosis: Biology, Epidemiology, and Control [Internet]. CABI; 2002. https://books.google.cd/books?id=eNNndEcHt2sC
[6]. Macpherson CN, Meslin F-X, Wandeler AI. Dogs, zoonoses and public health 2nd Edition. Wallingford, United Kingdom: CABI Publishing (Wallingford, Oxfordshire, Royaume-Uni); 2000.
[7]. Rodhain F, Perez-Eid C. Les tiques Ixodidés : systématique, biologie et importance médicale. Maloine. Paris; 1985.
[8]. Léger E, Vourc'h G, Vial L, Chevillon C, McCoy KD. Changing distributions of ticks: causes and consequences. Exp Appl Acarol [Internet]. 2013 [cited 2026 Jan 9];59:219–44. https://doi.org/10.1007/s10493-012-9615-0
[9]. De Clercq EM, Vanwambeke SO, Sungirai M, Adehan S, Lokossou R, Madder M. Geographic distribution of the invasive cattle tick Rhipicephalus microplus, a country-wide survey in Benin. Exp Appl Acarol [Internet]. 2012 [cited 2026 Jan 19];58:441–52. https://doi.org/10.1007/s10493-012-9587-0
[10]. Olwoch JM, Van Jaarsveld AS, Scholtz CH, Horak IG. Climate change and the genus *Rhipicephalus* (Acari : Ixodidae) in Africa. Onderstepoort J Vet Res [Internet]. 2007 [cited 2026 Jan 18];74:45–72. https://doi.org/10.4102/ojvr.v74i1.139
[11]. Balandi JB, Selemani TM, Hulu J-PPMT, Sambieni KR, Sikuzani YU, Bastin J-F, et al. Spatiotemporal Analysis of Urban Heat Islands in Kisangani City Using MODIS Imagery: Exploring Interactions with Urban–Rural Gradient, Building Volume Density, and Vegetation Effects. Climate [Internet]. publisher; 2025 [cited 2026 Jan 12];13. https://doi.org/10.3390/cli13050089
[12]. Moubamba D. Identification et distribution des espèces de tiques (Acari: Ixodidae) qui infestent les chiens à Libreville. Ann Méd Vét. 2006;150:193–6.
[13]. Goodman LA. Snowball sampling. The annals of mathematical statistics. JSTOR; 1961;148–70.
[14]. Heckathorn DD. Comment: Snowball versus respondent-driven sampling. Sociological methodology. SAGE Publications Sage CA: Los Angeles, CA; 2011;41:355–66.
[15]. Atkinson R, Flint J. Accessing hidden and hard-to-reach populations: Snowball research strategies. Social research update. Guildford; 2001;33:1–4.
[16]. Bouattour A. Clé dichotomique et identification des tiques (Acari: Ixodidae) parasites du bétail au Maghreb. Archives de l'Institut Pasteur de Tunis. 2002;79:43–50.
[17]. Walker AR. Ticks of domestic animals in Africa: a guide to identification of species. Bioscience Reports Edinburgh; 2003.
[18]. Pérez-Eid C. Les Tiques: Identification. Biologie, Importance Médicale et Vétérinaire. 2007;
[19]. Kamani J, Apanaskevich DA, Gutiérrez R, Nachum-Biala Y, Baneth G, Harrus S. Morphological and molecular identification of Rhipicephalus (Boophilus) microplus in Nigeria, West Africa: a threat to livestock health. Experimental and Applied Acarology. Springer; 2017;73:283–96.
[20]. Moumouni PFA, Minoungou GL-B, Dovonou CE, Galon EM, Efstratiou A, Tumwebaze MA, et al. A Survey of Tick Infestation and Tick-Borne Piroplasm Infection of Cattle in Oudalan and Séno Provinces, Northern Burkina Faso. Pathogens [Internet]. publisher; 2021 [cited 2026 Jan 16];11. https://doi.org/10.3390/pathogens11010031

[21]. Martinescu G-V, Ivănescu L, Mîndru R, Andronic L, Miron L. PREVALENCE OF TICK INFESTATION IN DOGS FROM IASI AREA (ROMANIA). 65.

[22]. Yessinou RE, Koumassou A, Galadima HB, Nanoukon-Ahigan H, Farougou S, Pfeffer M, et al. Tick Diversity and Distribution of Pathogen in Ticks Collected from Wild Animals and Vegetation in Africa. Pathogens [Internet]. publisher; 2025 [cited 2026 Jan 19];14. https://doi.org/10.3390/pathogens14020116

[23]. Farkas R, Gyurkovszky M, Solymosi N, Beugnet F. Prevalence of flea infestation in dogs and cats in Hungary combined with a survey of owner awareness. Med Vet Entomol. 2009;23:187–94. https://doi.org/10.1111/j.1365-2915.2009.00798.

[24]. Estrada-Peña A, Bouattour A, Camicas J-L, Guglielmone A, Horak I, Jongejan F, et al. The Known Distribution and Ecological Preferences of the Tick Subgenus Boophilus (Acari: Ixodidae) in Africa and Latin America. Exp Appl Acarol [Internet]. 2006 [cited 2026 Jan 16];38:219–35. https://doi.org/10.1007/s10493-006-0003-5

[25]. Khbou MK, Rouatbi M, Romdhane R, Sassi L, Jdidi M, Haile A, et al. Tick Infestation and Piroplasm Infection in Barbarine and Queue Fine de l'Ouest Autochthonous Sheep Breeds in Tunisia, North Africa. Animals [Internet]. publisher; 2021 [cited 2026 Jan 16];11. https://doi.org/10.3390/ani11030839

[26]. Ogden NH, Lindsay LR, Hanincová K, Barker IK, Bigras-Poulin M, Charron DF, et al. Role of migratory birds in introduction and range expansion of Ixodes scapularis ticks and of Borrelia burgdorferi and Anaplasma phagocytophilum in Canada. Appl Environ Microbiol. 2008;74:1780–90. https://doi.org/10.1128/AEM.01982-07

[27]. Yessinou RE, Adoligbe C, Atchade F, Adinci J, Brahi HD, Adehan S, et al. Phenotypic and genotypic characterization of dog tick Rhipicephalus sanguineus sensu lato (Acari: Ixodidae) resistance to deltamethrin in Benin. Veterinary Parasitology: Regional Studies and Reports [Internet]. 2021;26:100638. https://doi.org/10.1016/j.vprsr.2021.100638

[28]. Matallah F, Benakhla A, Bouattour A. Infestation du chien par Rhipicephalus sanguineus dans deux régions de l'extrême nord-est de l'Algérie. Revue d'élevage et de médecine vétérinaire des pays tropicaux. 2013;66:97–101.

[29]. Wyk C-L van, Mtshali K, Taioe MO, Terera S, Bakkes D, Ramatla T, et al. Detection of Ticks and Tick-Borne Pathogens of Urban Stray Dogs in South Africa. Pathogens [Internet]. publisher; 2022 [cited 2026 Jan 16];11. https://doi.org/10.3390/pathogens11080862

[30]. Martinescu G-V, Ivănescu M-L, Iacob O, Andronic B-L, Mardare Mîndru R, Acatrinei D-M, et al. The evolution of the major vector-borne diseases in Romania: consequences of climate changes. Publishing "Ion Ionescu de la Brad", Iași; 2024;

[31]. Hussain A, Hussain S, Yu A, Varga C, Leo GAD, Smith RL. Geographical epidemiology of Hyalomma anatolicum and Rhipicephalus microplus in Pakistan: A systematic review. PLOS ONE [Internet]. Public Library of Science; 2024 [cited 2026 Jan 17];19:e0309442. https://doi.org/10.1371/journal.pone.0309442

[32]. Agbajelola VI, Adigun DE, Falohun OO, Ayanyemi BS. Ticks infestation on household dogs and their zoonotic implications: a comparative study from two states in Nigeria. J Parasit Dis [Internet]. 2025 [cited 2026 Jan 17]; https://doi.org/10.1007/s12639-025-01850-y