Status of Tick Description and Geographical Distribution in Angola: A Literature Review

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Abstract: - This study provides a review about the diversity and distribution of ticks and tick-borne diseases in Angola territory. Ticks are blood-feeding parasites that affect vertebrates and create issues for livestock production. Even though research about ticks is done in the region, information about tick diversity and ways of control are still restricted. Hence, in this study were examined twenty-eight articles published from 1950 to 2022 about tick identification in Angola. Used sources comprised Scopus, Web of Science, PubMed, and Google Scholar. Based on that, forty tick species were reported in the region, thirty-seven species belong to Ixodidae family and three species from *Argasidae*. The most common genera were *Amblyomma, Rhipicephalus*, and *Hyalomma*. The main tick-borne pathogens were *Anaplasma*, *Babesia*, and *Theileria* species, The most affected hosts are dogs and cattle. With this review is possible to recognize that, more research on tick distribution, genetic diversity, and control procedures are required in the region.

Key-Words: - Angola, Argasidae, livestock, ticks, tick-borne diseases.

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1 Introduction

Several markets, in developing countries, still face significant food security tests. Livestock production is an important tool to develop national economies as well as for household nutrition, [1]. In Angola, there is an increase of livestock production, mostly of cattle, is considered as a viable strategy to address food deficiencies and fortify food security for the inhabitants, [2]. Agriculture and livestock assembly constitute the main sources of employment, especially for rural families, [3].

Livestock production in Angola includes two main systems: family and commercial agricultural farms, with the central plateau and southern provinces as the primary centres of animal production, the livestock subsector represents the fastest-rising area of agriculture in Angola, [4], [5]. Even with such increases, the sector still cannot meet food demand, with that it lead to a low *per capita* consumption of animal-sourced foods and to an increase in reliance on imports, Angola still has a huge potential to develop animal production, but, many challenges are still a issue, such as endemic diseases continue to limit productivity and cause large number of economic losses [5].

In 2022, the agri-livestock sector made up 8.9% of the Gross Domestic Product (GDP) [6].

The sector faces many difficulties and expose livestock to many health problems, ticks and tick-borne diseases (TBDs) such as ehrlichiosis, theileriosis, and anaplasmosis are common in tropical and subtropical regions, these diseases can damage animal health and productivity, causing major economic losses [7], [8], [9]. Ticks are blood-feeding parasites that go through larval, nymphal, and adult stages need blood for their survivor [10] in fact, known for different pathogens, including viruses, bacteria, fungi, and protozoa [11], which are between the most diverse in Sub-Saharan Africa livestock problems [12]. Taxonomic investigations in the region began in the early 20th century, with foundational work by Nuttall and Warburton (1908-1926), who documented various tick genera and their distribution, [13], [14], [15].

The first focused studies on Angolan ticks began in the late 1940s, [15]. Vasco de Sousa Dias (1948-1950) is widely regarded as a pioneer in Angolan tick research, [15]. In the same line we have Travassos Santos Dias, which works on the identification of several important species, including *Ornithodoros moubata*, *Argas persicus*, and *Rhipicephalus appendiculatus,* [16], [17].

Similarly, research caried out by Serrano (1963-1971), Gomes (1993, 1994), continued to document tick species and their geographical distribution in the country, [18], [19]. Contextually, ticks from the families Ixodidae and Argasidae have been found in many ecological zones across the country [7].

More than a few *Rhipicephalus* species, like for example *R. bursa*, *R. simus*, *R. evertsi evertsi*, and *R. evertsi mimeticus,* they can inoculate their hosts neurotoxins that can cause paralysis in their hosts [9]. Molecular studies helped to explain the taxonomy and epidemiology of Angolan tick species and the pathogens they transmit [20], [21]. These studies focus on the requirement for current investigation and up-to-date diagnostic apparatuses to improved and recognise tick-host-pathogen interactions in the region [21]. This review looks at both historical and recent data on tick species diversity, distribution, and related tick-borne pathogens in the Angolan territory. It also identifies important gaps in knowledge and suggests future research priorities in vector investigation, molecular diagnostics, and tick-borne disease control.

1.1 Tick-Borne Diseases (TBDs) and Public Health Impact

Ticks parasitize a variety of vertebrate hosts. They pose considerable risks to public health and livestock productivity [22], [23]. If we consider Angola territories, tick-borne diseases (TBDs) are an emerging concern because they harm animal health, food security, and economic stability [24]. Still, there is not a final common opinion about tick diversity, once is still fragmented [24], [25], [26]. In this study, we aim to organize and summarize the existing literature.

1.2 Research Gaps and Theoretical Framework

Current studies on ticks and TBDs in Angola reveal critical gaps in knowledge, particularly concerning their geographic distribution, seasonal dynamics, species diversity, and associated health risks, [26], [27].

Traditional taxonomical approaches have been helpful in species identification [10], however, these methods often fail to detect co-infections, [28]. The integration of molecular diagnostic tools, including polymerase chain reaction (PCR) and deoxynucleic acid (DNA) barcoding methods, are relevant to improve species-level resolution and pathogen detection, [28], [29], [30].

The effectiveness of current tick control measures, such as acaricide application, rotational grazing, and integrated pest management, control of TBDs, remains insufficiently documented in the country, [31].

Theoretical frameworks in disease ecology help address these knowledge gaps by accent the complex interactions among vectors, hosts, pathogens, and their environments [32].

2 Methodology

Literature Search and Data Sources

The following systematic bibliographic review was carried out to identify studies on ticks and tick-borne diseases in Angola. Further, a search was conducted in platforms such as Scopus, Web of Science, Google Scholar, and PubMed, which enabled us to cover the period from 1950 to 2022. Thereby, search terms included combinations of "tick(s)", "tick-borne disease(s)", "livestock", "Ixodid", and "Angola". An initial screening of titles and abstracts was performed to remove duplicates and irrelevant entries.

2.1 Literature Review Framework

So, the review followed the PRISMA guidelines [33]. For that, a set protocol was used to keep the methods clear, including how studies were chosen and how data were collected. Considering the established criteria 28 studies entered. From those, fifteen focused on identifying ticks by their shape, while eight examined tick-borne pathogens, and finally five addressed both areas. In this line, ten additional studies were excluded as considered duplicates.

2.2 Data Collection and Synthesis

Data extracted from eligible studies included: geographical location, study period, host species, used diagnostic methods, and identified pathogen species. Priority was given to peer-reviewed articles when both published articles and postgraduate theses were available.

The final dataset provides an overview of current knowledge on tick diversity, distribution, and pathogens in the country. Figure 1 offers a flowchart that summarize the used screening and selection process in this systematic review.

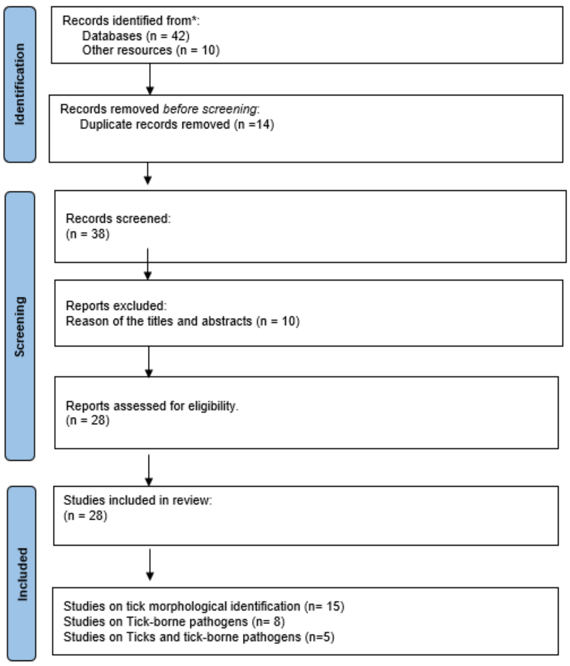

Fig. 1: PRISMA framework employed
Source: created by the authors

Figure 1 enables us to identify the structured summary of the review process following the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines, [33]. I fact, the systematic identification, screening, eligibility assessment, as well as the inclusion of peer-reviewed literature, along with the specific criteria employed for article selection are emphasized. To evaluate the association between tick species and the occurrence of tick-borne diseases (TBDs), a Chi-square test was performed using Microsoft Excel, [22], [34]. Additionally, bibliometric analysis of the retrieved literature was conducted using the Bibliometrix package [35] in R Studio version 4.3.0, allowing for quantitative assessment of publication trends and research focus areas.

2.3 Statistical Approach

The chi-square test of independence was a non-parametric statistical method used to determine whether there is a significant association between two categorical variables [34]. A chi-square test of independence was applied to a 2x40 contingency in this study. Data were characterised based on association of tick specie and tick-borne diseases infection, (yes) or not (no) for each species.

- Null Hypothesis (H0): There is no association between tick species and the presence of tick-borne disease (the variables are independent).
- Alternative Hypothesis (H1): There is an association between tick species and disease occurrence.

The expected frequencies for each cell were calculated considering the independence. The chi-square statistic was used, according to the formula below:

$$x^2 = \sum \left(\frac{O-E}{\mathrm{E}}\right)^2 \quad (1)$$

where:
O = observed frequency
E = expected frequency
The analyse was performed using Stata version 14 statistical software.

3 Results

3.1 Literature Overview and Tick Diversity

Around 40 different tick species on domestic and wild animals in Angola were found. The used studies cover themes such us species identification, host preferences, and the used method for the tick identification, as shown in Table 1 (see: Appendix). The Table 2 (see: Appendix) lists the tick-borne pathogens detected, including bacteria, protozoa, and viruses, these data show an overview of which pathogens are linked to which tick species in the region.

3.2 Bibliometric Trends and Temporal Patterns

The bibliometric analysis presented three main phases in research on ticks in Angola. The first phase, between 1950 and 1958, studies focused on the classification of the Angolan tick species, significant efforts done by Vasco de Sousa Dias (1940). There has been a reduction in research on ticks from 1959 to 2008 since of political instability and conflict. Since 2008, research has picked up again, supported by advanced academic resources, and stronger international partnerships.

The bibliometric analysis was performed using the Bibliometric package in RStudio software, version 4.3.0, emphasised the main themes and connections in the literature. Figure 2 and Figure 3 illustrate how recent research has shifted from topics such as species identification to focus more on epidemiology and molecular studies.

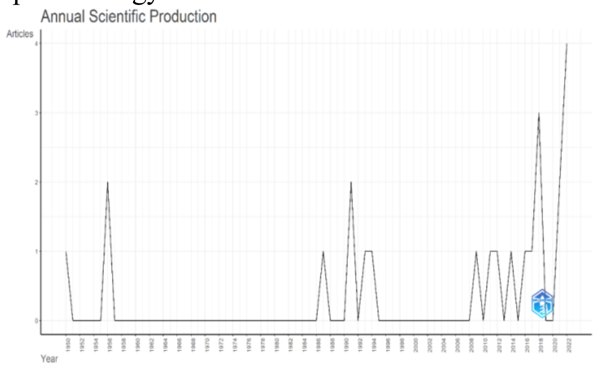

Fig. 2: Publications per year (1950–2022)
Source: created by the authors

The Figure 3 shows the thematic evolution in scientific research on ticks and tick-borne diseases, has changed over time. Initial studies primarily focus on tick identification, description, and distribution, which facilitated a basic knowledge of tick diversity in the region. In recent years, research has moved to study of prevalence, tick-borne diseases, epidemiology, and control strategies.

In the bibliometric network, several authors stand out for their strong citation records and extensive connections. Their work connects early taxonomic studies with current applied research; it shows their important role in the structure knowledge and how to improve control strategies for tick-borne diseases in Angola (Figure 3).

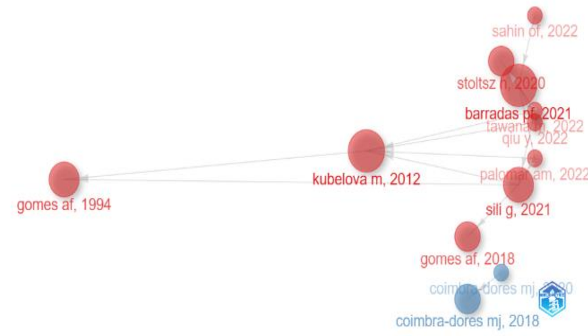

Fig. 3: Co-citation networks
Source: created by the authors

3.3 Report of Tick Described Species

The review identified a total of 40 tick species described across approximately 15 of Angola's 18 provinces, based on 28 eligible studies (Figure 4), Table 1 (Appendix). Most of the data back over three decades, with works by Dias and others, characterising tick fauna and describes geographic distribution.

Amblyomma Koch, 1844

The genus is spread and reported across multiple regions in the country. Main species include *A. astrion*, *A. tholloni*, *A. sparsum*, *A. hebraeum*, *A. variegatum*, *A. splendidum*, and *A. pomposum*. Species of this genus can spread pathogens such as *Theileria ovis*, *Babesia vogeli*, *Babesia bigemina*, *Ehrlichia ruminantium*, and *Anaplasma* spp. Table 1 (Appendix).

Aponomma Latreille, *1905*

Aponomma spp. were notable in Zaire Province (San Salvador), as shown in the Figure 4, Table 1 (Appendix).

Rhipicephalus Koch, 1844

Rhipicephalus spp. lead the tick fauna in the region owed their wide range of hosts. Described tick borne pathogens (TBPs) include transmitted by them, include *Anaplasma* spp., *Babesia* spp., *Hepatozoon* spp., *Ehrlichia canis*, *Rickettsia* spp., and *Coxiella* spp., the genus encompasses numerous species, including *R. evertsi mimeticus*, *R. zambesiensis*, *R. duttoni*, *R. appendiculatus*, *R. lunulatus*, *R. sanguineus*, and *R. turanicus*, as presented in Table 1 (Appendix).

Haemaphysalis Koch, 1844

Haemaphysalis genus is related to humid ecosystems such as rivers, valleys and swamps, *Haemaphysalis* species parasitise livestock cats and dogs. The predominant species of this genus include

H. paraleachi, *H. ethiopica*, and *H. leachi*, as indicated in Table 1 (Appendix).

Rhipicephalus (Boophilus)
The subgenus *Boophilus* was recognized as prevalent among cattle. Predominant species include *Rhipicephalus (Boophilus) decoloratus* and *Rhipicephalus (Boophilus) microplus*, together vectors of *Borrelia* spp., *Anaplasma marginale*, *Babesia*, and *Theileria* spp. (see Table 1 in Appendix).

Hyalomma Koch, 1844
Hyalomma spp. are adapted to arid and semi-arid environments. They can transmit a diverse range of pathogens, comprising *Rickettsia aeschlimannii*, *Coxiella* spp., *Francisella* sp., *Ehrlichia ruminantium*, and *Theileria parva*. Reported hosts range both domestic animals (e.g. cattle, goats, canines) and wildlife (e.g. *Diceros bicornis*, *Hippotragus equinus*, *Equus burchelii*, *Syncerus caffer*) (see Table 1 Appendix). Most common species include *H. truncatum*, *H. rufipes*, *H. marginatum* and *H. transiens* as seen in Table 1 (Appendix).

Ixodes Latreille, 1795
Characterised by in the country *I. henrichi* and *I. cavipalpus*, this genus was reported in Huila region, they may parasite domestic ruminants and wild ungulates.

The Argasidae family comprises genera such us *Argas* and *Ornithodorus*. These Soft ticks were reported occasionally. *Argas* and *Ornithodorus* species remained recorded in Malanje, Huambo, Zaire, Benguela, Bié, and Cabinda regions.

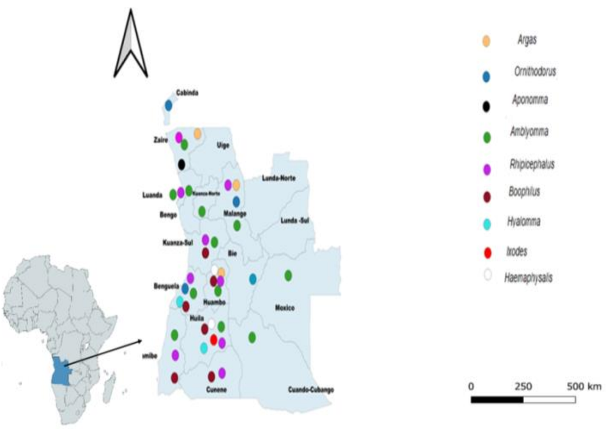

Fig. 4: Geographic distribution of ticks inside the country
Source: created by the authors

3.4 Tick and Tick-Borne Pathogens

TBPs was detected in livestock (cattle and small ruminants), domestic animals (dogs and cats), wildlife (birds, zebras, lions), small mammals, and reptiles (see Table 2, Appendix). Ticks infestation pose a substantial public and animal health risk owed to their capacity to spread zoonotic pathogens, comprising *Anaplasma*, *Babesia*, *Ehrlichia*, and *Rickettsia*, which affect humans, livestock, and wildlife.

Between the pathogens, *Anaplasma*, *Babesia*, and *Rickettsia* exhibited the peak of prevalence (16-13%) (Table 2, Appendix).

3.5 Tick-Borne Pathogens by Tick Species

A total of 21 tick species were associated to TBP´s transmission, while 19 were not. Important vectors include *Amblyomma hebraeum*, A. *pomposum*, *Rhipicephalus sanguineus*, and *Rhipicephalus (Boophilus) microplus*, which play key roles in veterinary and medical sceneries. In contrast, species such as *Amblyomma astrion, A. persicus*, and *Haemaphysalis ethiopica* was not associated with TBP´s transmission.

The knowledge and identification of species such *us R. B. microplus*, the main vector of bovine diseases, and *Amblyomma variegatum*, which spreads *Rickettsia*, are important to manage the public health and agriculture.

The statistical analysis, show a chi-square value (χ^2) of about 0.005 with 39 degrees of freedom. The p-value was 0.9948, which means the observed and expected frequencies were almost identical under the null hypothesis. Since the p-value is above 0.05, we do not reject the null hypothesis. This indicates no statistically significant association between tick species and the presence of tick-borne disease in the dataset (Table 3).

Table 3. Results of Chi-Square Test of Independence

Statistic	Value
Chi-square statistic (χ^2)	Very low (≈ 0.005)
p-value	0.9948
Degrees of freedom (df)	$(40 - 1) \times (2 - 1) = 39$
Significance level (α)	0.05
Conclusion	No significant association

Source: created by the authors

4 Discussion

The analysis of existing studies reveals a notable diversity of tick species across Angola, with at least 40 species documented. The genus *Amblyomma* is particularly prevalent, with *Amblyomma variegatum* reported as dominant, especially during the rainy season when environmental conditions support their proliferation, [36] the *Amblyomma* species are key vectors of pathogens causing diseases such as babesiosis, anaplasmosis and cowdriosis, particularly affecting livestock [21], [29], [37].

Several research sustain that areas of high humidity, mainly during the wet season, favour tick survival and reproduction, [9], [20]. The genus *Rhipicephalus*, comprising *R. sanguineus* and *R. (Boophilus) decoloratus*, shows a wide host variety, [9]. These species are significant vectors of zoonotic pathogens, causing diseases such as babesiosis, anaplasmosis, and ehrlichiosis, [9], [21], [27], [28].

H. truncatum and *H. marginatum*, dominate in southern Angola's drier regions, [8]. Despite harsher environmental conditions, these species are well adapted in other environments, they can transmit pathogens responsible for anaplasmosis and theileriosis, [38]. These species can parasite both domestic animals and wildlife such as buffaloes and zebras, [31], [35], [36], showing the importance of wildlife in the disease transmission cycle.

4.1 Tick-borne Diseases - The Potential Impacts

Tick-borne diseases affect livestock productivity and public health in Angola, [9]. The primary pathogens identified are *Babesia*, *Anaplasma*, and *Ehrlichia*, mainly infecting ruminants like cattle and goats, with substantial economic consequences for rural communities reliant on animal production, [7], [11], [29]. Even with the control strategies, the persistence of *Babesia spp.* and *Anaplasma spp.* highpoints the threat of TBDs [28], [34].

However, statistical analysis did not identify a significant correlation among tick species diversity and TBDs incidence ($p = 0.99$). This suggests other determinants, such as pathogen dynamics, host presence, and environmental factors, that may influence disease occurrence, more studies are need in this field.

Wildlife reservoirs, such as zebras and buffaloes [37] present an additional challenge by serving as vectors for zoonotic disease transmission, particularly in rural areas with frequent wildlife-livestock-human interactions [12], [31].

4.2 Historical Factors and Publication Context

Bibliometric analysis identifies three main phases in tick research in Angola. The first, from 1950 to 1958, featured pioneering taxonomic efforts by researchers such as Vasco Sousa Dias, [15]. During the second phase (1959-2008), research output varied, mainly due to Angola's long civil conflict [39]. From 2008 onward, the third phase saw research increase again as institutional collaboration improved, [39].

Co-citation network analysis shows that research has shifted from taxonomy to disease management and vector control, reflecting changing priorities. Thereby, developing more with international researchers has also helped Angola build its research capacity and raise its global scientific profile, [19], [21], [39].

4.3 Socioeconomic Implications and Research Gaps

The lack of a national system for tick surveillance and TBDs control presents a major threat to animal health, public health, and food security, [29], [39]. Losses from reduced animal productivity and increased veterinary costs are significant [26]. Traditional morphological identification methods remain limited in distinguishing morphologically similar tick species, [40]. Integrating molecular techniques such as DNA barcoding and next-generation sequencing (NGS) is essential for accurate tick identification and epidemiological monitoring, [41].

5 Future Steps

Regarding future research lines, we do believe that those should expand tick studies to include more regions of Angola that have not been well studied, especially by using molecular methods like DNA barcoding and next-generation sequencing. Also, they should consider seasonal changes and the interactions between wildlife and livestock to better understand how tick populations change and how diseases spread. Modelling tick distribution under future climate scenarios. Institutional research collaborations, and integrating ecological, epidemiological, and socio-economic data are essential to develop sustainable and targeted tick and TBD`s control strategies.

6 Conclusions

Studies analysed in this review focused predominantly on species identification using morphological methods, with limited application of genomic tools such as NGS. In this work were determined 40 tick species across two Argasid genera (*Argas*, *Ornithodoros*) and six Ixodid genera (*Amblyomma*, *Aponoma*, *Ixodes*, *Hyalomma*, *Haemaphysalis*, *Rhipicephalus*).

Based on the available data we may assume that *Amblyomma* and *Rhipicephalus* ticks genera, are more frequent cited by the authors as, they can transmit more TBPs compared to *Hyalomma* and *Haemaphysalis* genera. Several studies used molecular and serological tools to detect pathogens and few sequenced PCR amplicons.

This bibliography work shows the urge for comprehensive, integrative research and sustainable control strategies for TBDs in Angola. This study reviews the variety of ticks and tick-borne diseases found in Angola. It also helps us better understand tick ecology and how diseases spread in the country, and offers practical ideas for future research, public health, and policy planning.

6.1 Study Limitations and Prospective Research Lines

If we focus on the most relevant study limitations, the geographic area should be taken into account once leaves out many remote or ecologically diverse regions. Also, the study does not track how tick populations change with the seasons or even over time. Contextually, we also should consider that studies use only morphological identification, with limited use of molecular tools or pathogen screening.

About prospective research lines, those should include neglected regions and use molecular, next-generation sequencing, and genomic techniques to identify ticks and pathogens more accurately. Reinforcement of local research capacity and promoting integrated control and cross-border investigation are essential for improved regional management control against ticks.

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Contribution of Individual Authors to the Creation of a Scientific Article (Ghostwriting Policy)

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Conflict of Interest

The authors have no conflicts of interest to declare, that are relevant to the content of this article

APPENDIX

Table 1. Tick species reported, hosts and their geographical distribution in Angola.

Family	Genus	Species	Region	Hosts	Transmitted agents	Method of identification	Reference
	Argas Latreille, s. str., 1796	*Ar. Persicus s* (Oken, 1818)	*San Salvador/ zaire*	Unidentified by the author	Unidentified by the author	Morphological	(Theiler et al., 1954)
			Huambo, Zaire				
	Ornithodorus	*O. moubata*		Unidentified by the author	Unidentified by the author		
			Malange, Benguela, Bié and Cabinda				
		O. savignyi	Cabinda (Landana)	Unidentified by the author	Unidentified by the author		
IXODOIDAE	*Aponomma*	*A. exornatum*	San Salvador (Zaire)	Unidentified by the author	Unidentified by the author		(Theiler et al., 1954)
	Amblyomma Koch, 1844	*A. Compressum (Macalister, 1872)*	South of Angola	Pangoli	Unidentified by the author	Morphological	Santos Dias J. T. (1955)
		A. astrion Dönitz, 1909	Luanda	Buffalo	Unidentified by the author	Morphological	Santos Dias J. T. (1955)
			Angola	African bufallo	*Ehrlichia ruminantium*	Morphological	Walker & Olwage, 1987)
			Huila	Cattle, small ruminants and African	*Ehrlichia ruminantium* (formerly *Cowdria ruminantium*)	Morphological	(Gomes, 1993)
			Zaire, Bengo, Cuanza Norte, Cuanza Sul, Malanje, Benguela and Namibe provinces	Buffalo			
		A. Tholoni Neumann, 1899	*Huila*	Elephant, domestic ruminants, ungulates	Ehrlichia ruminantium (formerly Cowdria ruminantium)	Morphological	(Gomes, 1993)
			Angola				
			Angola	Wild animals' cattle and small ruminants	Unidentified by the author	Morphological	(Theiler et al., 1954)

Table 1. Cont.

Family	Genus	Species	Region	Hosts	Transmitted agents	Method of identification	Reference
IXODOIDAE	*Amblyomma Koch, 1844*	*A.sparsum Neumann, 1899*	Benguela, Namibe, Huila and Cuando Cubango provinces	Rhinoceros, snakes, man and tortoises, cattle and small ruminants	*Ehrlichia ruminantium* (formerly *Cowdria ruminantium*)	Morphological	(Gomes, 1993)
		A. Hebraeum Koch, 1844	Angola	Cattle and small ruminants	*Ehrlichia ruminantium* (formerly *Cowdria ruminantium*)	Morphological	(Gomes, 1993)
		A. Variegatum (Fabricius, 1794)	Cabinda and Moxico provinces	Ruminants, buffalo, wart hog, birds, and dogs	*Ehrlichia ruminantium* (formerly *Cowdria ruminantium*)	Morphological	(Gomes, 1993)
			South of Angola	Bufalo	Ehrlichia ruminantium, Theileria parva	Morphological and molecular	(Pascucci et al., 2011)
				Dogs and Cattle	*Richkettsia africae*, *Rickettsia aeschilimannii*, *Babesia caballi* and *Theileria velifera*	Morphological and molecular	(Qiu et al., 2022)
			Benguela	Cattle	*Rickettsia africae*, *Babesia* spp.	Morphological and molecular	(Palomar et al., 2022)
			Benguela	Unidentified by the author	Unidentified by the author	Morphological	(Theiler et al., 1954)
		A. Splendidum	Zaire	Unidentified by the author	Unidentified by the author	Morphological	(Theiler et al., 1954)
		Amblyomma spp.	Luanda	Dogs	*Rickettsia* spp.	Morphological and molecular	(Barradas et al., 2021)
		A. Pomposum Dönitz, 1909	Angola	Cattle and small ruminants	*Ehrlichia ruminantium* (formerly *Cowdria ruminantium*)	Morphological	(Walker & Olwage, 1987)
				Cattle, goat, and sheep	*Theileria*	Not performed	(Tawana et al., 2022)

Table 1. Cont.

Family	Genus	Species	Region	Hosts	Transmitted agents	Method of identification	Reference
IXODOIDAE	*Rhipicephalus* Koch, 1844	*Rh. punctatus*	Huila	Bovines	Unidentified by the author	Morphological	(Gomes et al., 1994)
		Rh. Kochi	Huila		Unidentified by the author	Morphological	(Gomes et al., 1994)
			Huambo	Dogs, sheeps, goats, bovines	*Theileria ovis, B. vogeli, B. bigemina, E. ruminantium, Anaplasma* spp.	Morphological and molecular	(Sili et al., 2021)
			Huambo		Unidentified by the author	Morphological	(Gomes, 1993)
		Rh. turanicus	Huambo	Dogs, sheeps, goats, bovines	*Theileria ovis, B. vogeli, B. bigemina, E. ruminantium, Anaplasma* spp.	Morphological	(Sili et al., 2021)
			Huila	Bovines	Unidentified by the author	Morphological	(Gomes et al., 1994)
		Rh. evertsi evertsi	South of Angola	Buffalo	*Ehrlichia ruminantium, Theileria parva*	Morphological and molecular	(Pascucci et al., 2011)
			Huambo	Cattle	Unidentified by the author	Morphological and molecular	(Carvalho, 2016)
			Bié	Cattle	*Theileria ovis, B. vogeli, B. bigemina, E. ruminantium, Anaplasma* spp.	Not performed	(Kubelová et al., 2012)
			Huila	Bovines	Unidentified by the author	Morphological	(Gomes et al., 1994)
		Rh. simus Koch, 1844	Huila	Bovines	Unidentified by the author	Morphological	(Gomes et al., 1994)
			Huambo	Unidentified by the author	Unidentified by the author	Morphological	(Theiler et al., 1954)
			Huila Huambo	Unidentified by the author	Unidentified by the author	Morphological	(Gomes, 1993)
		Rh. compositus	Huambo	Dogs, sheeps, goats, bovines	*Theileria ovis, B. vogeli, B. bigemina, E. ruminantium, Anaplasma* spp.	Morphological and molecular	(Sili et al., 2021)
			Huambo	Cattle	Unidentified by the author	Morphological and molecular	(Carvalho, 2016)
			Huambo	Unidentified by the author	Unidentified by the author	Morphological	(Gomes, 1993)

Table 1. Cont.

Family	Genus	Species	Region	Hosts	Transmitted agents	Method of identification	Reference
IXODOIDAE	*Rhipicephalus* Koch, 1844	*Rh. longus*	Angola	Unidentified by the author	Unidentified by the author	Morphological	(Theiler et al., 1954)
		Rh. oculatus	Bocoi, Lobito (Benguela)	Unidentified by the author	Unidentified by the author		
		Rh. capensis	San Salvador (Zaire)	Unidentified by the author	Unidentified by the author		
		Rh. falcatus	San Salvador (Zaire)	Unidentified by the author	Unidentified by the author		
			Huambo	Cattle	Unidentified by the author	Morphological and molecular	(Carvalho, 2016)
			San Salvador (Zaire)	Unidentified by the author	Unidentified by the author	Morphological	(Theiler et al., 1954)
		Rh. Distinctus	Angola	Unidentified by the author	Unidentified by the author	Morphological	Santos Dias J. T. (1960)
		Rh. pravus	Bailundo (Huambo) and Benguela	Unidentified by the author	Unidentified by the author	Morphological	(Theiler et al., 1954)
		Rh. sanguineus Latreille, 1806	South of Angola South of Angola	Dogs	*Hepatozoon canis*	Morphological and molecular	(Qiu et al., 2022)
			Luanda Luanda	Cats	*Ehrlichia canis, Hepatozoon felis* and *Anaplasma bovis.*	Not performed	(Oliveira et al., 2018)
			Luanda Luanda	Dogs	*Anaplasma platys, B. gibsoni, B. vogeli, E.canis, Hepatozoon canis*	Morphological and molecular	(Cardoso et al., 2016)
			Huila	Unidentified by the author	Unidentified by the author	Morphological	(Gomes et al., 1994)
			Huambo	Unidentified by the author	Unidentified by the author	Morphological	(Theiler et al., 1954)
		Rh. lunulatus Neumann, 1906	South of Angola	Dogs and Cattle	*Hepatozoon canis*	Morphological	(Qiu et al., 2022)
			Huambo	Cattle	Unidentified by the author	Morphological and molecular	(Carvalho, 2016)

Table 1. Cont.

Family	Genus	Species	Region	Hosts	Transmitted agents	Method of identification	Reference
IXODOIDAE		*Rh. lunulatus* Neumann, 1906	Huila	Bovines	Unidentified by the author	Morphological	(Gomes et al., 1994)
			Angola	Unidentified by the author	Unidentified by the author	Morphological	Theiler et al., 1954)
			Zaire (San Salvador)	Unidentified by the author	Unidentified by the author	Morphological	(Theiler et al., 1954)
		Rh. Appendiculatus	Angola	Unidentified by the author	Unidentified by the author	Not performed	(Olwoch et al., 2009)
			Huambo	Unidentified by the author	Unidentified by the author	Morphological	(Theiler et al., 1954),
	Rhipicephalus (Boophilus)	*Rhipicephalus microplus* Canestrini, 1888	Huambo	Dogs, sheeps, goats, bovines	*Theileria ovis, Babesia vogeli, Babesia bigemina, E. ruminantium, Anaplasma* spp.	Morphological and molecular	(Sili et al., 2021)
			Cuanza-Sul and Benguela provinces	Cattle	Unidentified by the author	Morphological	(Gomes & Neves, 2018)
		Boophilus decoloratus	Huambo Huila Cunene and Namibe	Cattle	*Babesia bigemina*	Morphological	(Gomes et al., 1991)
			Huila	Unidentified by the author	Unidentified by the author	Morphological	(Gomes et al, 1994)
			Huambo	Cattle	Unidentified by the author	Morphological and molecular	(Sili et al., 2021)
			Bié	Cattle, goats	*Anaplasma marginale/ovis, Babesia/Theileria spp*	Not performed	(Kubelová et al., 2012)
			Benguela	Dogs and Cattle	*Rickettsia africae, Ehrlichia* spp., *Spiroplasma ixodetis, Babesia bigemina.*	Morphological and molecular	(Palomar et al., 2022)
				Unidentified by the author	Unidentified by the author	Morphological	(Theiler et al., 1954), (Gomes et al., 1994)

Table 1. Cont.

Family	Genus	Species	Region	Hosts	Transmitted agents	Method of identification	Reference
IXODOIDAE	*Hyalomma*	*Hy. truncatum* Koch 1844	Benguela	Cattle	*Rickettsia aeschlimannii, Coxiella* spp., *Francisella* sp.	Morphological nd molecular	(Palomar et al., 2022)
			Huila	Unidentified by the author	Unidentified by the author	Morphological	(Gomes et al, 1994)
			South of Angola	Dogs and cattle	*Ehrlichia minasensis*	Morphological	(Qiu et al., 2022)
						Not performed	(Pascucci et al., 2011)
		Hy. rufipes	South of Angola	Buffalo	*Ehrlichia ruminantium, Theileria parva*	Not performed	(Pascucci et al., 2011)
		Hy. marginatum rufipes		Bovines	Unidentified by the author	Morphological	(Gomes et al., 1994)
		Hy. transiens	Angola	Unidentified by the author	Unidentified by the author	Morphological	(Theiler et al., 1954)
		Hyalomma marginatum Koch 1844	South of Angola	Dags and cattle	*Candidatus Midichloria mitochondrii*	Morphological	(Qiu et al., 2022)
		Hy. longi-cornis	Huila	Unidentified by the author	Unidentified by the author	Morphological	(Gomes et al., 1994)
	Ixodes, Latreille	*Ixodes heinrichi* Arthur, 1962	Angola	Unidentified by the author	Unidentified by the author	Morphological	(Arthur, 1962)
		Ixodes cavipalpus Nuttall & Warburton 1908	Huila	Bovines	Unidentified by the author	Morphological	(Gomes et al., 1994)
			Huila	Unidentified by the author	Unidentified by the author	Morphological	(Theiler et al., 1954)
	Haemaphysalis Koch, 1844	*Ha. Paraleachi* Camicas, Hoogstraal & El Kammah, 1983	Huambo	Dogs, sheeps, goats, bovines	*T. ovis, B. vogeli, B. bigemina, E. ruminantium, Anaplasma* spp.	Morphological and molecular	(Sili et al., 2021)
			Huambo	Unidentified by the author	Unidentified by the author	Morphological	(Gomes, 1993)

Table 1. Cont.

Family	Genus	Species	Region	Hosts	Transmitted agents	Method of identification	Reference
IXODOIDAE	*Amblyomma Koch, 1844*	*A. Pomposum Dönitz, 1909*	Huambo	Cattle	Unidentified by the author	Morphological and molecular	(Sili et al., 2021)
			Huambo	Dogs, sheeps, goats, bovines	*T. ovis, B. vogeli, B. bigemina, E. ruminantium, Anaplasma* spp.	Morphological	(Sili et al., 2021)
			Cabinda and Moxico provinces	Cattle, small ruminants (sheep, goats) horses, donkeys, pigs, and dogs	Unidentified by the author	Morphological	(Theiler et al., 1954)
			Huila	Sheep, goats, horses, donkeys, pigs, and dogs	*E.ruminantium* (formerly *Cowdria ruminantium*)	Morphological	(Gomes et al., 1993),
			Angola	Bufallo, carnivors, Zebra, roan antilope, red lechw, banded mongoose, wart hog, pangolin, birds, reptiles,	*E.ruminantium (formerly Cowdria ruminantium)*	Morphological	(Gomes, 1991)
	Rhipicephalus Koch, 1844	*Rh. evertsi mimeticus*	Cuanza-Sul and Benguela provinces	Unidentified by the author	Unidentified by the author	Morphological	(Gomes & Neves, 2018
			Huambo	Cattle	Unidentified by the author	Morphological	(Sili et al., 2021)
			Luanda, Huambo, Benguela and Huila provinces	Unidentified by the author	Unidentified by the author	Morphological	(Theiler et al., 1954)
			Huila	Unidentified by the author	Unidentified by the author	Morphological	(Gomes, et al, 1994)
		Rh. zambesiensis	Huila,	Cattle	Unidentified by the author	Morphological	(Gomes et al., 1994),
		Rh. duttoni Neumann, 1907	Cunene and Namibe	Cattle	Unidentified by the author	Morphological	(Gomes & Wouters, 1991)
			Southwestern Angola (Huila, Cunene and Namibe)			Morphological	
			Benguela	Dogs and Cattle	Coxiella genotypes	Morphological and molecular	(Palomar et al., 2022)
			Huila	Unidentified by the author	Unidentified by the author	Morphological	(Gomes et al., 1994)
			Huila			Morphological	
			Huila	Common eland	Unidentified by the author	Morphological	Santos Dias J. T. (1955)
			Malange (Quissama)			Morphological	
				Unidentified by the author	Unidentified by the author	Morphological	(Theiler et al., 1954),
		Rh. sulcatus	Huambo	Dogs, sheeps, goats, bovines	*Theileria ovis, Babesia vogeli, Babesia bigemina, E. ruminantium, Anaplasma spp.*	Morphological and molecular	(Sili et al., 2021)

Table 1. Cont.

Family	Genus	Species	Region	Hosts	Transmitted agents	Method of identification	Reference
IXODOIDAE	*Hyalomma*	*Hy. truncatum* Koch 1844	Benguela	Cattle	*Rickettsia aeschlimannii, Coxiella* spp., *Francisella* sp.	Morphological nd molecular	(Palomar et al., 2022)
			Huila	Unidentified by the author	Unidentified by the author	Morphological	(Gomes et al, 1994)
			South of Angola	Dogs and cattle	*Ehrlichia minasensis*	Morphological	(Qiu et al., 2022)
						Not performed	(Pascucci et al., 2011)
		Hy. rufipes	South of Angola	Buffalo	*Ehrlichia ruminantium, Theileria parva*	Not performed	(Pascucci et al., 2011)
		Hy. marginatum rufipes		Bovines	Unidentified by the author	Morphological	(Gomes et al., 1994)
		Hy. transiens	Angola	Unidentified by the author	Unidentified by the author	Morphological	(Theiler et al., 1954)
		Hyalomma marginatum Koch 1844	South of Angola	Dags and cattle	*Candidatus Midichloria mitochondrii*	Morphological	(Qiu et al., 2022)
		Hy. longi-cornis	Huila	Unidentified by the author	Unidentified by the author	Morphological	(Gomes et al., 1994)
	Ixodes, Latreille	*Ixodes heinrichi* Arthur, 1962	Angola	Unidentified by the author	Unidentified by the author	Morphological	(Arthur, 1962)
		Ixodes cavipalpus Nuttall & Warburton 1908	Huila	Bovines	Unidentified by the author	Morphological	(Gomes et al., 1994)
			Huila	Unidentified by the author	Unidentified by the author	Morphological	(Theiler et al., 1954)
	Haemaphysalis Koch, 1844	*Ha. Paraleachi* Camicas, Hoogstraal & El Kammah, 1983	Huambo	Dogs, sheeps, goats, bovines	*T. ovis, B. vogeli, B. bigemina, E. ruminantium, Anaplasma* spp.	Morphological and molecular	(Sili et al., 2021)
			Huambo	Unidentified by the author	Unidentified by the author	Morphological	(Gomes, 1993)

		Ha. ethiopica T. Dias (1957)	Angola	Unidentified by the author	Unidentified by the author	Morphological	Santos Dias J. T. (1957)

Table 1. Cont.

Family	Genus	Species	Region	Hosts	Transmitted agents	Method of identification	Reference
IXODOIDAE	*Haemaphysalis Koch, 1844-*	*Ha. Leachi (Audouin, 1826)*	Huambo	Dogs, sheeps, goats, bovines	*Theileria ovis, Babesia vogeli, Babesia bigemina, E. ruminantium, Anaplasma* spp.	Morphological and molecular	(Sili et al., 2021)
				Unidentified by the author	Unidentified by the author	Morphological	(Theiler et al., 1954)

Table 2. Tick-borne pathogens (TBPs) species reported in the studies.

Family	Genera	Species	Reported (n)	Method of identification	Region	Reference
Anaplasmataceae	*Anaplasma*	*A. bovis*	1	Molecular	Luanda	(Oliveira et al., 2018)
		A. platys	1	Molecular	Angola	(Coimbra-Dores et al., 2020)
		A. platys, A. bovis, A. centrale, A. Marginale, A. Sp.	5	Molecular	Huambo	(Sili et al., 2021)
		A. platys	1	Molecular	Luanda	(Cardoso et al., 2016)
		A. Marginale, A. Bovis, Anaplasma spp.	3	Molecular	Bié	(Kubelová et al., 2012)
		A. marginale, A. bovis, A. platys, A. phagocytophilum, A. Capra, Anaplasma spp	6	Not provided	Angola	(Tawana et al., 2022)
Babesiidae	*Babesia*	*B. bovis, B. vogeli, B. bigemina, B. rossi*	4	Molecular (RLB)	Huambo	(Sili et al., 2021)
		B. bigemina	1	Serodiagnosis (Indirect immunofluorescence -IFI)	Huambo Huila Cunene	(Gomes et al., 1991)
		Babesia spp., B. bigemina		Molecular (normal)	Benguela	(Palomar et al., 2022)
		B. vogeli, B.gibsoni, Babesia sp.	3	Molecular (nested-PCR)	Luanda	(Cardoso et al., 2016)
		Babesia caballi	1	Molecular	South of Angola	(Qiu et al., 2022)
		Babesia spp.		Molecular (normal)	Bié	(Kubelová et al., 2012)
		Babesia spp.	1	Molecular (qPCR)	Angola	(Cardoso et al., 2016)

Table 2. Cont.

Family	Genera	Species	Reported (n)	Method of identification	Region	Reference
Babesiidae	*Babesia*	*B. bigemina, B. rossi, B. bovis*	3	Not provided	Angola	(Tawana et al., 2022)
		Babesia vogeli	1	Molecular (qPCR)	Angola	(Coimbra-Dores et al., 2020)
Theileriidae	*Theileria*	*T. mutans, T. velifera, T. ovis, T. bicornis, Theileria sp.*	5	Molecular	Huambo	(Sili et al., 2021)
		T. parva.	1	Molecular (conventional)	South of Angola	(Pascucci et al., 2011)
		Theileria spp, T. velifera, T. mutans		Not provided	Angola	(Tawana et al., 2022)
		T. velifera	1	Molecular	South of Angola	(Qiu et al., 2022)
		Theileria spp.		Molecular	Bié	(Kubelová et al., 2012)
	Rickettsia	*Rickettsia spp., Rickettsia africae, R. aeschlimannii*	3	Molecular	Benguela	(Palomar et al., 2022)
Rickettsiaceae		*Rickettsia africae, R.aeschlimannii*	2	Molecular	South of Angola	(Qiu et al., 2022) (Tawana et al., 2022)
		Rickettsia spp		Molecular	Angola	(Coimbra-Dores et al., 2020)

Table 2. Cont.

Family	Genera	Species	Reported (n)	Method of identification	Region	Reference
Anaplasmataceae	*Ehrlichia*	*E. canis*	1	Molecular	Luanda	(Oliveira et al., 2018;
		E. canis	1	Molecular	Huambo	(Sili et al., 2021)
		Ehrlichia spp., Ehrlichia canis	2	Molecular	Benguela	(Palomar et al., 2022)
		E. canis	1	Molecular	Luanda	(Cardoso et al., 2016)
		E. ruminantium	1	Molecular	South of Angola	(Pascucci et al., 2011)
		E. ruminantium	1	Not provided	Huila	(Gomes et al., 1993),
		E. ruminantium	1	Not provided	Angola	(Walker & Olwage, 1987)
		E. ruminantium	1	Molecular	Bié	(Kubelová et al., 2012)
		Ehrlichia sp. Ehrlichia minasensis	2	Molecular	South of Angola	(Qiu et al., 2022;
		E. canis	1	Molecular	Angola	(Coimbra-Dores et al., 2020)
		E. ruminatium	1	Not provided	Angola	(Tawana et al., 2022)
	Coxiella	*Coxiella spp.*	1	Molecular	Benguela	(Palomar et al., 2022)
	Hepatozoon	*Hepatozoon spp.*	1	Molecular	Angola	(Coimbra-Dores et al., 2020)
		H. felis	1	Molecular	Luanda	(Oliveira et al., 2018)
		H.canis	1	Molecular	Luanda	(Cardoso et al., 2016)
		Hepatozoon canis	1	Molecular	South of Angola	(Qiu et al., 2022)
	Candidatus	*Candidatus Midichloria mitochondrii*	1	Molecular	South of Angola	(Qiu et al., 2022)
	Francisella	*Francisella sp.*	1	Molecular	Benguela	(Palomar et al., 2022)
	Spiroplasma	*Spiroplasma spp.*	1	Molecular	Benguela	(Palomar et al., 2022)