FULL ARTICLE

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Wildlife as important hosts of ticks in the flooded savanna of Colombia

Animais selvagens como importantes hospedeiros de carrapatos na savana inundada da Colômbia

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ABSTRACT

Records of wild animals acting as tick hosts in the flooded savanna region of Colombia's Orinoquia are scarce. Therefore, this study aimed to identify and map the ticks that infest these hosts. Ten locations were sampled in the municipality of Arauca, department of Arauca, Colombia, where ticks were collected infesting 19 wild animals, classified into 14 species, providing new information on tick infestation in the following taxa: (i) bird: *Crax daubentoni*, (ii) mammals: *Dasypus sabanicola*, *Dicotyles tajacu*, *Hydrochoerus hydrochaeris*, *Leopardus tigrinus*, *Myrmecophaga tridactyla*, *Odocoileus virginianus*, *Procyon cancrivorus*, *Urocyon cinereoargenteus* and *Tamandua tetradactyla*, and (iii) reptiles: *Boa constrictor*, *Chelonoidis denticulata*, *Eunectes murinus* and *Iguana iguana*. A total of 85 ticks were identified and classified as the species *Amblyomma mixtum*, corresponding to 72.8%, followed by *Amblyomma dissimile* – 11.7%, *Rhipicephalus microplus* – 8.2%, *Dermacentor nitens* – 4.7%, and *Amblyomma nodosum* – 2.3%. *Amblyomma mixtum* was the tick species that showed the highest variety of infestations to hosts, parasitizing 53.8%. The host infested with the greatest variety of tick species was *Hydrochoerus hydrochaeris*, from which *Amblyomma mixtum* and *Dermacentor nitens* were removed. The diversity and wide distribution of these wild animals make them potential tick hosts of medical and veterinary importance, given the close environmental, cultural, and economic interaction that has developed between wild and domestic animals, ticks, pathogens, and humans.

Keywords: *Amblyomma mixtum*. Orinoquia. *Rhipicephalus microplus*. Wild animals. Ticks.

RESUMO

Existem poucos registros de animais selvagens servindo como hospedeiros de carrapatos na região de savana inundada da Orinoquia, na Colômbia; portanto, o objetivo deste estudo foi identificar e mapear os carrapatos que infestam esses animais. Foram amostrados dez locais do município de Arauca, departamento de Arauca, onde foram coletados carrapatos que infestavam 19 animais selvagens, classificados em 14 espécies, fornecendo novas informações sobre infestação por carrapatos nos táxons (i) aves: *Crax daubentoni*, (ii) mamíferos: *Dasypus sabanicola*, *Dicotyles tajacu*, *Hydrochoerus hydrochaeris*, *Leopardus tigrinus*, *Myrmecophaga tridactyla*, *Odocoileus virginianus*, *Procyon cancrivorus*, *Urocyon cinereoargenteus* e *Tamandua tetradactyla* e (iii) répteis: *Boa constrictor*, *Chelonoidis denticulata*, *Eunectes murinus* e *Iguana iguana*. Foram identificados 85 carrapatos, classificados nas espécies *Amblyomma mixtum*, com 72,8%, seguido por *Amblyomma dissimile*, com 11,7%, *Rhipicephalus microplus*, com 8,2%, *Dermacentor nitens*, com 4,7% e *Amblyomma nodosum*, com 2,3%. Nos carrapatos, a espécie *Amblyomma mixtum* foi aquele em que ocorreu maior variedade de infestações aos hospedeiros, parasitando 53,8%. *Hydrochoerus hydrochaeris* foi o que apresentou maior variedade de espécies de carrapatos, sendo infestado por *Amblyomma mixtum* e *Dermacentor nitens*. A diversidade e a ampla distribuição destes animais selvagens tornam-nos potenciais hospedeiros de carraças de importância médica e veterinária, tendo em conta a estreita interação ambiental, cultural e econômica que se desenvolveu entre animais selvagens, domésticos, carraças, agentes patogênicos e humanos.

Palavras-chave: *Amblyomma mixtum*. Orinoquia. *Rhipicephalus microplus*. Animais selvagens. Carrapatos.

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Introduction

The flooded savannah region of Orinoquia is situated in the Colombian departments of Arauca and Casanare. This ecosystem is subjected to highly seasonal hydrological dynamics (Rangel-Ch et al., 2017). Its location on the western side of the Orinoco River basin that separates Colombia from Venezuela favors the maintenance and reproduction of different species of fauna and flora that are important for the environmental balance of this ecoregion (Beck et al., 2018; Jaramillo et al., 2015). In the municipality of Arauca alone, 34 species of reptiles, 17 species of amphibians, 178 species of birds, and 68 species of mammals have been identified (Parques Nacionales Naturales de Colombia, 2021). Included in the study area are domestic animals, such as cattle (300,185), horses (16,794), pigs (11,338), and buffaloes (6,397) (Instituto Colombiano Agropecuario, 2024), which share and compete for space and food with wild animals.

Sharing the same habitat can create a risk factor for infestation by different groups of ectoparasites, including ticks, leading to the spread of species (i.e., the transmission of a parasite from one host species to another) between domestic and wild animals (Adlard et al., 2015). In addition to facing infestation by their parasite species, animals face exposure to new species that infest domestic animals or vice versa (Keesing et al., 2013).

Ticks are an arthropod of importance for animal health. They are the main vectors of pathogens in domestic animals and wildlife (de la Fuente et al., 2008; Jongejan & Uilenberg, 2004). Ticks cause economic losses in bovine production systems through parasitism and in the pharmacological treatment of diseases caused by the pathogens they transmit (Grisi et al., 2014; Lew-Tabor & Rodriguez Valle, 2016).

For ticks to remain in each habitat, several abiotic and biotic factors are required, such as humidity, temperature, precipitation, and the presence of hosts, the latter being of vital importance since they will contribute to the life cycles of ticks and animal pathogens they transmit (Ledwaba et al., 2022; Titcomb et al., 2017). Any change in the above factors directly or indirectly impacts the distribution and incidence of tick populations and the epidemiology of the pathogens they transmit (Wikel, 2018). The above climate conditions and availability of hosts can be found in the flooded savanna region of the Orinoquia, which makes this region an important ecological niche for the maintenance and development of ticks in Colombia.

Tick infestations have been recorded in several species of wild birds and mammals in this region of Colombia (Cardona-Romero et al., 2020; Ossa-López et al., 2024). However, there is no information about other wild animal taxa that act as hosts for ticks. Therefore, this study aimed to expand and update information on the distribution and identification of ticks that infest the different taxonomic groups of wild animals inhabiting the flooded savanna region of the department of Arauca, Colombia. To this end, ticks were collected from wild animals found in veterinary clinics, at the Wild Animal Rescue Center, and from roadkill.

Materials and Methods

Location of the study area

Ten different locations were visited in the flood-prone region of the municipality of Arauca, Arauca department, Colombia (Figure 1). This region, situated 120 m above sea level, has an average annual precipitation of 1477 mm, 90% relative humidity, and a temperature of 26.1 °C (Rangel-Ch et al., 2017).

The locations were selected considering previous sightings of wild animals by researchers and calls from farm owners, veterinarians, and biologists working at animal clinics and wildlife rescue centers in Arauca.

Collection and identification of ticks

Ticks were obtained from wild animals through two routes: (i) veterinarians and biologists with experience handling wild animals treated at clinics and wildlife rescue and rehabilitation centers, and (ii) opportunistically, through inspection of roadkill picked up on inter-municipal roads in the study area. The animals were taken to the aforementioned clinics and rescue centers by civilians and environmental protection authorities for a medical check-up or recovery after they were seized from wildlife traffickers.

The animals were examined for ticks over 10 min, focusing on regions of less dense hair, such as the inguinal, axillary,

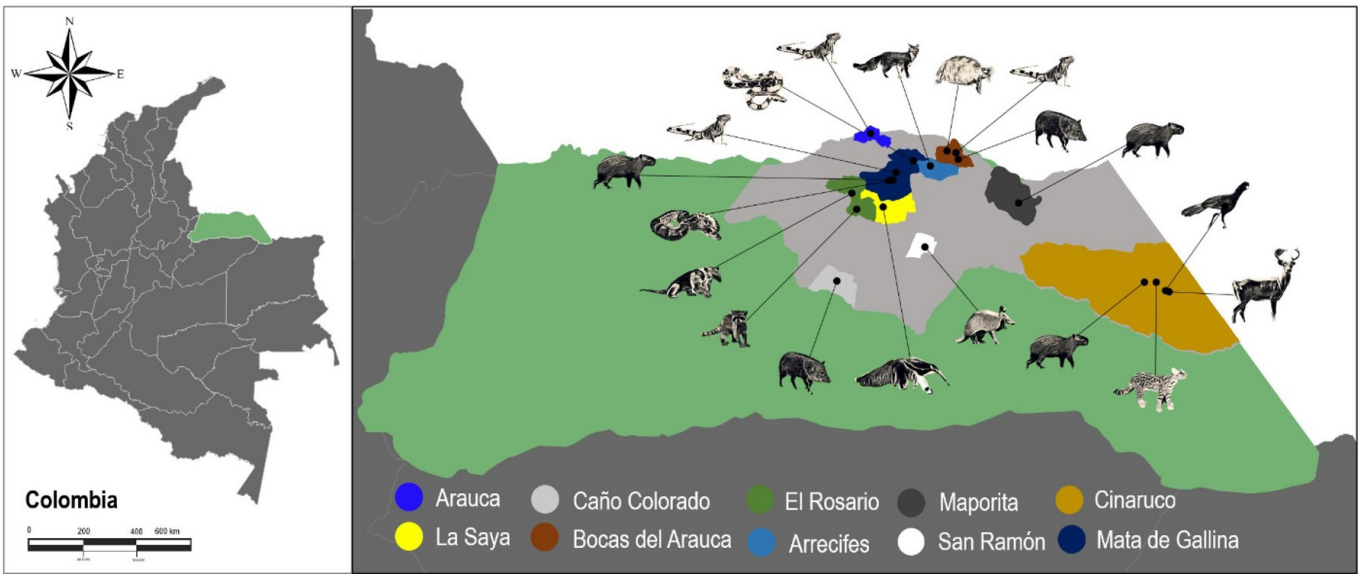

Figure 1 – Locations where ticks parasitizing different wild animal species were collected in the flooded savanna region of Orinoquia in Colombia.

ventral, and pinna areas. Each animal infested with ticks was identified with a tag indicating the location where it was found (in the case of roadkill) or its origin (animals treated at clinics and rescue centers) and georeferenced with the help of a device (Garmin ETrex 32X, USA) in order to establish the distribution of ticks in this region of Colombia.

The ticks were preserved in 70% alcohol and stored at room temperature until morphological identification at the Veterinary Parasitology Laboratory of the National University of Colombia, Bogotá D.C., Colombia (UNAL). Taxonomic identification was carried out in this lab using a stereoscopic microscope (Olympus SZ61, USA) under 100x magnification, considering the phenotypic characteristics described by Strickland et al. (1976), Barros-Battesti et al. (2006, 2024), Kleinjan & Lane (2008), Estrada-Peña (2015), and Nava et al. (2017).

Statistical analysis

The data on each tick and each animal examined were recorded in several formats, including georeferencing of the area where the animals were found, the species of wild animal, sex, age status (chicks for birds, neonate, young or adult), and the number of collected ticks. The results of the taxonomic classification of ticks and infested wildlife species were analyzed by descriptive statistics using IBM SPSS Statistics software (Statistical Package for the Social Sciences) (IBM, USA), version 19.0, seeking to identify differences between tick species and genera, wild animal species, and frequency of ticks found in the locations of this study.

Results

A total of 19 wild animals were inspected, comprising 14 different bird, mammal, and reptile species (Figure 2). The animals that underwent the most numerous inspections were *Hydrochoerus hydrochaeris* and *Iguana iguana*, each corresponding to 15.8% (n = 3/19). However, the largest number of ticks were collected from *Crax daubentoni* and *Boa constrictor* species, with 19 ticks from the former and 12 from the latter (Table 1). The locations where the largest number of wild animal species were inspected were Cinaruco and Mata de Gallina, with 22.3% each (Figure 1).

A total of 85 ticks distributed among the genera *Amblyomma*, *Dermacentor,* and *Rhipicephalus* were identified, all belonging to the family Ixodidae. Of this total, 33 corresponded to adult females, 14 to adult males, and 38 to nymphs. Five different tick species were identified, with the most frequently observed species being *Amblyomma mixtum* corresponding to 72.8% and *Amblyomma dissimile* to 11.7%. The species found in the lowest numbers were *Rhipicephalus microplus* to 8.2%, *Dermacentor nitens* to 4.7%, and *Amblyomma nodosum* to 2.3% (Figure 3).

Amblyomma mixtum was the most frequently observed tick species, infesting 100% (n = 14/14) of the wild animals recorded in this study (Figure 4). On the other hand, the animal species infested with more than one tick species were *Odocoileus virginianus*, *Myrmecophaga tridactyla*, *Hydrochoerus hydrochaeris*, *Iguana iguana*, *Leopardus tigrinus*, and *Eunectes murinus* (n = 2/5). The other wild animal species were only parasitized by one tick species.

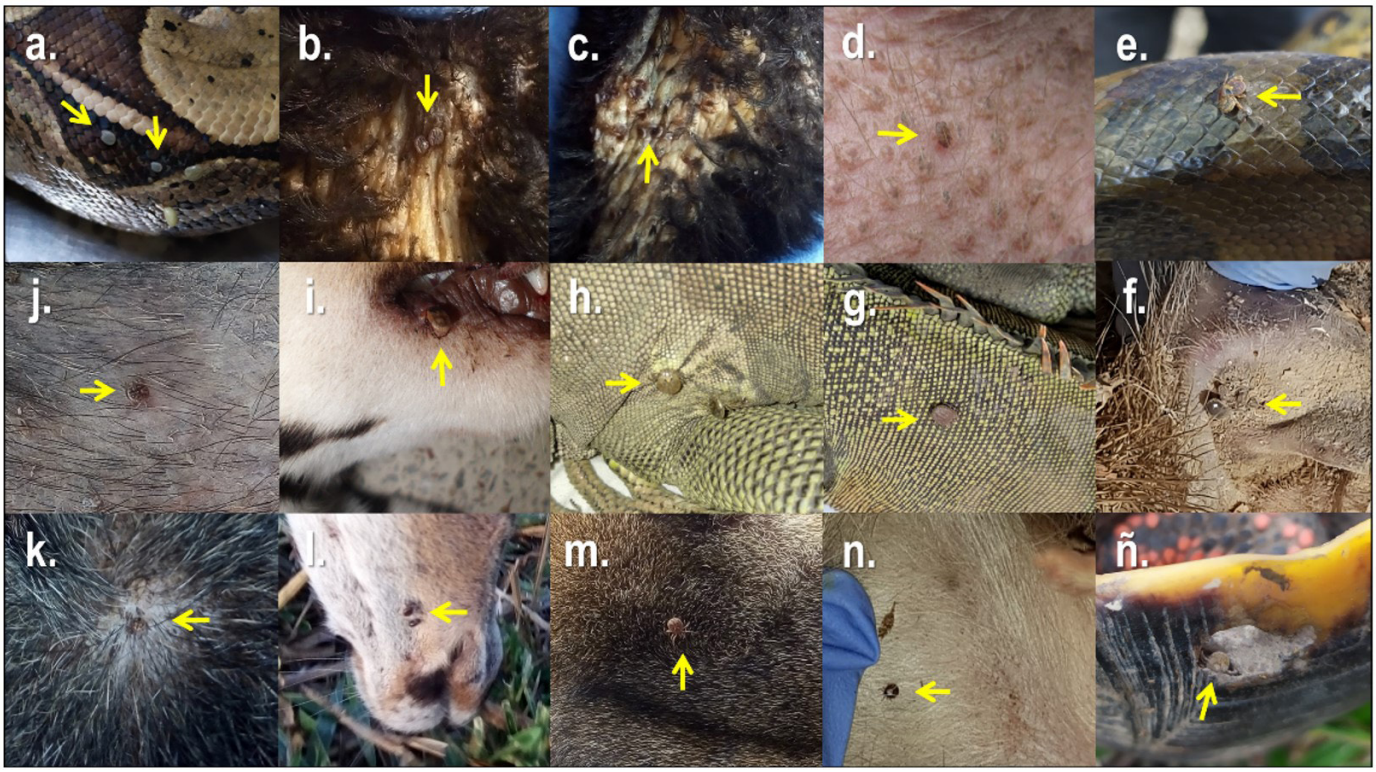

Figure 2 – Different wild animal species are infested with ticks in the flooded savannah region of Colombia. a. Boa (*Boa constrictor*) (5.3%), b. and c. Paujil (*Crax daubentoni*) (5.3%), d. Armadillo (*Dasypus sabanicola*) (5.3%), e. Güio (*Eunectes murinus*) (5.3%), f. Chigüiro/Capivara (*Hydrochoerus hydrochaeris*) (15.8%), g. and h. Iguana (*Iguana iguana*) (15.8%), i. Tigrillo (*Leopardus tigrinus*) (5.3%), j. Chácharo (*Dicotyles tajacu*) (10.5%), k. Palmero (*Myrmecophaga tridactyla*) (5.3%), l. Venado (*Odocoileus virginianus*) (5.3%), m. Mapache (*Procyon cancrivorus*) (5.3%), n. Zorro (*Urocyon cinereoargenteus*) (5.3%), and ñ. Morrocoy (*Chelonoidis denticulata*) (5.3%).

Discussion

We identified ticks that parasitize birds, mammals, and reptiles, expanding knowledge about infestations by five different species of ticks in the 14 wild animal species native to this region. Previous studies in the region found the infestation of *Amblyomma nodosum*, *Amblyomma longirostre,* and *Amblyomma mixtum* in native and migratory birds (Cardona-Romero et al., 2020). However, the infestation of *Amblyomma mixtum* parasitizing *Crax daubentoni*, one of the most endangered bird families, had not been reported (BirdLife International, 2021). Regarding reports of tick infestation in mammals, the presence of *Amblyomma mixtum* in *Hydrochoerus hydrochaeris* and *Rhipicephalus microplus* in *Odocoileus virginianus* had been recorded previously (Ossa-López et al., 2024), while tick infestations in the species *Dasypus sabanicola*, *Dicotyles tajacu*, *Leopardus tigrinus*, *Myrmecophaga tridactyla*, *Procyon cancrivorus*, *Urocyon cinereoargenteus* and *Tamandua tetradactyla* were new reports, which also include the reptiles *Boa constrictor*, *Chelonoidis denticulata*, *Eunectes murinus* and *Iguana iguana*.

The risk of spreading tick infestation between domestic and wild animals or humans can increase when they interact in the same habitat. In this study, we established that ticks are widely distributed in rural areas and that all possible hosts are constantly in contact with each other, directly and indirectly, by meeting and sharing the same habitat where the ticks were identified. In the case of wild animals, we observed that ticks use a variety of species as hosts, with mammals being the most frequently involved.

Another risk factor for the health of animals and humans is the pathogens transmitted by the tick species identified in this study. Some of the five species are more relevant to the epidemiology of diseases of public health interest, such as rickettsiosis. For example, the second tick species with the highest rate of animal infestation was represented by *Amblyomma mixtum* (21.1%), a species in which the pathogens *Rickettsia rickettsii* and *Rickettsia amblyommatis* have been identified in populations of *Amblyomma mixtum* collected in this same region of Colombia (Chaparro-Gutiérrez et al., 2023; Rivera-Páez et al., 2018). Likewise, pathogenic bacteria of the *Escherichia-Shigella* and *Enterobacter* genera have been documented in *A. mixtum,* and *Rhipicephalus microplus* found actively feeding on *Hydrochoerus hydrochaeris* and *Odocoileus virginianus* (Ossa-López et al., 2024).

The findings of this study may indicate that some tick species parasitize domestic and wild animals without

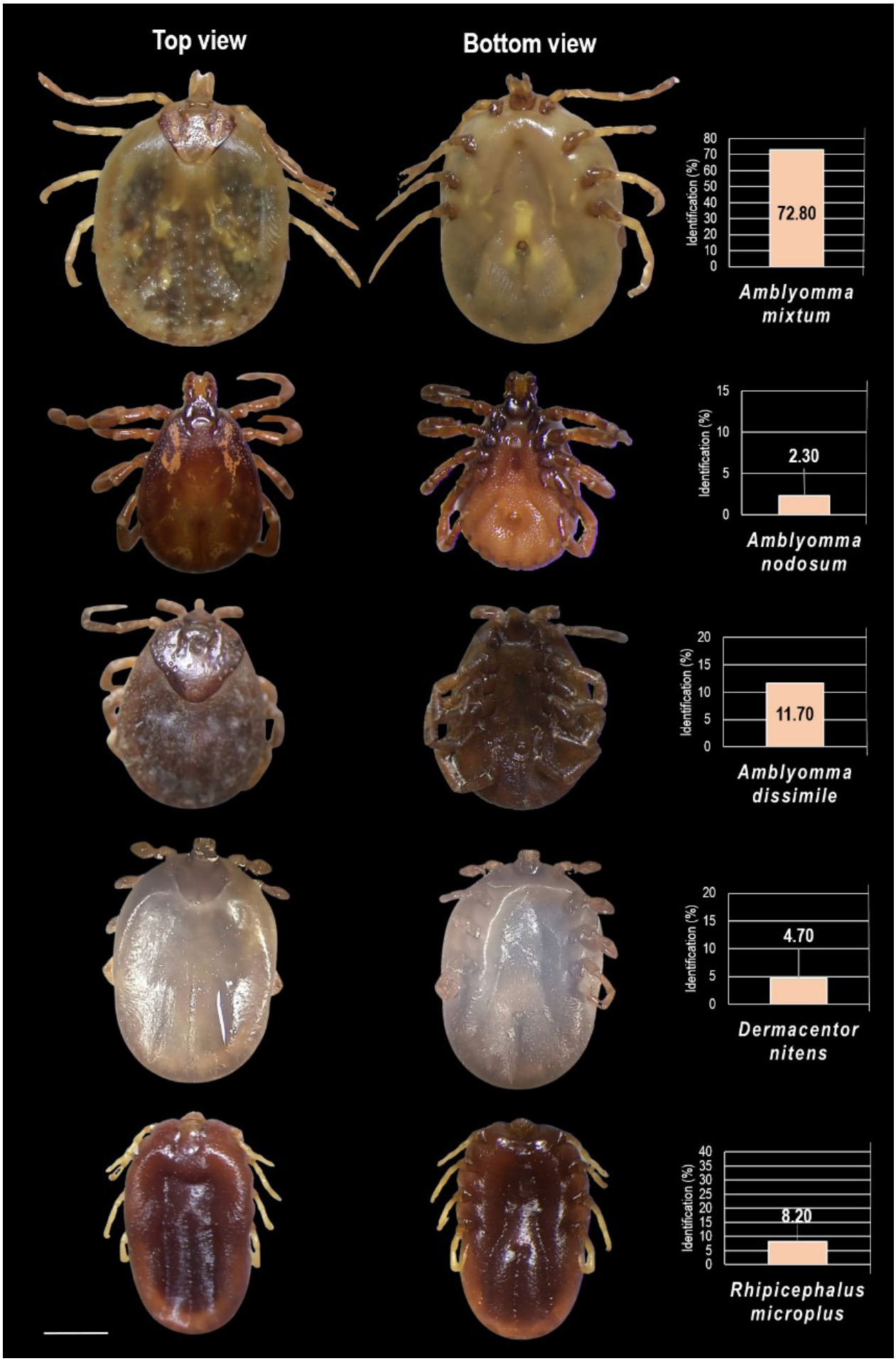

Figure 3 – Taxonomic identification and percentage of tick species parasitizing different species of wild animals in the flooded savanna region of Colombia.

Table 1 – Tick species that infect different wild animal species in the flooded savanna region of Orinoquia in Colombia

No	Animals location	Classification	Animal species	Gener	Tick species	Life-stage	Tick Sex*	Total ticks	Place of origin s	Geographic coordinates
1	Veterinary clinic	Reptile	*Iguana iguana*	Female	*Amblyomma mixtum*	Adult	Female	1	Arauca	7°05′25.00″ N; 70°45′41.00″ W
2	Rescue center		*Boa constrictor*	Female		Nymphs/ Adults	NA/Female	12	Mata de Gallina	7°06′63.32″ N; 70°73′20.58″ W
3	Cadaver	Bird	*Crax daubentoni*	Female		Larva/ Nymphs/ Adults	NA/NA/ Female	19		6°74′47.80″ N; 69°97′14.89″ W
4	Rescue center	Mammal	*Dasypus sabanicola*	Male		Nymph	NA	2	San Ramón	6°59′38.27″ N; 70°59′70.53″ W
5	Cadaver	Reptile	*Eunectes murinus*	Female	*Amblyomma dissimile*	Adults	Female and male	3	Mata de Gallina	7°04′76.12″ N; 70°72′74.63″ W
6	Cadaver	Mammal	*Tamandua tetradactyla*	Male	*Amblyomma mixtum*	Adult	Female	1	El Rosario	6°91′71.88″ N; 70°88′67.65″ W
7	Rescue center		*Hydrochoerus hydrochaeris*	Female	*Amblyomma mixtum*	Nymphs/ Adults	NA/Female	9	Cinaruco	6°69′20.05″ N; 70°00′83.49″ W
8	Cadaver			Male	*Dermacentor nitens*		Female	4	Maporita	6°92′80.25″ N; 70°46′14.48″ W
				Female	*Amblyomma mixtum*			2		
9				Female		Nymphs/ Adults	NA/Male	3	Mata de Gallina	7°04′08.89″ N; 70°72′29.01″ W
10		Reptile	*Iguana iguana*	Female	*Amblyomma dissimile*	Adult	Female and male	5		7°04′09.01″ N; 70°72′30.28″ W
11	Rescue center			Male	*Amblyomma mixtum*		Male	2	Bocas del Arauca	7°07′66.82″ N; 70°56′21.10″ W
						Nymphs/ Adults	NA/Male	2		
12	Veterinary clinic	Mammal	*Leopardus tigrinus*	Male	*Amblyomma nodosum*	Adult	Female	1	Cinaruco	6°65′24.21″ N; 70°06′31.78″ W
13	Rescue center		*Dicotyles tajacu*	Male	*Amblyomma mixtum*	Nymphs/ Adults	NA/Femal	6	Caño Colorado	6°67′41.57″ N; 71°06′75.51″ W
14	Cadaver			Female		Adult	Male	2	Bocas del Arauca	7°03′55.05″ N; 70°57′79.16″ W
15	Veterinary clinic		*Myrmecophaga tridactyla*	Female	*Amblyomma nodosum*		Male	1	La Saya	6°92′31.93″ N; 70°71′76.16″ W
16	Cadaver		*Odocoileus virginianus*	Male	*Rhipicephalus microplus*	Nymphs/ Adults	NA/Male	7	Cinaruco	6°73′66.57″ N; 69°96′06.51″ W
17			*Procyon cancrivorus*	Male	*Amblyomma mixtum*	Adult	Female	1	El Rosario	6°95′73.07″ N; 70°85′75.43″ W
18			*Urocyon cinereoargenteus*	Male				1	Arrecifes	6°99′15.89″ N; 70°64′37.56″ W
19	Rescue center	Reptile	*Chelonoidis denticulata*	Female				1	Bocas del Arauca	7°03′55.05″ N; 70°57′79.16″ W

*Not applicable: NA.

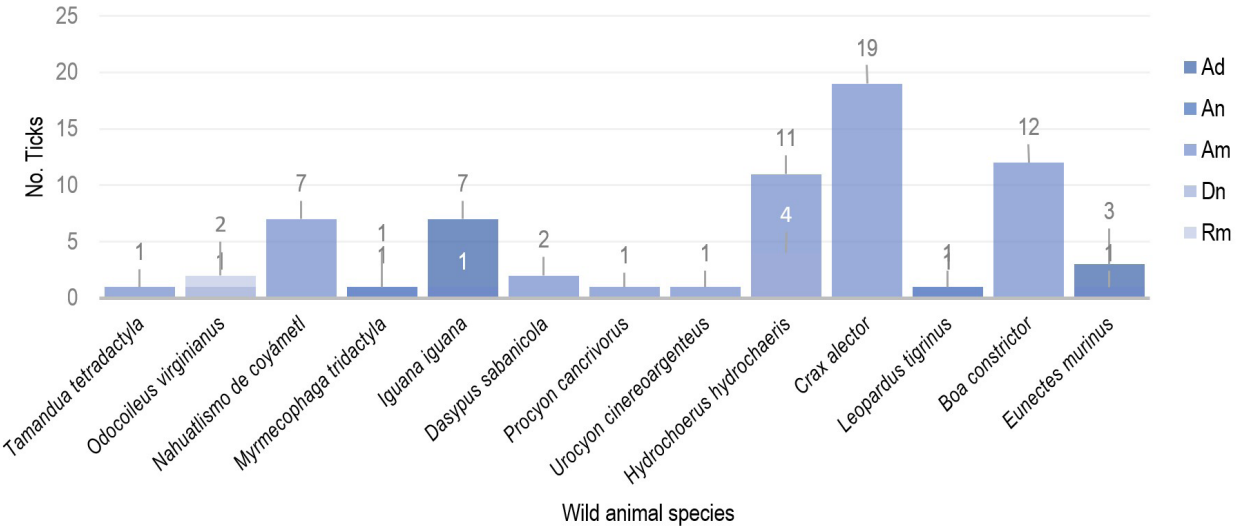

Figure 4 – Number of ticks that infest different wild animal species in the flooded savanna region of Colombia. Ad: *Amblyomma dissimile*. An: *Amblyomma nodosum*. Am: *Amblyomma mixtum*. Dn: *Dermacentor nitens*. Rm: *Rhipicephalus microplus*.

any selection for any animal species. Examples are the species *Rhipicephalus microplus* and *Dermacentor nitens*, which parasitize *Odocoileus virginianus* and *Hydrochoerus hydrochaeris*, respectively. These two tick species have a monoxenous life cycle, with infestations in domestic animals, such as cattle and horses, frequently reported (Andrade et al., 2022; Koller et al., 2017). In the case of *Rhipicephalus microplus*, *Odocoileus virginianus* was observed feeding in pastures where domestic animals, mainly cattle and horses, grazed. In contrast, in the case of *Dermacentor nitens* infestations, *Hydrochoerus hydrochaeris* was found to share the same habitat with many horses and other domestic and wild animal species.

Three species of the genus *Amblyomma* were identified, *Amblyomma mixtum* being the most frequently found in the animals of this study. This may be because these ixodids have a heteroxenous life cycle (with more than two hosts) (Pina et al., 2017; Robayo et al., 2020). During the larval and nymphal life stages, they can parasitize a wide range of hosts with a preference for mammals, accidentally including humans (Nava et al., 2014). Previous studies have also identified the tick species *Amblyomma cajennense* sensu lato (s.l.), *Amblyomma mixtum,* and *Amblyomma nodosum* in domestic and wild animals in the region (Cardona-Romero et al., 2020; Rivera-Páez et al., 2018). However, in this study, we report for the first time the species *Amblyomma dissimile* in the municipality of Arauca, thus expanding the distribution of this species in Colombia (Mogollon et al., 2017).

The diversity and wide distribution of wild animals found in the flooded savanna region of Colombia's Orinoquia region provides a source of potential hosts for different tick species of medical and veterinary importance since it offers an abundance, variety, and selection of important hosts for the continuity of the life cycle of ticks and the pathogens they transmit (Cumming, 1998). On the other hand, these wild animals serve as sentinels of parasitosis caused by these arthropods and of some bacterial, protozoan, and rickettsial pathogens of zoonotic importance, which may initially be affected, especially in times of food and water scarcity, being the first to show symptoms of diseases caused by tick-borne pathogens.

The flooded savannah region of the Colombian Orinoquia is an ecosystem that is subject to highly seasonal hydrologic dynamics (Rangel-Ch et al., 2017), which, together with the climate conditions of temperature and humidity, favors the development of a variety of plants and forests that serve for the maintenance and reproduction of different species of wild animals (Jaramillo et al., 2015). This balance has favored the biology and ecology of ticks in this region, which find, in a single place, a variety of hosts that serve not only as food but also as a means of transport to other non-infested areas whose climate conditions are suitable for their life-cycle development.

Conclusions

In this study, we established that ticks are widely distributed in the flooded savanna region of the department of Arauca, Colombia and that they use a variety of wild animals as definitive or intermediate hosts. In addition, mammalian species were found to be more heavily tick-infested than other taxa. Moreover, interactions between wild animals, domestic animals, and humans in this region may be a risk factor for infestation by the various tick species recorded in this study or for possible infection by pathogens transmitted through these arthropods when hosts live in close contact with each other in the same habitat.

Limitation

Removing ticks from carcasses may have led to an error in the number of tick species recorded in this group of sampled animals since some ticks may have left the carcasses shortly after death. Moreover, a taxonomic identification using molecular techniques did not complement this study. This means identifying other tick species collected (e.g., *A. cajennense* s.l.) could not be confirmed. It is hoped that such identification will be possible soon.

Conflict of interest statement

The authors declare they have no conflict of interest with this study.

Ethics Statement

This research did not directly involve using and handling wild animals since the ticks were opportunistically collected from carcasses and provided by other professionals who care for wild animals in this region of the country.

Acknowledgements

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