Central Asian Journal of Veterinary Science – Astana: S. Seifullin Kazakh Agrotechnical Research University, 2026. – № 1 (013). – P.104-117.- ISSN 3135-2413, 3135-2421

doi.org/10.51452/cajvs.2026.1(013).2181
UDC 591.69-54:591.9(475.7) **Research article**

Species composition and distribution of animal ectoparasites in Kyrgyzstan

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Received: 28 March 2026 **Accepted:** 28 March 2026 **Published:** 30 March 2026

Abstract

Background and Aim. Ectoparasites represent a significant threat to animal health and may act as vectors of infectious diseases. This study aimed to determine the species composition and geographical distribution of animal ectoparasites in Kyrgyzstan.

Materials and Methods. Ectoparasites were collected from livestock, companion animals, and birds across seven regions of Kyrgyzstan (Chuy, Talas, Issyk-Kul, Jalal-Abad, Osh, Batken, and Naryn) and the city of Bishkek during 2021-2022. Sampling included cattle, goats, sheep, horses, poultry, dogs, and cats. Collected specimens were identified using standard morphological methods.

Results. A total of 5,267 ectoparasite specimens were collected, which demonstrated substantial diversity across the study areas. The tick species *Rhipicephalus turanicus* was widely distributed in most regions, except for Issyk-Kul and Talas. Several species exhibited restricted geographical distribution. Specifically, *Haemaphysalis sulcata* and *Hyalomma anatolicum* were detected exclusively in the Chuy Valley, *Dermacentor ushakovae* in the Issyk-Kul region, *Hyalomma asiaticum* in Jalal-Abad region, and *Dermacentor niveus* and *Dermacentor ushakovae* in the Naryn region. Host specificity was observed among several ectoparasite species.

Conclusion. The study identified 12 tick species of the family *Ixodidae*, 2 species of the family *Argasidae*, and 2 species of blood-sucking insects of the family *Hippoboscidae*. The findings highlight the diversity and regional specificity of ectoparasite fauna in Kyrgyzstan and provide a basis for further epidemiological surveillance and control strategies.

Keywords: animals; blood-sucking; species composition; ticks.

Introduction

Currently, ongoing changes in agricultural practices, together with climate change, are contributing to shifts in the habitats and distribution of ticks. These alterations are associated with the emergence of new natural foci of hemoparasitic diseases. This trend has been documented in numerous studies [1-3]. For instance, according to *Gubeydullina* et al., a comparative analysis of two observation periods (1966-1969 and 2007-2008) in the forests of the Volga Right Bank area of the Ulyanovsk Region demonstrated a significant reduction in the distribution range of Ixodes ricinus, accompanied by an increase in the abundance of Dermacentor reticulatus [1]. Similarly, Marques et al. reported that climate change is one of the most critical global challenges influencing the geographical distribution of vectors and pathogens, thereby increasing the risk of the spread of hemoparasitic diseases [2].

By the end of the twentieth century, the fauna of ixodid ticks in Kyrgyzstan included 42 taxa of seven genera: *Ixodes, Haemaphysalis, Anomalohimalaja, Dermacentor, Rhipicephalus, Hyalomma, Boophilus* [3]. Subendemic tick species that were registered for the first time in Kyrgyzstan are presented in the

works of domestic and Russian scientists, they include: Ixodes eldaricus (*N.A. Filippova* ,1974) [4]; Dermacentor ushakovae (*N.A. Filippova*, *I.V. Panova*,1987) [5]. *E.A. Bardzimashvili* (1990) registered the spread of new species of ixodid ticks for the fauna of the republic, such as *Ixodes kaizei, Ixodes arboricola, Ixodes lividus, Ixodes caledonicus, Ixodes semenovi* [6].

Research on the ixodid tick fauna of Northern Kyrgyzstan, including the Chuy Valley and the Issyk-Kul Basin, has shown that its current biodiversity comprises 27 species, 15 of which are ectoparasites of domestic and farm animals [7]. According to *Fedorova* [8], significant climatic and socio-economic changes have taken place both nationally and globally over recent decades.

These changes have inevitably affected the composition of ixodid tick faunal complexes, since ticks are temporary ectoparasites that spend most of their life cycle in the external environment. These changes have led to the expansion of the geographical range of certain arthropod species, such as *Rhipicephalus turanicus;* while changes in agricultural practices have resulted in the disappearance or contraction of the ranges of several previously abundant tick species, including *Haemaphysalis sulcata, H. punctata,* and others. In all natural zones, the species composition of dominant and subdominant ticks has changed in recent years. Currently, *R. turanicus* is the dominant species in the Chuy Valley, having displaced the formerly abundant *H. concinna*. In the Issyk-Kul Basin, *Dermacentor ushakovae* predominates, whereas in the high-mountain region of the Terskey Ala-Too, D. pavlovskyi is the dominant species.

Ixodid ticks are of major epidemiological and epizootiological importance as reservoirs and vectors of zoonotic pathogens and as essential components of natural foci of infectious diseases. According to *Fedorova* [7], the tick-borne infections of greatest medical and veterinary importance include tick-borne encephalitis, Lyme disease, Omsk hemorrhagic fever, Q fever, tularemia, anaplasmosis, and piroplasmosis in farm animals.

According to *Jane E. Sykes* [9], *Ixodes ricinus* and *Ixodes persulcatus* are presumed vectors of *Anaplasma phagocytophilum*, whereas *Rhipicephalus sanguineus* is considered the principal vector of *Anaplasma platys*. The author further notes that Ixodes persulcatus and *Dermacentor silvarum* serve as important vectors in Asia and Russia, although other *Ixodes* spp. may also be involved in transmission.

All *Babesia* species are transmitted by ticks with a relatively narrow host range. The primary arthropod vectors include *Ixodes ricinus*; however, in certain regions, species of the genus Rhipicephalus act as the main vectors, particularly for *Babesia bigemina* and *Babesia bovis* [10]. It has also been reported that *Rhipicephalus sanguineus, Dermacentor* spp., and *Haemaphysalis ellipticum* are capable of transmitting *Babesia canis*, whereas *Babesia gibsoni* is transmitted by *Haemaphysalis bispinosa* and *Haemaphysalis longicornis* [11].

Canine vector-borne diseases (CVBDs) represent a significant global health concern in dogs and may also pose zoonotic risks, particularly in developing countries where scientific data remain limited. In one study conducted in Tamil Nadu (southern India), blood and tick samples were collected from stray dogs to assess the prevalence of CVBD pathogens (*Anaplasma* spp., *Babesia* spp., *Ehrlichia* spp., *Hepatozoon* spp., filarioids, and *Leishmania* spp.). Of the 230 examined dogs, 229 (99.6%) were infested with ticks (mean intensity of 5.65), with *Rhipicephalus sanguineus sensu lato* and *Rhipicephalus haemaphysaloides* morphologically identified in 98.3% and 1.7% of infested animals, respectively [11]. In addition, fleas are among the most common ectoparasites of dogs and cats. Beyond causing discomfort to animals (and their owners), fleas may induce allergic dermatitis and act as vectors of pathogens and endoparasites [12].

The distribution, abundance, and vector competence of parasitiform ticks in Kyrgyzstan have not been systematically investigated over the past 30 years. During this period, substantial changes in environmental conditions and habitat structure have likely influenced the distribution of ixodid ticks, which, in turn, may have led to shifts in the species composition of pathogens responsible for vector-borne diseases. In this regard, the present study provides data on the distribution and species composition of ectoparasites in Kyrgyzstan.

Materials and Methods

The aim of this study was to investigate the species distribution of ectoparasites among farm animals, companion animals, and poultry in Kyrgyzstan. Accordingly, the objective was to assess the distribution and species composition of ectoparasites across the different regions of the country.

Ectoparasites were collected from farm animals, domestic poultry, dogs, and cats. The specimens were removed directly from the animals and preserved in 96% ethanol. Species identification was carried out at the Laboratory of Microbiology and Molecular Biology, Faculty of Veterinary Medicine, Kyrgyz National Agrarian University named after K.I. Skryabin. The collected ticks were identified using the Atlas of Animal Blood Parasites and Ixodid Ticks by V.F. Kapustin [13].

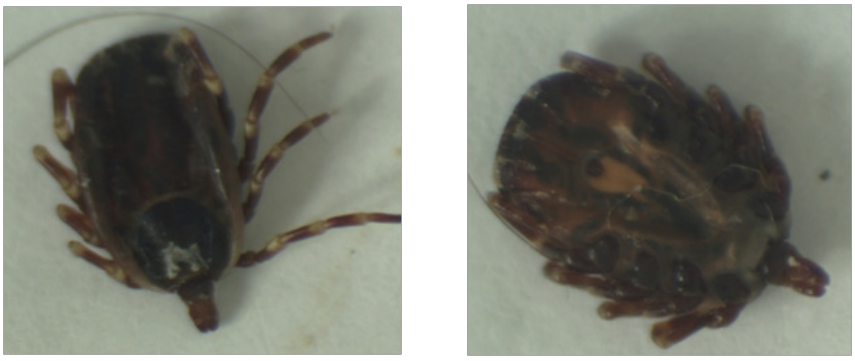
In addition, in collaboration with the Division of Vectors and Parasitic Diseases of the Republic of Korea, a molecular genetic study was performed to confirm the species identity of ixodid ticks within the framework of the research project entitled *Epidemiological Surveillance of Vector-Borne and Parasitic Diseases in Kyrgyzstan.* Microscopic examination was conducted using a stereomicroscope equipped with a VisiCam 16 Plus camera.

Results and Discussion

The principal hematophagous ectoparasites in Kyrgyzstan include ticks, horse flies, louse flies, fleas, and certain mosquito species. In the present study, particular attention was given to ticks, which appear to predominate in the republic in terms of abundance compared with other blood-feeding ectoparasites. Most ectoparasites are known to serve as carriers and disseminators of numerous infectious and parasitic diseases.

During the study, the species composition of ectoparasites, their abundance, and their distribution range were determined. In total, 5,267 ectoparasite specimens were collected during 2021-2022 from various animal species, including cattle, sheep, goats, horses, chickens, dogs, and cats. The tick species collected from animals are presented in Figures 1-9.

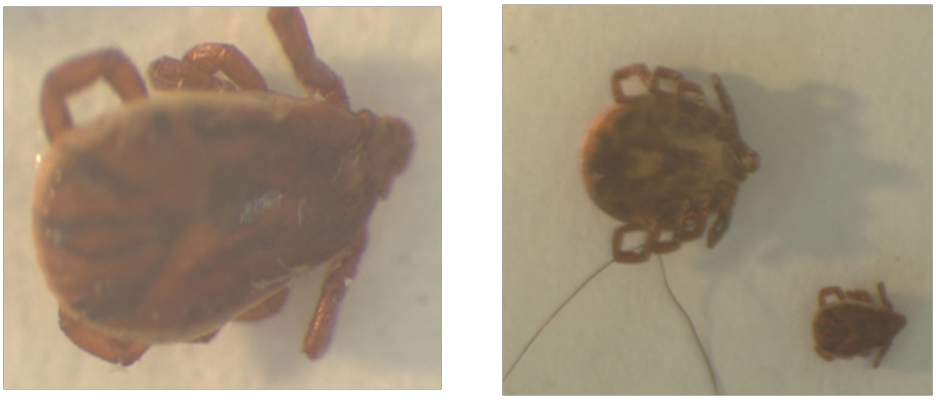
Ixodes ricinus specimens were collected in the village of Zher-Kazar, Alamudun District, Chuy Region.



Ixodes ricinus – dorsally *Ixodes ricinus – ventrally*

Figure 1. *Ixodes ricinus*

Ixodes persulcatus specimens were collected from sheep in the village of Lebedinovka, Alamudun District.



Ixodes persulcatus – dorsally *Ixodes persulcatus – ventrally*

Figure 2. *Ixodes persulcatus*

Boophilus calcaratus specimens were collected from sheep in the village of Kara-Zhigach, Alamudun District. The ticks were located predominantly in the head region. On average, 5 to 16 tick specimens were recorded per animal. Nymphs at the third developmental stage were the most frequently encountered.

Boophilus calcaratus nymph stage III – dorsally

Boophulus calcaratus nymph stage III – ventrally

Figure 3. *Boophilus calcaratus*, third-stage nymph

Hyalomma scupense specimens were collected from sheep and dogs in the village of Kashka-Suu (Ala-Archa Gorge area, Alamudun District).

Hyalomma scupense – dorsally

Hyalomma scupense – ventrally

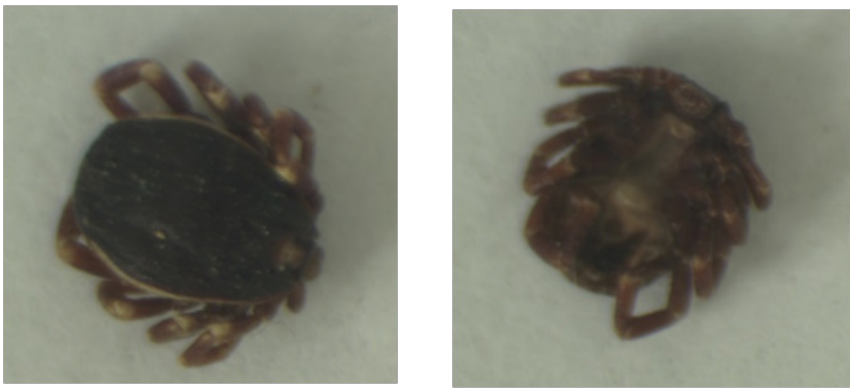
Figure 4. *Hyalomma scupense*

Ticks of the species *Dermacentor marginatus* were collected from sheep and cattle in the Tokmak region, in the village of Ak-Beshim.

Dermacentor marginatus – dorsally

Dermacentor marginatus – ventrally

Figure 5. *Dermacentor marginatus*

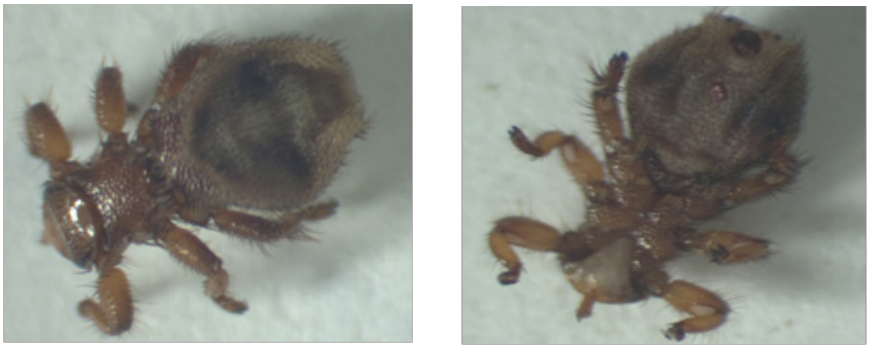


Rhipicephalus bursa – nymph, dorsally

Rhipicephalus bursa – nymph, ventrally

Figure 6. *Rhipicephalus bursa*

Louse flies of the species *Melophagus ovinus* were detected in large numbers in sheep in the village of Orto-Sai, Alamudun District. Approximately 10-15 insects were found on each sheep.

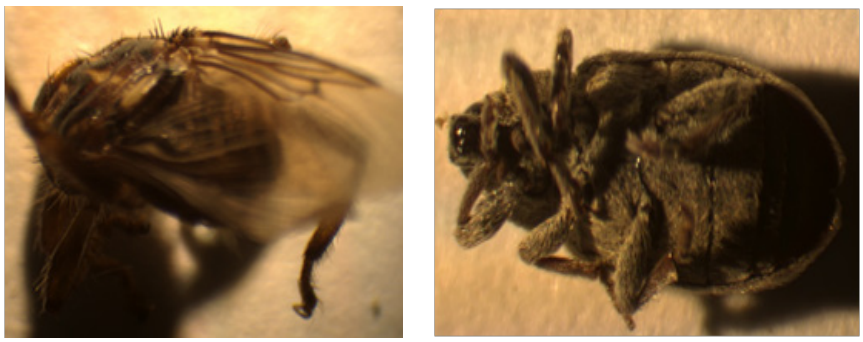


Melophagus ovinus – dorsally

Melophagus ovinus – ventrally

Figure 7. Melophagus ovinus

Among horses in the village of Orto-Sai, Alamudun District, winged blood-feeding flies of the species *Hippobosca equina* were also identified. On horses, these insects were distributed over the entire body, predominantly in the tail region. Up to 20-25 specimens were recorded per animal.



Hippobosca equina – dorsally

Hippobosca equina – ventrally

Figure 8. *Hippobosca equina*

At a veterinary clinic in Bishkek, two dogs of different breeds infested with ticks of the species *Haemaphysalis punctata* were examined. The ticks were located predominantly in the head region.

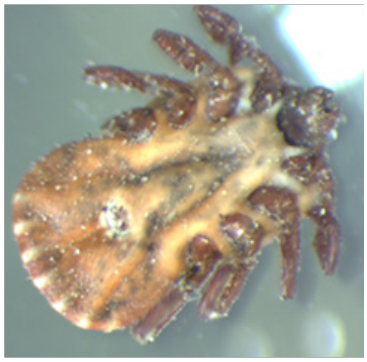


Figure 9. *Haemaphisalis punctate*

The conducted studies demonstrated the diversity of ectoparasite populations in the investigated territories, as summarized in Table 1.

Table 1. Distribution of ectoparasites across the regions of the Kyrgyz Republic

No	Regions	Animal ectoparasites
1	Bishkek	*Rhipicephalus turanicus, R.sanguineus, Haemaphysalis punctate, Ctenocephalides canis*
2	Chuy Region	*R.turanicus, H. punctata, H.sulcata, D.marginatus, Hl.marginatum, Hl.scupense, Hl.anatolicum, Boophilus annulatus, A. Lahorensis Argas persicus Melophagus ovinus Hippobosca equina*
3	Talas Region	*H. punctata, Hl.marginatum, Boophilus annulatus, A. Lahorensis Argas persicus Melophagus ovinus*
4	Issyk-KulRegion	*H. punctata, Dermacentor marginatus, D. ushakovae A. Lahorensis Melophagus ovinus*
5	Jalal-Abad Region	*Rhipicephalus turanicus, Hyalomma scupense, Hl. marginatum, Hl.asiaticum, A. lahorensis Argas persicus Melophagus ovinus*

Continuation of Table 1

6	Osh Region	*R.turanicus,* *Hl.marginatum,* *A. Lahorensis* *Argas persicus* *Melophagus ovinus*
7	Batken Region	*Rhipicephalus turanicus* *Hyalomma marginatum,* *Alveonasus lahorensis,* *Melophagus ovinus*
8	Naryn Region	*R.turanicus,* *H. punctata,* *D.niveus,* *D. ushakovae,* *D.marginatus* *Alveonasus lahorensis* *Melophagus ovinus*

As a result of the investigation of ectoparasites collected from domestic and farm animals during 2021-2022 in seven regions of the Kyrgyz Republic and the city of Bishkek, 12 species of ticks belonging to the family *Ixodidae*, two species of the family *Argasidae* (*A. lahorensis* and *Argas persicus*, highlighted in blue in the table), and two species of blood-feeding insects of the family *Hippoboscidae* (*Hippobosca equina* and *Melophagus* ovinus, highlighted in yellow in the table) were identified.

As shown in Table 1, ixodid ticks are distributed throughout all regions of the republic. According to our findings, *Rhipicephalus turanicus* occurs in all regions except the Issyk-Kul and Talas Regions. The two argasid species and representatives of the family *Hippoboscidae* were recorded across the republic. In the northern part of the country, *Dermacentor marginatus* and *Hyalomma marginatum* were frequently recorded, whereas in the southern regions, *Hyalomma marginatum* was encountered more commonly.

Over the two-year period of ectoparasite collection, several species were found only rarely and showed clear geographical restriction to specific territories. Thus, *Haemaphysalis sulcata* and *Hyalomma anatolicum* were detected only in the Chuy Valley, whereas *Dermacentor ushakovae* was recorded only in the Issyk-Kul Basin. In the Jalal-Abad Region, *Hyalomma asiaticum* was identified, while in the Naryn Region, two species restricted to this area were recorded, namely *Dermacentor niveus* and *D. ushakovae*.

The present study also demonstrated that ectoparasites exhibit a certain degree of host specificity with respect to the animals they parasitize. Table 2 presents the parasite species identified and the corresponding animal species on which they were found.

Table 2. List of ectoparasites and their hosts

No	Ectoparasites	Hosts
1	*Rhipicephalusturanicus*	dogs, cats, cattle, sheep, goats, and horses
2	*Rhipicephalus sanguineus*	dogs
3	*Haemaphysalispunctata*	cattle, sheep, horses
4	*Haemaphysalis sulcata*	cattle, sheep
5	*Dermacentormarginatus*	cattle, sheep, horses
6	*Dermacentorniveus*	dogs, cattle, sheep
7	*Dermacentorushakovae*	cattle, sheep
8	*Hyalommamarginatum*	dogs, cattle, sheep, horses
9	*Hyalomma scupense*	dogs, cattle, sheep, horses

Continuation of Table 2

10	*Hyalomma asiaticum*	cattle
11	*Hyalomma anatolicum*	cattle
12	*Boophilusannulatus*	cattle, horses
13	*Alveonasus lahorensis*	sheep, cattle
14	*Argas persicus*	hens
15	*Melophagusovinus*	sheep
16	*Hippobosca equina*	horses
17	*Ctenocephalides canis*	dogs

According to the material obtained, *Rhipicephalus turanicus* exhibited the broadest host range, being recorded on six host species. A relatively wide host range was also observed for *Haemaphysalis punctata, Hyalomma marginatum*, and *Hyalomma scupense*, each of which was found on four host species. In contrast, *Rhipicephalus sanguineus, Hyalomma asiaticum, Hyalomma anatolicum, Argas persicus, Melophagus ovinus*, and *Hippobosca equina* were identified as monoxenous species. Fleas collected from captured stray dogs belonged to the family Pulicidae and were identified as *Ctenocephalides canis.*

To investigate the prevalence of ectoparasites within a natural focus, parasite collection was carried out during the period of their seasonal activity at selected sites in the Chuy Valley, as presented in Table 3.

Table 3. Summary data on the abundance of ticks collected from animals in the designated study area of the Chuy Valley during the period from May to November

Ticks and blood-sucking insects	Animal species	Number of ticks collected			
		larvae	nymphs	adults	total
Ixodids:	Cattle	-	6	92	98
	Sheep	-	43	188	231
	Horses	-	4	39	43
	Hens	9	11	20	40
	Dogs	2	6	31	39
Argasids:	Cattle		8	24	32
	Sheep		12	164	176
	Horses		5	24	29
	Hens	3	9	13	25
	Dogs		6	11	17
Gamasoids:	Hens	11	29	276	316
Melophagus ovinus, Hippobosca equina	Sheep	-	-	238	238
	Horses	-	-	67	67
	All species	25	139	1187	1351

The prevalence of infestation of animals with hematophagous ectoparasites in the study area was 14.3% (657/4593 × 100). A high number of ectoparasites was detected in sheep, goats, and poultry. Ixodid and argasid ticks were identified in small ruminants, with 231 and 176 specimens recorded, respectively. The extent of infestation with ixodid ticks in these animals was 34.75%, whereas the extent of infestation with argasid ticks was 12.05%. The relatively low prevalence of argasid tick infestation may be explained by the fact that during the observation period (September-November), animals were predominantly kept outdoors rather than in enclosed premises, where these ectoparasites are typically localized.

A large number of gamasid mites was collected from chickens, amounting to 316 specimens; however, the extent of infestation in poultry was 11.86%. A considerable number of louse flies was also recorded in sheep, with 238 specimens collected and an extent of infestation of 10.93%.

The results of the analysis of tick infestation in animals are presented in Table 4.

Table 4. Infestation of animals with ticks and blood-sucking insects in the study area of the Chuy Valley

Ticks and blood-sucking insects	Animal species	Number of animals examined		Total number of ticks collected	Prevalence of infestation %	Abundance index	Mean intensity of infestation
		Total	Number of infested animals				
Ixodids	Cattle	110	43	98	39.1	0.89	2.28
	Sheep	751	261	231	34.8	0.3	0.89
	Horses	139	13	41	9.4	0.3	3.15
	Hens	677	14	40	2.1	0.06	2.86
	Dogs	118	24	39	20.3	0.3	1.6
	Total	1795	355	449	19.8	0.25	1.36
Argasids	Cattle	185	9	32	4.8	0.17	3.6
	Sheep	846	102	186	12,1	0.22	1.2
	Horses	151	8	29	5.3	0.19	3.6
	Hens	13	5	25	38.5	1.9	5
	Dogs	2	2	17			
Gamasoids	Hens	700	83	316	11.8	0.45	3.8
Blood-sucking flies	Sheep	750	82	238	10.9	0.32	2.9
	Horses	151	11	67	7.3	0.44	6.1

As shown in Table 4, cattle exhibited a high prevalence of infestation with ixodid ticks (39.1%). At the same time, the abundance index of ectoparasites among the examined animals was 0.89, while the mean intensity of tick infestation was 2.28. The intensity of infestation reached up to 23 tick specimens per animal. A relatively high prevalence of ixodid tick infestation was also observed in small ruminants; however, both the abundance index (0.3) and mean intensity (0.89) were considerably lower than those recorded in cattle. Horses also showed a high mean intensity of infestation with ixodid ticks (3.15), reaching up to 13 specimens per animal. In addition, a high mean intensity of ixodid tick infestation was recorded in poultry (2.86).

Infestation with argasid ticks was comparatively high in poultry, with a prevalence of 38.5%, an abundance index of 1.9, and a mean intensity of infestation of 5. Among small ruminants, the prevalence of infestation with these ticks was 12.1%, while the abundance index was 0.22 and the mean intensity was 1.2. Cattle and horses showed almost similar levels of infestation with argasid ticks: prevalence was 4.8% and 5.3%, respectively; the abundance index was 0.17 and 0.19, respectively; and the mean intensity was 3.6 in both animal species.

A high level of infestation with gamasid mites was recorded in poultry, with a prevalence of 11.8%, an abundance index of 0.45, and a mean intensity of 3.8.

Blood-sucking flies were identified in small ruminants and horses. In small ruminants, the prevalence of infestation with these parasites was 10.9%, the abundance index was 0.32, and the mean intensity of infestation was 2.9. In horses, the prevalence was 7.3%, the abundance index was 0.44, and the mean intensity was 6.1. In some cases, more than 20 specimens of blood-sucking flies were detected on a single animal.

Figure 10 illustrates the percentage of infestation with ixodid ticks in different animal species.

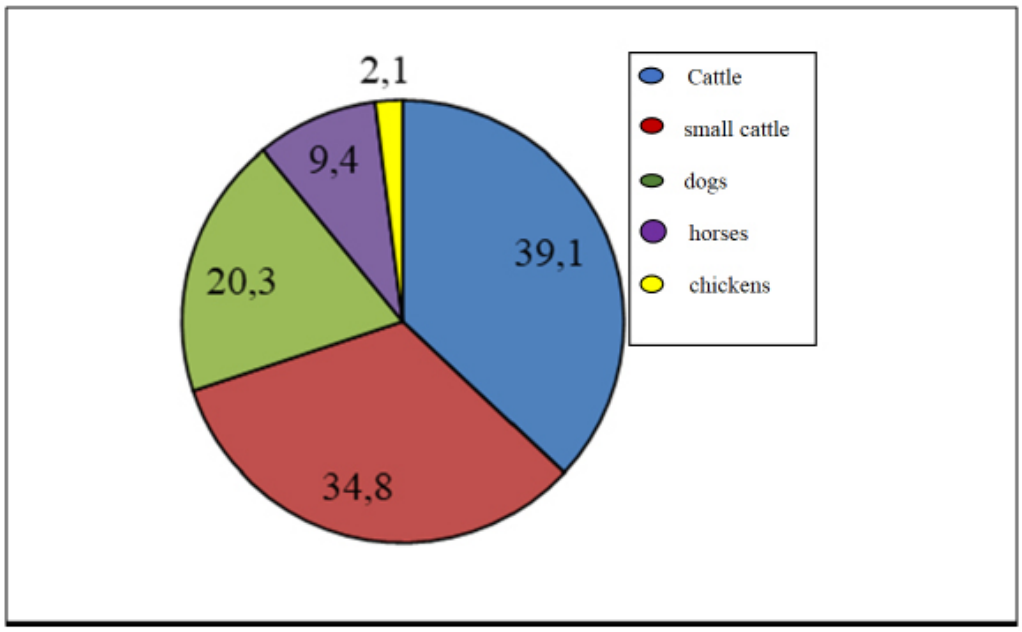


Figure 10. Prevalence of ixodid tick infestation in different animal species

The chart clearly illustrates the prevalence of ixodid tick infestation among the examined animals. The highest prevalence was observed in cattle (39.1%) and small ruminants (34.8%). In dogs, the prevalence of infestation was 20.3%. By contrast, horses and chickens showed relatively low levels of infestation with ixodid ticks, at 9.4% and 2.1%, respectively.

For visual comparison of argasid tick infestation in different animal species, the corresponding chart is presented in Figure 11.

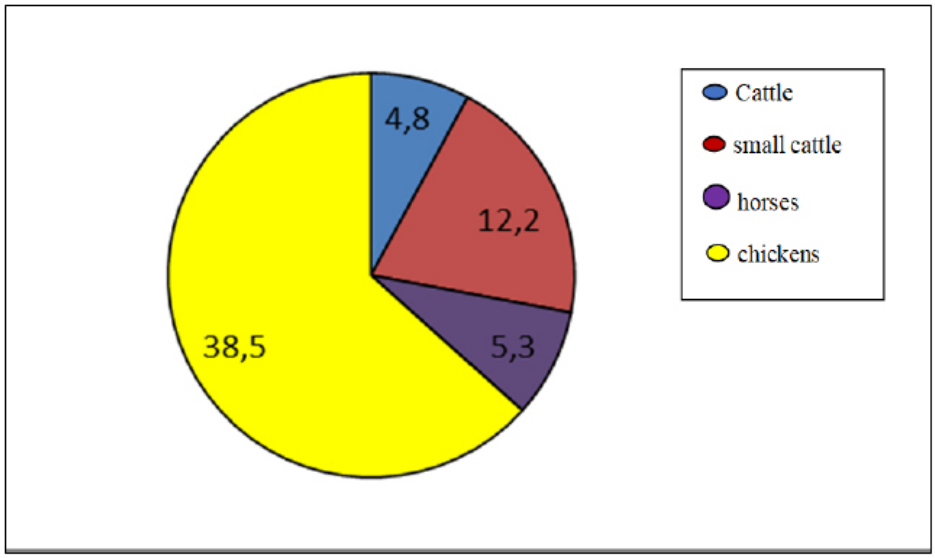


Figure 11. Diagram of the prevalence of argasid tick infestation in different animal species

The diagram of prevalence of argasid tick infestation shows that the highest proportion of infested animals was recorded in poultry (38.5%), which is apparently associated with the permanent housing of chickens in poultry shelters and the seasonal activity of argasid parasites. Considerably lower prevalence values were observed in small ruminants (12.2%), horses (5.3%), and cattle (4.8%). The relatively low infestation with argasid ticks may be explained by the fact that tick collection was carried out from late September, when the first specimens began to appear on animals, until November, when animals were still predominantly kept outdoors rather than in enclosed premises where these parasites are usually localized.

As demonstrated by the present study, ectoparasites are widely distributed in Kyrgyzstan and are represented by a diverse range of taxa, including ticks, horseflies, louse flies, fleas, and mosquitoes. Each group of these blood-feeding arthropods occupies its own ecological niche and poses a different epidemiological threat. Among them, ticks represent the greatest concern, with ixodid ticks being the principal vectors of transmissible infections. As a result of the investigations conducted in the republic, 12 species of ticks belonging to the family *Ixodidae*, two species of the family *Argasidae*, and two species of blood-feeding insects of the family *Hippoboscidae* were identified.

Certain ectoparasite species were found to be widely distributed in Kyrgyzstan and were recorded more frequently than others among animal hosts. The dominant species among ixodid ticks were *Rhipicephalus turanicus, Haemaphysalis punctata, Hyalomma marginatum,* and *Dermacentor marginatus.* Among argasid ticks, *Argas persicus* was the dominant species, whereas *Melophagus ovinus* predominated among blood-sucking insects.

According to our findings, *Rhipicephalus turanicus* was distributed throughout all regions except the Issyk-Kul and Talas Regions. The two argasid species and members of the family *Hippoboscidae* were recorded across the republic. In the northern part of the country, *Dermacentor marginatus* and *Hyalomma marginatum* were frequently encountered, whereas in the southern Over the two-year period of ectoparasite collection, several species were encountered only rarely and exhibited a clear association with specific territories, suggesting local endemism. Thus, *Haemaphysalis sulcata* and *Hyalomma anatolicum* were detected only in the Chuy Valley, whereas *Dermacentor ushakovae* was found only in the Issyk-Kul Basin. In the Jalal-Abad Region, *Hyalomma asiaticum* was identified, while in the Naryn Region two species restricted to this area were recorded, namely *Dermacentor niveus* and *D. ushakovae*.

The present study demonstrated that ectoparasites show a certain degree of host specificity with respect to the animals they parasitize. According to the material obtained, *Rhipicephalus turanicus* exhibited the broadest host range, having been recorded on six host species. A relatively broad host range was also observed for *Haemaphysalis punctata, Hyalomma marginatum,* and *Hyalomma scupense*, each of which was found on four host species. In contrast, *Rhipicephalus sanguineus, Hyalomma asiaticum, Hyalomma anatolicum, Argas persicus, Melophagus ovinus,* and *Hippobosca equina* were identified as monoxenous species. Fleas collected from captured stray dogs belonged to the family *Pulicidae* and were identified as *Ctenocephalides canis*.

The high prevalence of infestation with ixodid ticks in cattle and small ruminants (39.1% and 34.8%, respectively) indicates a substantial level of tick infestation in these animal species within natural foci. In dogs, the prevalence of infestation was 20.3%. By contrast, horses and chickens showed lower levels of infestation with ixodid ticks, at 9.4% and 2.1%, respectively.

The findings of the present study confirm the data reported by Fedorova [8] regarding the distribution of *Rhipicephalus turanicus*. At the same time, our results demonstrated that *R. turanicus* occurs in all regions of Kyrgyzstan except the Issyk-Kul and Talas Regions. In addition, the two argasid species and representatives of the family *Hippoboscidae* were recorded throughout the republic. In the northern part of the country, *Dermacentor marginatus* and *Hyalomma marginatum* were frequently encountered, whereas in the southern regions *Hyalomma marginatum* was the predominant species. It was also established that *Haemaphysalis sulcata* and *Hyalomma anatolicum* occur only in the Chuy Valley, *Dermacentor ushakovae* in the Issyk-Kul Basin, *Hyalomma asiaticum* in the Jalal-Abad Region, and *Dermacentor niveus* in the Naryn Region.

According to published data, canine hemoparasitic diseases are associated with tick species such as *Rhipicephalus (Boophilus) microplus* [2], as well as *Rhipicephalus sanguineus* and *Rhipicephalus haemaphysaloides* [12]. In our study, however, in addition to *Rhipicephalus sanguineus, Rhipicephalus*

turanicus was also frequently recorded and was more often associated with mixed infections involving anaplasmosis and babesiosis.

In Kyrgyzstan, insufficient attention has been paid to blood-feeding flies of the family *Hippoboscidae*, although available data indicate that they may pose a certain epidemiological risk as vectors of transmissible infections. Researchers from France and the United States investigated the potential role of hippoboscid flies in the transmission of *Bartonella* among ruminants [15]. *Bartonella* was detected in 94% of the 83 examined flies, including 48 (71%) adults *Lipoptena cervi,* 17 (100%) adults *Hippobosca equina*, 20 (100%) adults *Melophagus ovinus*, and 10 pupae of *M. ovinus*. These findings suggest that members of the family *Hippoboscidae* may play a role in the transmission of *Bartonella*.

In addition, chewing lice of the family *Trichodectidae* are not uncommonly encountered among animals in Kyrgyzstan. These parasites cause considerable damage to animal husbandry by infesting domestic animals. Specifically, *Bovicola bovis* parasitizes cattle, *Bovicola ovis* sheep, *Bovicola caprae* and *Bovicola limbatus* goats, *Bovicola equi* horses, *Trichodectes canis* dogs, and *Felicola subrostratus* cats. The dog and cat chewing lice serve as intermediate hosts of the parasitic tapeworm *Dipylidium caninum*, the causative agent of dipylidiosis [16].

Blood-sucking flies are also widely distributed among animals in the republic and may pose an epidemiological threat in livestock production. Among them, *Melophagus ovinus* (the sheep ked), a hematophagous ectoparasite belonging to the family *Hippoboscidae* (Diptera: Hippoboscoidea), is particularly common and primarily parasitizes sheep. According to Chinese researchers working in southern Xinjiang, *M. ovinus* not only causes direct harm to its animal hosts but also serves as a vector of infectious agents. Using molecular biological methods, they confirmed the presence of *Anaplasma* spp. in both pupae and adult specimens of *M. ovinus*, as well as the vertical transmission of the pathogen.

Conclusions

As a result of the present study, 12 tick species belonging to the family *Ixodidae,* two species of the family Argasidae, and two species of blood-feeding insects of the family *Hippoboscidae* were identified in the republic.

The dominant ectoparasite species were as follows: among ixodid ticks, *Rhipicephalus turanicus, Haemaphysalis punctata, Hyalomma marginatum*, and *Dermacentor marginatus*; among argasid ticks, Argas persicus; among blood-sucking insects, *Melophagus ovinus*.

Rhipicephalus turanicus was distributed in all regions except the Issyk-Kul and Talas Regions.

In the northern part of the republic, *Dermacentor marginatus* and *Hyalomma marginatum* were frequently recorded, whereas in the southern regions Hyalomma marginatum was the predominant species.

Several tick species showed restricted territorial distribution:

Haemaphysalis sulcata and *Hyalomma anatolicum* in the Chuy Valley; *Dermacentor ushakovae* in the Issyk-Kul Basin; *Hyalomma asiaticum* in the Jalal-Abad Region; *Dermacentor niveus* and *D. ushakovae* in the Naryn Region.

A high prevalence of ixodid tick infestation was observed in cattle and small ruminants, amounting to 39.1% and 34.8%, respectively.

Authors' Contributions

NA and BA: conceptualized and designed the study, conducted a comprehensive literature search, analyzed the gathered data and drafted the manuscript. EJ and US: conducted the final revision and proofreading of the manuscript. All authors have read, reviewed, and approved the final manuscript.

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