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ORIGINAL ARTICLE

DIVERSITY AND SPECIES DISTRIBUTION OF *HYALOMMA* C. L. KOCH, 1844 (IXODIDA, IXODIDAE) INFESTING LIVESTOCK IN DIYALA PROVINCE, CENTRAL OF IRAQ

Noora D. Abed and Nagham Y. Albayati♦

Dep. of Biology, College of Education for Pure Science, University of Diyala, Diyala, Iraq
♦Corresponding author: nagham.alfadaam@uodiyala.edu.iq

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ABSTRACT

Due to the increase in tick-borne diseases globally, this investigation was proposed to investigate the distribution and intensity of the species belonging to *Hyalomma* C. L. Koch, 1844 that have been infesting livestock in Diyala Province, central of Iraq. The total percentage of infestation was 14.955% distributed as 19.600% for cow, 12.254% for sheep, and 29.411% for goat. The infestation varies among the districts of Diyala Province, and the highest infestation was in females compared with males, and it was distributed in different sites of animal bodies. The study concludes that the genus *Hyalomma* is widespread in all districts of the province and that there are six species belonging to this genus, including: *Hyalomma anatolicum* Koch, 1844, *H. exacavatum* Koch, 1844, *H. impeltatum* Schulze & Schlottke, 1930, *H. marginatum* C. L. Koch, 1844, *H. rufipes* C. L. Koch,1844, and *H. scupense* Schulze, 1919.

Keywords: Cattle, *Hyalomma*, Ixodidae, Livestock, Ticks.

INTRODUCTION

The infestation with ticks is a relevant topic for interested farmers and researchers because it leads to the exposure of dairy livestock to pathogenic microorganisms, causing much damage to these animals and to human economics (Madison-Antenucci *et al*., 2020).

Ticks are ectoparasites that are hematophagous, and as they attach themselves to the legs, neck, lower abdomen, udder areas, or places characterized by abundant blood vessels (Evans *et al*., 2024), they cause direct and indirect damage to both domestic and wild animals in addition to humans (Monoldorova *et al*., 2024). They lead to a loss of blood and cause harm to detrimental skin by puncturing and digging, irritation, as well as they cause weight loss, and reduced meat and dairy production (Hatem, 2020; Perveen *et al*., 2021), along with causing allergies of their hosts, so the infestation of ticks is associated with anemia, weakness

(since the adult female tick causes a loss of 0.5-2 ml of blood per day, resulting in a loss of 1 gram of body weight), and suppression of immunity (Barros *et al*., 2024).

Age, gender, and breed are factors that also affect susceptibility to infection (Mandloi *et al*., 2024). Infection with cattle tick fever (CTF), a viral fever transmitted by ticks, leads to the death of many cattle (Barros *et al*., 2024). Crimean-Congo Hemorrhagic Fever (CCHF) is one of the deadliest diseases that causes death in animals and humans, which is transmitted by ticks in more than 30 countries in Asia, Africa, Europe, and the Middle East. The disease records more than 10,000 cases annually, and the fever causes approximately 500 deaths worldwide, according to World Health Organization reports (Frank *et al*., 2024).

It has been reported that more than 950 species of ticks have been discovered, which belong to different genera and families, but it has been noted that the most common species of tick spreading Crimean-Congo hemorrhagic fever is the *Hyalomma* species. The genus *Hyalomma* of the family Ixodidae is the most common in the majority of the world, including Iraq (Al-Bayati and Al-Bayati, 2024; Kaya *et al*., 2024). *Hyalomma* followed by *Rhipicephalus* species are the most common tick in Iraq, both genera species are common parasites of sheep, cattle, buffalo, goats, camels, horses, and donkeys (Makawi and Hadi, 2023; Hadi, 2024; Kokas and Al-Hasnawy, 2024). Tick infestation among these diseases is a major risk to livestock health and animal productivity in Diyala Province (Hasson, 2016); therefore, the present study was conducted to identify the species of *Hyalomma* ticks in this province, their infestation intensity, and what affects their distribution.

MATERIALS AND METHODS

Study area: The Diyala Province, located in northeast Iraq, is specialized in its agricultural sector. It is composed of six districts commonly referred to as Baqubah, Al-Miqdadiyah, Al-Khalis, Khanaqin, Balad Ruz, and Kifri.

Specimens' collection: During the study, 500 tick specimens were randomly collected from 896 livestock, distributed between 250 cows, 612 sheep, and 34 goats, during the period from October 2023 to June 2024. Specimens were collected from several parts of the animals' bodies, including the head, tail, udder, legs, abdomen, and genitalia. The specimens were removed from the host manually using forceps and placed in test tubes with hermetically sealed caps containing 97% ethanol. Ticks were removed from the host with extreme care to avoid damage to the host's skin and to ensure that the tick's head did not break off inside the host's skin. Information about each animal including: age, sex, location of infestation, and name of localities were recorded.

Ticks' identification: During the study, 500 tick specimens were randomly collected from the above-mentioned study sites of Diyala Province. The ticks were diagnosed based on Walker (2003) and Hassan and Al-Zubaidi (2014), then the specimens' identification was assured by Iraq Natural History Research Center and Museum- University of Baghdad.

Statistical analysis: For statistical analysis a Chi-Square test was used to compare the infection status (infested versus non-infested) between groups of animals, determining if the observed differences in infestation rate between these groups were statistically significant or simply due to random chance. Statistically significant differences were considered when p value <0.05.

RESULTS

In this study, there were six species belonging to the genus *Hyalomma* were recorded, these species are listed below: *Hyalomma anatolicum* Koch, 1844, *H. exacavatum* Koch, 1844, *H. impeltatum* Schulze & Schlottke, 1930, *H. marginatum* C. L. Koch, 1844, *H. rufipes* C. L. Koch,1844, and *H. scupense* Schulze, 1919

The total percentage of infestation among the 896 examined animals was 14.955%, it was distributed as follows: 19.600% for cow, 12.254% for sheep, and 29.411% for goat with significant differences among animals' groups (Tab. 1). The total intensity of infestation was 3.269 ticks for the animal. In cows, the intensity of infection was 2.693 ticks per animal, while in sheep and goat it was 3 .693 and 2.900 ticks per animal, respectively. Diagram (1) shows the numbers of infested animals in comparison with non-infested animals.

Table (1): Types of livestock, intensity of infestation, numbers of ticks, and infestation percentage during the present survey.

Types of livestock	The examined Animals	Livestock infested	Intensity of infestation	Number of ticks	The percentage %
Cow	250	49	2.693	132	19.600
Sheep	612	75	3.693	277	12.254
Goat	34	10	2.900	29	29.411
Total	896	134	3.269	438	14.955
Chi Square	Value :13.336a Asymptotic Significance (2-sided):0.001				

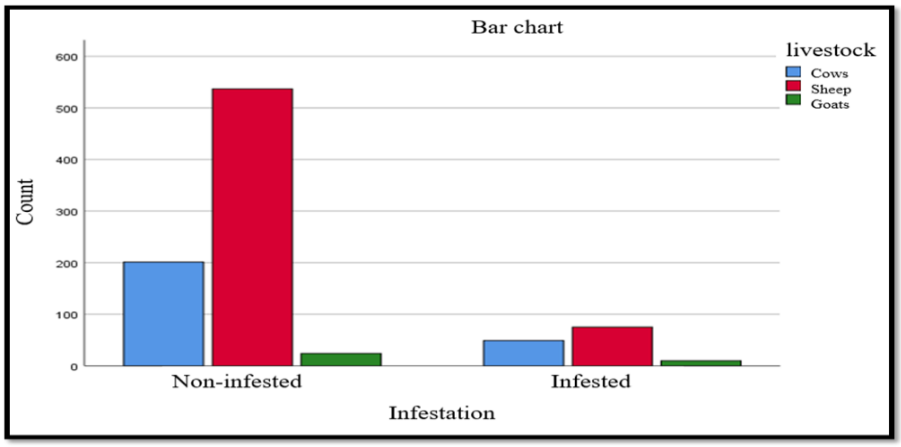

Diagram (1): Comparison between numbers of infested and non-infested animals.

Diversity and species distribution

As for the distribution of infestation among animals in the different Districts of Diyala Province, the highest infestations were recorded in Baqubah District for cows (21.987%), and the lowest in Al-Khalis District. On the contrary, it was found in sheep. The highest infestations among sheep were in Al-Khalis District (23.809%) and the lowest in Baqubah (8.533%). As for goats, infestations were the highest in Balad Ruz (42.857%), while the lowest percentage of infestation was in Al-Miqdadiyah with 20%. It can be noted that no infestations were recorded in the Khanaqin District due to the lack of tested samples in this district, statistical analysis was significant for different areas as shown in Table (2).

Table (2): Distribution of infestation in some districts of Diyala Province.

Types of livestock	Districts	Examined livestock	Livestock infested	Percentage %
Cow	Baqubah	91	20	21.987
	Al-Miqdadiyah	111	22	19.819
	Al-Khalis	15	2	13.333
	Khanaqin	5	1	20.000
	Balad Ruz	28	4	14.285
Sheep	Baqubah	375	32	8.533
	Al-Miqdadiyah	52	6	11.538
	Al-Khalis	63	15	23.809
	Khanaqin	31	6	19.354
	Balad Ruz	91	16	17.582
Goat	Baqubah	19	5	26.315
	Al-Miqdadiyah	5	1	20.000
	Al-Khalis	3	1	33.333
	Khanaqin	0	0	0
	Balad Ruz	7	3	42.857
Chi Square	Value: 154.606a	Asymptotic Significance (2-sided):0.000		

The numbers and percentages of infestation in female animals were higher than in males [102 (76.119%) for females vs. 32(23.881%) for males] as shown in Table (3). Cows were the most infested by ticks among the animals studied, with 87.795%, while goats had the lowest infestation rate, 60% among infested females. Male goats had the highest infestation rate (40%), while male cows (bulls) had the lowest infestation rate (10.204%). Statistical analysis shows that there was significant between males and females it was tend to females.

Table (3): Tick infestation depends on livestock sex.

Types of livestock	**Livestock infested**	**Percentage and sex**			
		Females	**%**	**Males**	**%**
Cow	49	44	89.796	5	10.204
Sheep	75	52	69.333	23	30.667
Goat	10	6	60.000	4	40.000
Total	134	102	76.119	32	23.881
Chi-Square	Value: 8.371a	Asymptotic Significance (2-sided): 0.015			

The most preferred areas for ticks to infest were the tail (41.045%), as shown in Table (4), followed by the udder (23.880%), while the limbs were the least preferred areas (5.970%). For cows, the udder was the most infested area (40.816%), while for sheep, the tail was the most infested (58.666%), and for goats, the head was the most infested (40.000%). Statistical analysis shows that it was significant according to the location of infestation.

Table (4): Location of infestation on livestock bodies and its percentage.

Types of livestock	Location of infestation											
	Genitalia	%	Tail	%	livestock limbs	%	Udder	%	Abdomen	%	Head	%
Cows	4	18.163	8	16.326	5	10.204	20	40.816	6	12.244	6	12.244
Sheep	0	0	44	58.666	3	4	11	14.666	10	13.333	7	9.333
Goats	0	0	3	30.000	0	0	1	10.000	2	20.000	4	40.000
Total	4	2.985	55	41.045	8	5.970	32	23.880	18	13.432	17	12.686
Chi-Square	Value: 83.483a							Asymptotic Significance (2-sided): 0.000				

DISCUSSION

In the present study, six species belonging to the genus *Hyalomma* were identified among farm animals (cows, sheep, and goats). This agrees with previous studies, indicating that the central provinces of Iraq are more suitable for Ixodida ticks, including this genus (Mohammad, 2016; Shanan *et al*., 2017). In Diyala Province, *Hyalomma* ticks infest farm animals such as cows and sheep, and have been recorded to be the prevalent ticks. In their study, Al Bayati and Al Bayati (2024) recorded six species including *H. anatolicum*, *H. exacavatum*, *H. marginatum*, *H. scupenes, H. trunicatum*, and *H. rufipes*. This is consistent with the current study with respect to all recorded species except *H. trunicatum* which was replaced by *H. impeltatum*.

The domestic hosts such as sheep, goats, and camels are present in the region, providing potential hosts for the ticks. Camels are greatly infested by *Hyalomma* species (Al-Salihi *et al*., 2018). As well as *Hyalomma* ticks are ecologically suited to central Iraqi conditions and sustain their broad dispersal. Added to that, climatic variation in the area shows a cyclical rise

in activity synchronized with high times of the period, such that they peak between spring and fall, being higher (Mohammad *et al*., 2020; Kodama *et al*., 2025).

The total percentage of infestation in the present study was 14.599% (Table 1). When compared with previous studies in Iraq, this rate is lower than the infestation levels reported in Dhi Qar and Muthanna Provinces (59.65%), where *Hyalomma* ticks were predominant (Mohammed *et al*., 2020). Weather patterns in these regions create favorable conditions for hard ticks, and research indicates that several genera and species are particularly common in Africa and the Middle East. The richness and composition of these species are largely influenced by environmental variation and fluctuations in host abundance (Makwarela *et al*., 2024).

Regarding infestation intensity, the overall intensity of ticks on goats reported in previous studies ranged from 6.8 ticks per goat (Estrada-Peña, 2008; Modammad, 2016) to 4.49 ticks per goat in Baghdad (Mohammad *et al*., 2020). Tick intensity varies by host species and tick genus. In Basrah Province, Hatem (2020) recorded a mean intensity of *Rhipicephalus sanguineus* Latreille, 1806 of 5.82 ticks per infested dog, 6.37 in sheep, 5.71 in goats, 6.29 in cattle, and 2.33 in horses. The current study agrees with Hatem (2020) in that sheep were the animals with the highest infestation density.

As for the distribution of infestation among animals in the different districts of Diyala Province, the rates of tick infestation varied between the districts under study, and there was no specific pattern to which this variation could be attributed. This is what was noted in Table (2), as the number of animals examined did not play a role in this variation. These regions are characterized by their agricultural nature and similar climates. However, this difference may be due to overcrowding on the farms where the animals were examined, the lack of overcrowding, and the nature of the grass on which the animals graze.

Adult ticks prefer many mammalian hosts, but they prefer large animals. Livestock such as cows, sheep, goats, and camels are among the preferred hosts of ticks, including the genus of *Hyalomma* (Valcárcel *et al*., 2023). The infection rates of these animals may vary from one to another. In the current study, it was found that the infestation among sheep was the highest. This may be since sheep may provide a more suitable environment for tick attachment and feeding as the wool covering the sheep provides protection for ticks from the effect of the animal's attempt to remove the tick from its body cows and goats cover their bodies with hair, which is less dense than sheep's wool (Marufu *et al*., 2011). Also, the nature of the skin may influence the rate of infestation. Hussain *et al*. (2023) indicated that the lower infestation rate among ruminants could be due to the extra care they take, as they are a major source of milk and meat in Pakistan. In addition, the tick infestation rate varies depending on the local climatic and environmental conditions, such as temperature, humidity, and the presence of host animals.

Tick infestations are higher in female cattle because hormonal changes in lactation and reproduction can suppress the immune response. The nutritional and physiological demand of

a lactating cow is relatively higher, and so is the chance of getting infested with the tick compared to non-lactating female cattle or male cattle (Bilkis *et al*., 2011). There may be male-female variations in grazing or resting, and females may be more prone to certain host environments with heavier ticks (Hatem and AbdulKarim, 2023; Valcárcel *et al*., 2023).

Cattle are larger, providing more substantial blood meals for ticks, which is crucial for their reproduction and survival. This makes them a more attractive host, and the ticks are distributed on different sites on the animal's body. In the current study, the infestation of ticks varied among different sites on animals' bodies. It was recorded that the most preferred areas for ticks to infect were the tail, as shown in Table (4), followed by the udder, while the limbs were the least preferred areas. For cows, the udder was the most infected area, while for sheep, the tail was the most infected, and for goats, the head was the most infected. Generally, tick attachment preferences can vary based on host behavior, tick species, and environmental conditions. Some of the preferred sites for ticks are with thin skin and rich blood flow since these assure easy access to the needed substances for the tick's feeding. For example, the udder of the cow is one preferred site of *Amblyomma variegatum*, while the anal region is mostly infested by *Hyalomma rufipes* (Addo *et al*., 2024). The behavior of a certain type of animals also determines the distribution of its ticks; camels, being in the open for longer periods, stand a higher chance of being infected with ticks because of exposure. Evolutionary adaptations have geared ticks towards the selection of a few enabling sheltered areas from both grooming and environmental stressors in animals, such as the tail in sheep and the head in goats (Addo *et al*., 2024).

CONCLUSIONS

This study demonstrates that livestock in Diyala province are severely affected by a widespread and diverse infestation of the *Hyalomma* ticks. Infestation intensity was especially elevated in sheep and in female animals, emphasizing a disproportionate vulnerability within these groups. Such heavy tick loads show a serious threat to animal health and productivity. These results underscore the urgent need to develop and implement targeted, species-specific tick control programs across the province to minimize economic losses and to reduce the potential transmission of zoonotic pathogens to humans, given that this species is known to transmit diseases such as Crimean-Congo hemorrhagic fever.

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ETHICAL APROVAL

Ticks' specimens were collected in full accordance with the guidelines approved by the Research Ethics Committee of the College of Education for Pure Sciences, University of Baghdad, under protocol CEPEC/029, dated September 1, 2023.

CONFLICT OF INTEREST STATEMENT

"The author declares no conflict of interest".

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تنوع وتوزيع انواع جنس *Hyalomma* C. L. Koch, 1844 (Ixodida, Ixodidae) التي تصيب الماشية في محافظة ديالى، وسط العراق

نورا ضياء الدين عبد و نغم ياسين البياتي
قسم علوم الحياة، كلية التربية للعلوم الصرفة-جامعة ديالى، ديالى، العراق

الاستلام: 2025/7/5، المراجعة: 2025/12/5، القبول 2025/12/6، النشر: 2025/12/20

الخلاصة

نظراً لتزايد الأمراض المنقولة بالقراد عالمياً، طُرح هذا البحث لدراسة توزيع وشدة أنواع القراد من جنس *Hyalomma* C. L. Koch, 1844 التي تُصيب الماشية في محافظة ديالى، وسط العراق. بلغت النسبة الكلية للإصابة 14,955% موزعة على النحو التالي: 19.600% للأبقار، و12.254% للأغنام، و29.411% للماعز. وتختلف الإصابة بين مناطق محافظة ديالى، حيث سُجلت أعلى نسبة إصابة لدى الإناث مُقارنةً بالذكور، وتوزعت في مواقع مُختلفة من أجسام الحيوانات. وتوصلت الدراسة إلى أن انواع هذا الجنس منتشر في جميع أقضية المحافظة، وأن هناك ستة أنواع تنتمي إلى هذا الجنس وهي:

Hyalomma anatolicum Koch, 1844, *H. exacavatum* Koch, 1844, *H. impeltatum* Schulze & Schlottke, 1930, *H. marginatum* C. L. Koch, 1844, *H. rufipes* C. L. Koch,1844, and *H. scupense* Schulze, 1919.