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Research Article

Estimate of hard ticks parasitizing herbivorous animals in the northern Albania

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Abstract **–**Hard ticks are arthropods of the class Arachnida. They are vectors of many pathogens causing diseases not only in wild animals but also in farm animals and humans. The aim of the study was to collect and then identify hard ticks in farm and grazing animals of northern part of Albania, in the areas covered by the Regional Directorate of Veterinary and Plant Protection Shkodra, which includes the districts of Shkodra, Kukës and Lezhë. A total of 639 samples were collected and identified during their two typical seasons, 311 ticks were found on sheep, 98 on cattle's, 79 on goats and 151 ticks on equines. In the whole region, five tick genera were identified, with the most widespread being *Rhipicephalus*, followed by *Hyalomma*, *Ixodes*, *Haemaphysalis* and *Dermacentor*. Among many species of hard ticks collected, resulted that 13 species of them parasitize herbivorous animals of the area. These data confirms the presence of all species previously mentioned and reported by literature in Albania. However, their importance resides in their capacity to transmit a multitude of microbial and parasitic disease-causing agents. All hard tick species names reported in these work were recently updated by the latest parasitology literature. We also systematically revised and analyzed the current situation in the study region and highlighted future research priorities to encourage further and deeper studies on this topic and raise awareness among parasitology, veterinary and biochemistry.

Keywords –Hard Ticks, Area, Herbivorous, Season, Key, Species.

I. INTRODUCTION

Hard ticks are hematophagous ectoparasites of both wild and farm animals. They also affect humans by causing them severe infection diseases. Ticks survival is closely linked to the presence of hosts on which they feed. Infestation by ticks and the diseases transmitted by them always represent one of the most important seasonal problems for animals. The territory covered by the Regional Directorate of Veterinary and Plant Protection Shkodra, is highly diverse, ranging from the coastal areas, Lezhë and Shkodra to the Alps of Albania in Kukës, Has and Tropoja. The diversity of the areas conditions the

variability of key meteorological factors such as temperature and humidity, creating zones with distinct vegetation, which in turn affects the spread of animal hosts for hard ticks. Ticks, being ectoparasites of animal skin, manifest a dependency on the microclimate of the region and the phytocoenosis. Ticks are often biological vectors because the pathogenic agents transmitted by them must pass through a stage of their biological cycle within their host organism. Understanding the biology of ticks, and thus their behavior in different environments and seasons, is crucial to understand their direct pathogenic role and particularly their indirect pathogenicity, in order to update control methods and ensure that preventive plans are as effective and long-lasting as possible. Many ticks are not selective for their hosts, meaning they can also bite humans. In these areas, particularly in the Kukës region, the phenomenon of human infection with the hemorrhagic fever virus is well-known, with ticks of the *Hyalomma* genus serving as vectors. These decade several sdudies has been conducted by Albanian authors [4], [5], [6] to detect and identify ticks species in dogs an only a few studies were focused in domestic and wild animals [1], [3]. So the aim of the study was to detect and identify the hard ticks species that affect domestic animals from Shkodra district.

II. MATERIALS AND METHOD

The ticks were identified using the Optica WF 10 x 22 digital stereomicroscope, utilizing the keys used by Bizhga (2024) [5] with the identification key.

Genus *Rhipicephalus* are typically without markings, equipped with eyes and festoons. The rostrum is short. The base of the capitulum is hexagonal dorsally, and the first pair of coxae are separated. Males have two pairs of ventral setae and a caudal extension. The peritremes are comma-shaped, short in females and elongated in males. The first coxae have two large and equal spines. The male measures about 2 mm in length, while the female is 12-15 mm long. The following species from this genus are of importance: *Rhipicephalus bursa* is characterized by both sexes having two scutal plates with rounded, uniform tips on the dorsal scutum. The scutum color is dark, with medium-sized punctations, densely distributed. The setiferous punctations are unclear. The eyes are visibly convex. The caudal part of the genital opening is V-shaped and narrow. The additional adanal plates are small in males. The shape of the adanal plates is wide and curved. The caudal extension is not clearly visible. *Rhipicephalus bursa* is a two-host tick with a 1-year life cycle. All developmental stages feed on sheep, goats, cattle, horses, donkeys, and occasionally wild ungulates, though the preferred hosts are sheep and goats. *Rhipicephalus turanicus* parasitizes cattle, sheep, dogs, and rarely horses. It has two scutal plates with punctuations like *R. bursa*, but more pronounced. What distinguishes it is the presence of four longitudinal rows of very distinct punctations on a somewhat straight scutum. The cervical field shape is large and curved. The scutum is dark in color. The size of the punctations is small on average, and their distribution is sparse. The setiferous punctations are distinguishable. The eyes are flat. The caudal part of the genital opening is U-shaped and narrow. The additional adanal plates are large in males. The shape of the adanal plates is narrow and trapezoidal. The caudal extension is wide and distinct. *Rhipicephalus sanguineus* parasitizes dogs and rarely cattle. The cervical field shape is large and straight. The scutum is pale. The size of the punctations is small on average, and the distribution is sparse. The punctuations near the eyes are unclear. The eyes are slightly convex. The caudal part of the genital opening is V- or U-shaped and wide. The additional adanal plates are large in males. The shape of the adanal plates is narrow and trapezoidal. The caudal extension is wide and appears as a slight swelling. The genus *Boophilus* is considered a subgroup of *Rhipicephalus*. The size of unfed ticks ranges from 2 to 3 mm, including the mouthparts. The lateral groove is absent. The texture of the integument has striae. The mouthparts are directed forward. The palp articles are all small. The base of the capitulum has angular lateral lips. The legs are thin and lack pale rings. The scutum is present in females (a concutum in males). The enamel is absent in the scutum and conscutum. The eyes are present but unclear (very unclear in males). Festoons are absent in both females

and males. The spiracular plates are large and posterior to the legs. The spiracular cups are distributed across the spiracular plates. The ventral plates are present only in males. The anal groove is unclear (it is behind the anus if visible). The fourth coxae are of normal size. The first coxae have small paired spines (very small in both females and males). The genital opening of females is a small U- or V-shape. Genus *Hyalomma* ticks are hard ticks with eyes, metastriata, with a non-glossy scutum and a uniform color. The second palp segment is at least twice as long as the third, the first coxae are split into two parts, and males have a ventral scutum. Festoons may be present or absent. They generally lack markings, but sometimes they may have them. In males, one pair of ventral setae can be observed near the anus, and sometimes accessory setae. Their legs are long, with pale rings at the articulations. Peritremes are usually comma-shaped. The male is 4-5.5 mm long, while the female is 20 mm long. *Hyalomma marginatum* parasitizes cattle, sheep, goats, and horses. Males are larger, darker, and have well-developed subanal scutal plates. The size of the punctuations is small, and the distribution of the spots is sparse. The scutum and conscutum are dark in color. The color of the legs is light with pale rings. The depression of the cervical field is noticeable. The central festoon is dark in color. The shape of the adanal plates has square edges. *Hyalomma anatolicum* parasitizes cattle, sheep, goats, horses, and equines. Males are smaller, with rudimentary subanal scutal plates. The scutum and alloscutum are light-colored. The legs are pale with unclear rings. The size of the punctuations is small, and their distribution is sparse. The depression of the cervical field is noticeable. The central festoon is dark in color. The shape of the adanal plates has a rounded end. *Hyalomma detritum* is an endophilic polymorphic species with different ecological preferences and life cycles. It parasitizes cattle, sheep, horses, and goats. The scutum and alloscutum are dark in color. The legs are without pale rings, having a yellow-orange color, and are extremely long. The size of the punctuations is small, and their distribution is sparse. The depression of the cervical field is noticeable but small. The central festoon is pale in color. The shape of the adanal plates has square edges. *Hyalomma aegyptium* parasitizes tortoises, hedgehogs, horses, dogs, and is a three-host tick with an extremely long feeding period [4]. All stages, but especially adults, are highly host-specific and feed primarily on tortoises. Occasionally, *Hyalomma aegyptium* immatures are found on other animals and humans [1], [2]. The central festoon is slightly pale. The depression of the cervical field is noticeable in females, while in males, it is unclear. The two spines of coxae 1 are large and equal. In females, the punctuations are large and sparse, while in males, they are rare and unclear. The legs have pale articulations. The scutum and conscutum are dark in color. Genus *Ixodes* -males range in size from 1.5 to 2 mm, while females range from 7 to 12 mm. These are ticks with a long rostrum, without eyes, without festoons, and the anal groove extends before the anus. The first coxae have only one spine, and their legs do not have pale rings. Ventral plates are present only in males. A confirmed species in our country is *Ixodes ricinus*, a three-host tick that parasitizes all types of hosts and is also called the sheep tick. The tarsi are narrowed toward the claws, and the punctuations are distinguishable. *Ixodes gibbosus* parasitizes all types of hosts. The tarsi are laterally expanded toward the claws. The punctuations are indistinct. *Genus Haemaphysalis* are exophilic ticks with a short rostrum, a quadrilateral capitulum base, no eyes, and festoons. Males do not have ventral plates. The anal groove extends behind the anus. The first coxae have only one spine. The palps are short and conical in shape, with the second element being very wide. In females, the peritremes are oval or comma-shaped, while in males, they are oval. Males range from 1 to 3.5 mm, and females from 12 to 14 mm. *Haemaphysalis sulcata* is a three-host exophilic tick. It parasitizes small ruminants, primarily sheep. Adults mostly feed on domestic and wild ungulates, while immature ticks have a special preference for reptiles. There is one spine present on the ventral side of the palps. From coxae 1 to 3, the spines are short, and the spine on coxa 4 is absent. It has 9 festoons, with each lateral groove having a closed festoon. The punctuations are rare. In males, the spine on coxa 4 bends laterally. *Haemaphysalis puncta* parasitizes sheep, cattle, goats, and horses. There is no spine on the ventral part of the palps. The spines on coxae 1 to 3 are of medium size, and the spine on coxa 4 is

distinguishable. It has 11 festoons, with 3 closed festoons in each lateral groove in females. The distribution of the punctuations is dense. In males, the spine on coxa 4 bends medially. There are 2 closed festoons from each lateral groove in males. *Haemaphysalis inermis* parasitizes cattle, horses, sheep, dogs, foxes, and hedgehogs. The spines on coxae 1 to 4 are small but visible. The scutum and alloscutum are pale. The depression in the cervical field of the female's mitre is barely visible, while in males, it is absent. The punctuations are small and dense. The adanal plates are very large. Genus *Dermacentor* are exophilic, metastriata, three-host ticks with decorations, a short rostrum, and a quadrilateral capitulum base. They are equipped with eyes and festoons. The first coxae are split into two parts, while the fourth coxae in males are larger than the other three. The fourth coxae are very large compared to the other coxae. Coxae 1 have two very large and equal spines. The dorsal scutum is marked with varying punctuations, while the ventral scutum is absent in males. The peritremes are oval in shape. These ticks are large, with males measuring 6-7 mm and females 10-20 mm. Of more than 10 species, only *Dermacentor marginatus* was found in our country, parasitizing cattle, sheep, goats, and occasionally dogs.

Statistical Analysis

The Chi-Square Tests, Symmetric Measures,Case Processing Summary,Season Crosstabulation was used to determine if there are statistically significant differences between two or more groups of an independent variable on a continuous variable. Since we have two seasons and multiple groups in the study, testing was used to determine which groups differ from each other.

III. RESULTS

The results of the study are given in the below tables and figures (Tab.1 and 2).

Table1. Total number of ticks identified in the study

Nr	Animal	Season		Total
		Summer (Number of Ticks)	Autumn (Number of Ticks)	
1	Sheep	154	157	311
2	Cattle	51	47	98
3	Goats	36	43	79
4	Equines	72	79	151
Sum		313	326	639

Table 2. Data on Tick Species in Herbivores in the northern part of Albania

Nr	Name	Sheep		Cattle		Goats		Equines		Tot.
		Summer	Autumn	Summer	Autumn	Summer	Autumn	Summer	Autumn	
1	*Ixodes* spp.	23	27	9	8	7	9	12	15	110
2	*Haemaphysalis* spp.	24	21	7	7	6	11	9	13	98
3	*Hyalomma* spp.	41	38	10	8	8	5	23	19	152
4	*Rhipicephalus* spp.	52	55	23	19	14	13	21	27	224
5	*Dermacentor* spp.	14	16	2	5	1	5	7	5	57
6	Sum	154	157	51	47	36	43	72	79	639

IV. DISCUSSION

From the genus *Ixodes*, we identified the species *Ixodes ricinus*, commonly known as the sheep tick. This species was observed parasitizing all types of herbivorous animals. It turned out to be the third most frequent tick species with 110 specimens. It was more prevalent in the autumn season compared to other tick species in Albania. On the hosts, this tick was found predominantly on the face and limbs, which are not covered by thick fur, and much less frequently on the abdomen, particularly in the autumn. Therefore, it was found more on body parts in contact with grass and the ground, where it is most commonly found. Out of the 110 *Ixodes* specimens, all were identified as *I. ricinus*. The highest number was found along the border of Albania and Montenegro in sheep. Of the 50 specimens found on sheep, 23 were observed in the summer, and 27 in the autumn. The same distribution was noted for other animals as well. From the genus *Haemaphysalis*, we identified the species *Haemaphysalis punctata*, *Haemaphysalis sulcata*, and *Haemaphysalis inermis*. *Haemaphysalis punctata* was identified in herbivores with nearly uniform distribution across regions and tick seasons, with a higher predisposition in the summer season, except in horses. *Haemaphysalis sulcata* was found with almost the same distribution as *Haemaphysalis punctata*. All three species of *Haemaphysalis* have a short rostrum, a four-sided capitulum base, and lack eyes. Their local distribution on hosts was primarily in the perineal region. *Haemaphysalis inermis* was found only in sheep during the autumn season. The genus *Hyalomma* was the second most widespread genus in the study area. From the genus *Hyalomma*, we identified the species *Hyalomma marginatum*, *Hyalomma anatolicum*, *Hyalomma detritum*, and *Hyalomma aegyptium* based on infestation prevalence. The species of the genus *Hyalomma* were found throughout the Shkodër region with uniform distribution across both regions and tick seasons. Parasitism by *Hyalomma detritum* and *Hyalomma aegyptium* was observed in all types of hosts but with a frequency 5 times lower than *Hyalomma marginatum*. *Hyalomma marginatum*, the most prevalent species, was primarily located in the abdominal region, particularly in the genital areas. *Hyalomma anatolicum* was found more often in the internal parts of the body, such as under the shoulder blades and thighs, and less frequently in the genital region. These ticks had nearly uniform distribution in both spring-summer and autumn. Overall, and specifically *Hyalomma marginatum*, which was the most widespread species, are known as the main vectors of hemosporidiosis in animals, but also as agents of other zoonotic diseases affecting both animals and humans. The transmission of hemorrhagic fevers by these ticks at the border with Kosovo (Kukës-Tropoja) is well known, causing fatal consequences not only in animals but also in humans. The genus *Rhipicephalus* was the most widespread genus in herbivores in the region. It was observed with the same intensity across seasons and species, and it was represented by four species: *Rhipicephalus bursa*, *Rhipicephalus turanicus*, *Rhipicephalus* (*Boophilus*) *annulatus*, and *Rhipicephalus sanguineus*. *Rhipicephalus bursa* was present in animals in the

region and was the most widespread species in all types of animals. Following it, *Rhipicephalus turanicus* was the second most common species. *Rhipicephalus (Boophilus) annulatus* ranked as the third most common species and was found not only in cattle but also for the first time in goats, mainly during the autumn season. *Rhipicephalus sanguineus* was found only occasionally in all animals and seasons (more often in spring). *Rhipicephalus sanguineus*, known as the dog tick, as well as *Rhipicephalus bursa* and *Rhipicephalus turanicus*, which are known to primarily parasitize small ruminants, are non-selective ticks that were found in abundance both in spring and autumn, particularly in sheep and horses. *Rhipicephalus sanguineus*, known as the dog tick, was also observed to parasitize other animals, but only occasionally. The genus *Dermacentor* and its only identified species *Dermacentor marginatus* was identified as the least widespread tick species in the Shkodra region. It was found in small numbers of specimens with no statistically significant differences between hosts or seasons. Adults were more active in spring and autumn, rarely in summer, and were most commonly found in the genital regions, the inner part of the ear, and less frequently in the internal areas of the limbs and neck.Is there any relationship between animals and seasons based on the number of parasite cases?To answer this question, we have employed the chi-square test of independence (or test of association). This is used to determine whether the frequency of occurrences for two category variables is significantly related. The null hypothesis, H_0: The null hypothesis states that the row and column categorical variables (animals, season) are not associated or in other words, are independent. Alternative hypothesis H_1The alternative hypothesis (H_1) states that the row and column variables are associated (are dependent). The chi-square test statistic results are in the tables (3) below:

Table 3. Chi-Square Tests Hypothesis 1

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)
Pearson Chi-Square	.873[a]	3	.832	.832
Likelihood Ratio	.873	3	.832	.832
Fisher's Exact Test	.879			.834
N of Valid Cases	639			
a. 0 cells (0.0%) have an expected count of less than 5. The minimum expected count is 38.70.				

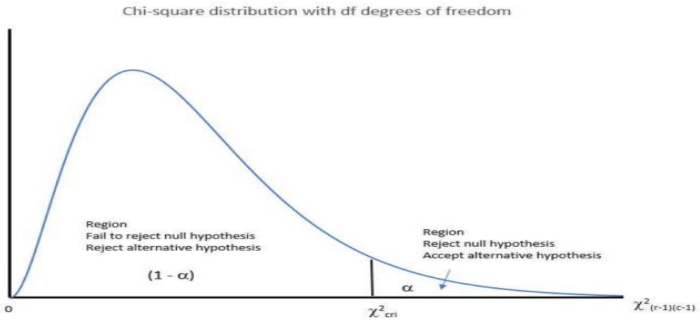

Figure1. Chi-square region of acceptance-rejection for the null hypothesis

Conclusion 1 - From the calculations, we have χ^2 calk< χ^2 critic, so we do not reject the null hypothesis, H_0. We conclude that no significant relationship exists between the categorical variable animals and season. These two variables are independent of each other. The diversity observed reflects the specific conditions of the Albanian territory, which are such that they favor the development and survival of hard ticks. Few territories in the Balkan Peninsula and southern Europe as a whole offer conditions that allow such a rich development as the studied area. The terrain is such that it provides conditions for both Mediterranean species and those from colder regions. This area represents a very diverse territory with many variations in regions and climates, which also explains the results of the statistical analysis. Furthermore, the variety of hosts and the characteristics of tick parasitism on them reflect the variability

of the correlations involved. Hypothesis 2. Is there any relationship between the type of parasite and season based on the number of parasite cases? To answer this question, we have employed the chi-square test of independence (or test of association). This is used to determine whether the frequency of occurrences for two category variables is significantly related. The null hypothesis, H_0: The null hypothesis states that the row and column categorical variables (type of parasite, season) are not associated or in other words, are independent Alternative hypothesis H_1: The alternative hypothesis (H_1) states that the row and column variables are associated (are dependent). The chi-square test statistic results are in the tables (4) below:

Table 4. Chi-Square Tests Hypothesis 2

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	2.595[a]	4	.628
Likelihood Ratio	2.599	4	.627
N of Valid Cases	639		
a. 0 cells (0.0%) have an expected count of less than 5. The minimum expected count is 26.94.			

Conclusion 2 - From the calculations, we have χ^2 calk< χ^2 critic, so we do not reject the null hypothesis, H_0. We conclude that no significant relationship exists between the categorical variable the type of parasite and the season. These two variables are independent of each other. The relief and seasonal variability are such that they provide distinct conditions for both ticks and hosts. The results presented are part of a larger study that represents the other three regions of the country, which are also diverse and closely related to the geographical features and characteristics of both hosts and ticks.

V. CONCLUSION

In herbivorous animal populations within the territory of Shkodër, north Albania, we identified the genera of ticks *Ixodes*, *Hyalomma*, *Rhipicephalus*, *Haemaphysalis* and *Dermacentor* with a total of 13 species. The identified species were *Rhipicephalus bursa*, *Rhipicephalus turanicus*, *Rhipicephalus* (*Boophilus*) *annulatus*, *Rhipicephalus sanguineus*, *Hyalomma marginatum*, *Hyalomma anatolicum*, *Hyalomma detritum*, *Hyalommaa egyptium*, *Ixodes ricinus*, *Haemaphysalis punctata*, *Haemaphysalis sulcata*, *Haemaphysalis inermis* and *Dermacentor marginatus*. Sheep's were found to be the most affected animals by hard ticks, while goats resulted to the least affected. No significant changes were observed between the spring-summer period compared to the autumn season or the type of host. However, the phenomenon was seen to be strongly influenced by environmental conditions, which vary each year.

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