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ORIGINAL RESEARCH ARTICLE

Hivernal infestation of sheep with Ixodidae in Botoşani area: unusual epidemiological aspects

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Abstract. The research was performed between January 2008 and April 2010 on a flock of 540 sheep on a private property from Hăneşti-Vlăsineşti area, Botoşani County, in order to study the emergence and evolution of ectoparasites. The flock was examined during calving and grazing seasons. We have analyzed the geographical location of settlements, the layout of grasslands and pastures, their floristic composition, presence of tall vegetation on pasture, climatic factors, prevention and control measures applied, epidemiological history, growing and operating conditions and the biological comfort of the herd. Peripheral blood samples were also examined for detection of *Babesia*. Epidemiological results show that constant change of climate's factors in winter months with records of high average temperatures (0°C and rainfall of 50.8 mm^3/m^2 in February 2010), have attracted unprecedented changes in tick biology of Ixodidae family, allowing them to be active during the winter, which has triggered massive invasion in sheep. Ixodidae infestation developed in association with psoroptic scabies leading to significant economic losses. Prevalence dynamics (%) of ectoparasites revealed that tick infestation has affected the entire flock of sheep, both in summer (98%) and winter (82%), completely unique for this geographical area and across the country. Psoroptic scabies developed as a unique infestation with low prevalence (2%) in summer and higher (9%) in winter. Associated development has been found in winter in 9% of the flock. In this paper we report for the first time in the country, massive infestation of sheep with ticks from Ixodidae family in January and February (2010), in the north-east area of the country.

Keywords: Sheep; Winter; Ixodidae; Massive infestation; Epidemiology.

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Introduction

Sheep infestation with ticks from Ixodidae family is known in Romania as a condition with sporadic development and focal character (Cosoroabă, 2000; Şuteu and Cozma, 2004). Ticks of Ixodidae family have a cosmopolitan distribution (Iacob, 2002; Bowman, 2008). There are areas where ticks are constantly present as extremely large populations (resulting in epidemics of tick-borne diseases) and areas where climatic and

biocenotic conditions allow only sporadic and inconsistent survival. Wide spreading of the tick species is based on morphological, physiological and behavioral characteristics (Cosoroabă, 2000). The tick's maximum activity period when they are either in the body or the host, is correlated with the frequency of climate factors (Hornok, 2009). In the equatorial area, ticks are active throughout the year while in the temperate regions ticks are particularly active in spring and autumn. Preferred biotopes by ticks of Ixodidae family are unused land, bush land, forest edges and meadows with abundant vegetation or marshes. Animal infestation has a seasonal character corresponding to the seasonal activity of the ticks and is performed by host passing or stopping in the tick's characteristic biotope (Hoch et al., 2008). Veterinary medical importance of Ixodidae family resides both in the direct aggression on the host (amphibians, reptiles, birds and mammals) and indirectly by transmission of pathogenic microorganisms (protozoa, bacteria, viruses) (Mitrea et al., 2001; Ocaido et al., 2009). Global warming has induced an attenuation of the season boundaries and the occurrence of unexpected thermal values with chaotic oscillations, unknown until now. Climate change has led to an extension in the activity of Ixodidae family ticks even in winter, thus inducing clinical episodes in sheep, with great economic losses.

Epidemiological investigations were performed on a flock of Karakul, Ţurcană and crossbred sheep, on a private property, in order to study the emergence and development of ectoparasites in sheep in Botoşani County.

Materials and methods

Epidemiological study was conducted from January 2008 to April 2010 on a flock of 540 sheep, on a private property in Hăneşti-Vlăsineşti area, Botoşani County. The sheep were Karakul, Ţurcană and crossbred, being raised for milk production, but also for meat. Karakul breed has robust to fine constitution, pear-shaped body and a characteristic tail which has a bilobed fat deposit. The head is elongated, thin and the facial profile is slightly convex, especially in males. The most common color is black, followed by brown and occasionally silver or gold.

In grazing season sheep have been organized in summer camps and as food has been used grazing obtained herbaceous vegetation. Special watering devices supplied by rivers, but also by the natural accumulation of rain water have been used for drinking.

During the winter the animals have been housed in sheds placed on pasture, with the possibility of using pasture whenever weather conditions allowed.

The flock has been examined by general inspection and individual examination, analyzing the ectoparasite prevalence and intensity in the flock of sheep, depending on the season. We studied the evolution of climatic factors and the data were placed in tables and graphically expressed as climatograms. Parasitological examination of the skin has been made both macroscopically and microscopically to identify and collect etiologic agents. The examination of the samples has been done in the parasitology laboratory of the Faculty of Veterinary Medicine, Iaşi, Romania.

The samples were represented by ticks collected from the body of sheep, skin scrapings taken from the limit of hyperkeratosis lesions and peripheral blood obtained by vein puncture of the external ear, and then displayed on glass slides as smears and stained using the MGG method.

Identification of tick species and taxonomic classification was based on the microscopic study of morphological characters, using a binocular microscope and published keys (Adam et al., 1971; Cosoroabă, 2000; Şuteu and Cozma, 2004).

The identification of *Babesia* was performed after microscopic examination of smears of peripheral blood (Cosoroabă et al., 2002).

Monthly average values of climatic factors (temperature, precipitation) were provided by the local meteorological center Săveni-Botoşani on which we built the climatograms.

The analysis of the interdependence between climatic factors and development of tick populations was also based on comparative studies conducted in other geographical areas of Romania: west (Cosoroabă, 2000); south-east (Mitrea et al., 2001); north-east (Şuteu and Cozma, 2004).

Results and discussion

Epidemiological survey results highlight the geographical location of settlements where the study has developed, the layout of grasslands and pastures, the floristic composition of pasture, climatic factors: temperature, humidity, rainfall.

Geography

Hăneşti and Vlăsineşti are surrounding to the city of Săveni (located in the north east of Botoşani County) along the Başeu river. These are neighboring municipalities and the limits are represented as follows: Dângeni and Ungureni villages on south, Avrămeni on north, on east Mihălăşeni and on west Săveni city. Summed area of the two villages is 12 800 hectares of which 2700 hectares are represented by pastures.

Climate and rainfall

The climate is temperate continental, heavily influenced by air masses from the east of the continent, which causes the annual average temperature to be lower than that of the rest of the country (8-9°C), with variable rainfall, poor snow winters, low moisture regime in summer, with prevailing winds from the northwest and southwest. The average winter temperature is -10°C – -5°C and in summer can reach 30 or 35°C.

Mean monthly values for the climatic factors in January 2008-April 2010 period are listed in table 1 and the monthly dynamics of climate factors in the analyzed period is given in figures 1-3.

Soil types, vegetation

Steppes occur on soils of mollisols class: chernozem, gray soil, ground balance. Flora is dominated by grasses and herbs with rhizomes (which is growing rapidly when favorable conditions occur), and the scrub and thorny plants. Eastern side of Botoşani County is characteristic to steppe areas, consisting mainly of agricultural land and grassland which occupies the place of former forests. The natural vegetation is characteristic for forest soils, with meadows and pastures where perennial herbs are growing: field grass (*Agrostis alba*), horse tail (*Equisetum silvaticum*) and meadow-grass (*Poa pratensis*).

Housing types

In winter, sheep are housed in sheds placed directly on pasture. Thus, during the day the animals are in pens and receive food in feeders like manger and overnight are placed in shelters such sheds. Bedding is permanent which favors keeping humidity and affecting hooves, emanating harm irritative gases to respiratory airways and provides preservation conditions for parasitic elements. In general, no preventive measures (pest, disinsection, decontamination) allow survival and perpetuation of parasitic elements from one season to another.

Around 1st of May sheep are gathered for summer camps while ensuring the spread of ectoparasites by direct contact. Transmission would not be possible if all livestock owners would apply preventive measures regarding the occurrence of ectoparasites in sheep.

In our area we have recently observed an increase in the number of sheep (table 2). This was due the subsidies granted by the European Union or due the lack of jobs and the redirection of people to animal husbandry. The dynamics for the flocks of sheep in the analyzed period is shown in figure 4.

Leaving sheep to pasture in winter (January-February) was followed by massive infestation with ticks, uncharacteristic to the cold season, first reported case in the country. Grasslands covered by the flock of sheep were located on uncultivated, fallow land, with thistles and high vegetation and on forest edges, typical areas for the biotope of ticks from Ixodidae family.

Table 1. Mean monthly climatic factors during the period 2008-2010

Nr. crt.	Month	2008		2009		2010	
		Average temp. (˚C)	Average rainfall (mm³/m²)	Average temp. (˚C)	Average rainfall (mm³/m²)	Average temp. (˚C)	Average rainfall (mm³/m²)
1.	January	-3	22,5	-5	21,4	**-7**	56,4
2.	February	-2	21,8	0,5	23	**0**	50,8
3.	March	0,1	53	2	18,8	**3**	40,2
4.	April	10	11,7	11	13,2	11,3	10,6
5.	May	16,3	65	14	40		
6.	June	21	57	20	87,6		
7.	July	23	53,4	25	96,7		
8.	August	25	48,3	27	50		
9.	September	15	53,8	14	68,1		
10.	Octomber	10	47	11	50,3		
11.	November	5	50	6	42		
12.	December	1	66	1	63		
Average annual		10,11	42,04	10,45	47,84	1,8	39,5

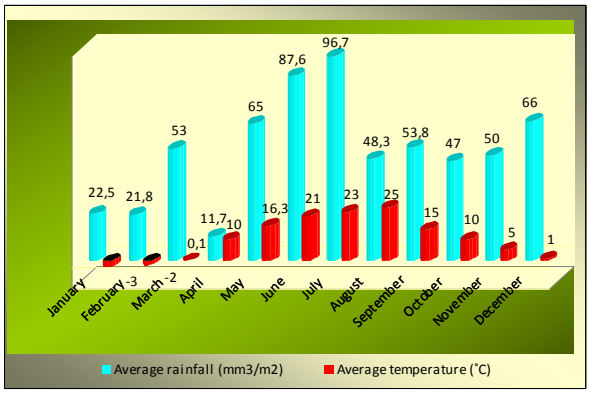

Figure 1. The dynamics of temperature and rainfall in 2008

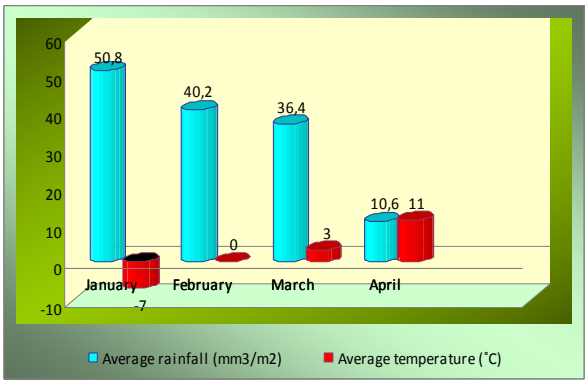

Figure 3. The dynamics of temperature and rainfall in the first months of 2010

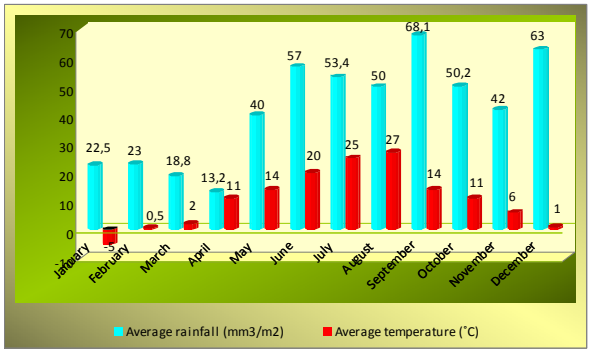

Figure 2. The dynamics of temperature and rainfall in 2009

Under these conditions the sheep were massively attacked by an abundant, biotope existing tick population, inducing severe clinical episodes associated with other ectoparasites (scabies) which evolved during this period. Prevalence of ectoparasites is show in table 3 and its dynamics is given in figure 5.

Microscopic examination of peripheral blood revealed the presence of few intraerythrocytic parasitic elements belonging to protozoa of the

genus *Babesia*. Morphologically, they were identified as *Babesia motasi* and *Babesia ovis* (Adam et al., 1971). *Babesia motasi* is transmitted by ticks of the *Dermacentor marginatus* species and *Babesia ovis* has as vector *Ixodes ricinus*. Both species of ticks were collected from the body of sheep.

Table 2. Evolution of the flocks of sheep in the period 2008 – April 2010

Age categories	2008	2009	2010
Adult sheep	360	370	390
Aries	5	6	7
Ewes	10	20	30
Yearling	5	8	3
Lambs	40	30	110
Total	**420**	**434**	**540**

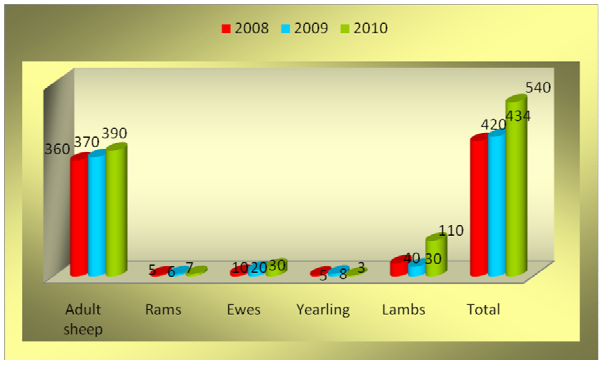

Figure 4. The dynamics in the number of sheep in the 2008-2010 period

Table 3. Extensivity (E%) of the ectoparasitosis depending on the season

Total	SUMMER		WINTER		
540 (100%)	Ticks	Scabies	Ticks	Scabies	Ticks and scabies
	98%	2%	82%	9%	9%

Economic losses have been recorded through mortality, recorded cases being diagnosed with massive tick infestation associated with extensive lesions of hyperkeratosis caused by *Psoroptes ovis* and the presence in reduced number of *Babesia* in the red blood cells.

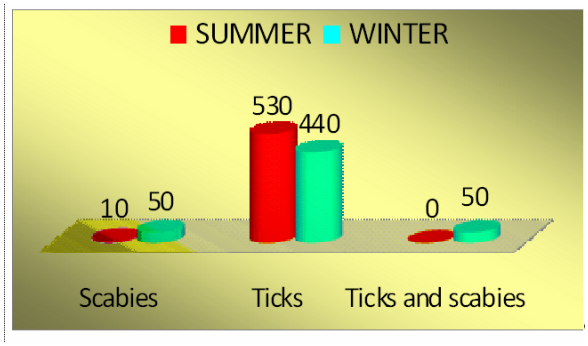

Figure 5. The dynamics of ectoparasitosis extensivity in sheep according to season

The emergence of massive infestations of sheep with ticks during the winter raises new epidemiological issues regarding the this condition in livestock. The infestation of herbivores with ticks from Ixodidae family is known to be seasonal, dependent on climate conditions, respectively temperature and humidity in the warm season (Dulceanu and Terinte, 1994; Davoudi et al., 2008). Winter infestation of sheep with ticks induced the occurrence of clinical episodes of babesiosis against season for which neither owners nor specialists have been trained. Subsequent identification of *Babesia* from blood samples contributed to elucidation of the losses through mortality and complicated evolution of associated cutaneous and blood parasites. Tick infestation comparative results show similar values between hot and cold season (figure 5). The prevalence of ectoparasites show that tick infestation has affected the entire flock of sheep in summer (98%) and winter (82%), something quite unusual for this geographical area or throughout the country. *Psoroptes scabies* infestation has evolved as a unique infestation with reduced prevalence (2%) in summer and slightly higher in winter (9%). In winter tick infestation was higher inhibiting the progress of *Psoroptes scabies* infestation. The two ectoparasites have evolved associated in winter to 9% of the effective. These new epidemiological aspects are no longer in accordance with the data provided by literature up to date regarding the development of these parasitic conditions in our country (Şuteu, 1996; Cosoroabă, 2000; Mitrea et al., 2001; Chiţimia et al., 2009). It is also known that *Psoroptes ovis* evolves in winter to early spring and tick infestation in

warm season up to late autumn (Dulceanu and Terinte, 1994). Climate global changes induced significant changes in the biological cycle of ticks. The consequences of the climate changes are reflected directly on the biology of ticks in the temperate zone thus canceling the season barriers, and leading to changes in the periods of application of preventive measures. The increasing of the monthly average temperature in winter (table 1) (-3°C -2°C in Jan-Feb 2008, -5°C 5°C in Jan-Feb. 2009 and -7°C 0°C in Jan-Feb. 2010) ensures the survival of ectoparasites populations, increasing their active period, animal infestation and induction of clinical episodes against season with or without babesiosis episodes. In future, the establishment of immunoprophylaxis by vaccination of the livestock will help to control the infestation with ticks from Ixodidae family.

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