

## BIODIVERSITY AND SEASONAL DISTRIBUTION OF TICKS IN SOUTHEASTERN SERBIA

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**Summary:** Ticks are a relatively small group of hematophagous arthropods distributed in three families: Argasidae, Ixodidae and Nuttalliellidae. Ticks are found all over the world and we find them on land and on islands, and even in Antarctica, where seabirds are parasitized by the Northern Memoirs endemic species. They find all types of climates favourable, as well as the temperatures from +4°C and up. They are common in places where there is a large fluctuation of animals. The most common hosts are mammals, but in their absence they can be found on birds and reptiles. Ticks belong to a group of arthropods that are of exceptional biomedical importance due to their role as vectors of various types of diseases and the immediate harmful effects caused by the hematophagous diet. During research in domestic animals and humans in the area of southeastern Serbia, the prevalence of *Ixodes ricinus*, *Dermacentor marginatus*, *D.pictus*, *Rhipicephalus sanguineus*, *R.bursa*, *Haemaphysalis punctata* and *He.inermis* was established.

**Key words:** ticks, biodiversity, epidemiology, southeast Serbia

### INTRODUCTION

Ticks belong to a group of arthropods that are of exceptional biomedical importance for the living world, primarily due to their role as vectors of various types of diseases, and the immediate harmful effects caused by the hematophagous diet. It is a relatively small group of hematophagous arthropods (896 described species so far) from the phylum *Arthropoda*, under the order *Chelicerata*, class *Arachnidae*, subclasses *Acari*, suborder *Parasitoformes*, order *Ixodia* and superfamily *Ixodida* (Like all of arthropods they started their own rise in Devon and the biggest breakthrough they achieved during Mesozoic, especially in the Chalk period, from which the largest Number of fossils come. Evolutionary transition of ticks was closely connected with the evolution of hosts on which they feed.

They are divided into three families: *Argasidae*, the soft-shelled ticks, *Ixodidae* the hard-shelled ticks, and *Nuttalliellidae*, which have the characteristics of both of the aforementioned ticks.

*Argasidae*, has 183 species distributed in five genera *Argas*, *Antricol*, *Nothoaspis*, *Ornithodoros* and *Otobius*

*Ixsodidae* has 241 species from the genus *Ixodes* and 442 species from the genera *Amblyomma*, *A nomalohimalaya*, *Bothriocroton*, *Cosmiomma*, *Dermacentor*, *Haemaphysalis*, *Hyalomma*,

*Margaropus*, *Nosomma*, *Rhipicentor* and *Rhipicephalus*.

*Nuttalliellidae* is a monospecies family (has only one representative) *Nuttalliella namaqua*

Ticks are strictly hematophagous arthropods. After reaching sexual maturity, the female tick attaches itself to the host. During feeding on blood, eggs develop in the ovaries of females. When the female finds a good place and starts feeding, she attracts the male by smell. The male clings to the feeding female and fertilizes her. After copulation, the males die, and the females separate from the host, fall to the ground and lay eggs in the grass, bushes or under fallen leaves. The number of eggs ranges from 300 to 9000.

During feeding on blood, the tick stays on the host for a long time. The most common hosts are mammals, but in their absence ticks can be found on birds and reptiles. All developmental stages of the tick, starting with the larva, attach to the host [1,2,3].

When tick eggs hatch into larvae, their hosts are small mammals, primarily rodents, and in their absence, any other type of animal can serve as a host. Larvae, unlike other tick stages, have three pairs of legs. After feeding, they leave the host and change into nymphs. In the nymph stage, they are most often found on bushy vegetation in a "hunting" position. The most common hosts are still small rodents, but also animals such as foxes, dogs, squirrels, as well as

any animal species found there, including humans [1].

After feeding, they are detached from the host and change into adults, and the waiting place for hosts is usually high vegetation or treetops from where they attack mammals, birds and reptiles [25,26]. Small ruminants are frequent hosts of adult ticks throughout the world [3-10].

#### EPIDEMIOLOGICAL SIGNIFICANCE OF TICKS

Ticks belong to a group of arthropods that are of exceptional biomedical importance for the living world, primarily due to their role as vectors of various types of diseases and the immediate harmful effects caused by the hematophagous diet.

The most famous tick-borne diseases are: Lyme borreliosis, *Ehrlichia* sp., *Babesia* sp., *Anaplasma* sp., Hemorrhagic fevers: Crimean-Congo hemorrhagic fever (with and without renal syndrome), Marburg hemorrhagic fever, Omsk hemorrhagic fever, Kyasanur forest disease etc.), African swine fever, Spirochetosis a, *Aegyptela* sp., *Theillera* sp., Hatma virus, Q fever, arboviruses, adenoviruses, Nairobi disease, Tick-born encephalitis (Powassan encephalitis, Russian spring-summer encephalitis), Typhus (Siberian tick-borne typhus, *Typhus endemica*, *Th.erythromatosa* ), bouton fever and other diseases [11-16].

#### TICKS OF SERBIA

Research on ticks on the territory of Serbia began at the beginning of the last century. These researches are still ongoing and mainly *Ixodidae* species have been studied, primarily exophilic species (given that they are vectors and reservoirs of many infectious diseases).

During the research, the presence of argasid species was recorded only in birds (poultry, pheasants, etc.), namely *Argas pesicus* and *A. reflexus* [17,18].

Endophilic species of ixodids are the most represented. Five genera of ixodid ticks have been recorded in the fauna of Serbia: *Ixodes*, *Dermacentor*, *Rhipicephalus*, *Haemophysalis* and *Hyaloma*. Among them, the most frequent ones are of the following types:

*Ixodes ricinus*, *I.concina* and *I.persucatus* were identified

*Dermacentor marginatus* and *D.recticulatus* were identified from the genus *Dermacentor*

From the genus *Rhipicephalus*, the following were identified: *Rhipicephalus sanguineus*, *R.bursa*, *R. (Boophilus) annulatus* and *Boophilus calcaratus*

From the genus *Haemophysalis*, the following were identified: *Haemophysalis punctata*, *Ha.inermis*, *Ha.leporis-palustris*, *Ha.sulcata* and *Ha.concina*

*Hyalomma marginatum marginatum*, *Hy.exavatum* and *Hy.detrutum* were identified from the genus *Hyalomma*

The geographical distribution of established ticks in domestic and wild animals (mammals) was quite uniform. Here we present the average data for the area of southeastern Serbia.

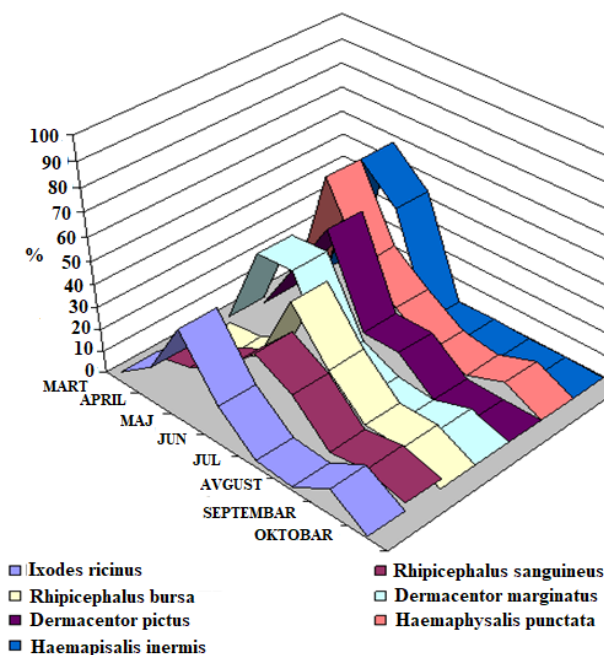
#### INFLUENCE OF CLIMATE CONDITIONS ON POPULATION DYNAMICS

The temperature optimum of activity (the period when the largest number of ticks are looking for a host) is at temperatures of 20-25°C, when more than 40% of adults and 30% of nymphs are active. Air humidity is also an important factor, so the optimal amount is 45-80%. The length of day and night - photoperiod, is also important for tick activity. For species that live in open habitats, solar radiation has a significant impact, which leads to the accumulation of heat in the tick's body and causes the start of activity even at lower temperatures. From the beginning of September until the first snow appears and the temperature drops below 0°C, the new generation has its own natural cycle. In the autumn, when the temperature drops below 5°C, they bury themselves into the surface layer of the soil to a depth of up to 7 cm and remain there until the soil temperature rises above 5-8°C, when they come to the surface again and wait for their victims [2,19-22].

For most species of ticks, the period from mid-March to mid-June is the time when they are most active. At that time, they lay eggs, develop, find the final host on which they will perform their reproductive role. In the period from mid-June to the end of August, there is a time when the new individuals have not yet hatched, so in that period the frequency of finding them is lower. They are mostly found in the grass and shrub communities (forests, parks, steppes, savannas) and ruderal habitats. They can easily adapt to different environmental conditions, so they are found in facilities for housing animals and in residential buildings.

In our climatic conditions, the first appearance of ticks on pastures was observed in the period March-April. In March, we established the presence of: *Ixodes ricinus*, *Rhipicephalus sanguineus*, *Dermacentor marginatus* and *Haemaphysalis punctata*. In April, the presence of the following species was established: *Dermacentor pictus*, *Rhipicephalus bursa* and *Haemaphysalis inermis*. The species *Dermacentor marginatus*, *Haemaphysalis punctata* and *Ha.inermis* reach their maximum number in April. In the same month, the presence of *Boophilus calcaratus* and *Hyalomma savignyi* species, which reach their population peak in September was established. The species *Ixodes ricinus* reaches its maximum number in May, when we also find the maximum number of the species *Dermacentor pictus*. In June, the population peak of the species *Rhipicephalus sanguineus* and *R. bursa*, which are also the most frequently found species in both July and August, is observed. In September, we observe an increase in the population of two types of ticks: *Ixodes ricinus* and *Dermacentor marginatus*, while in October we observe the appearance of the species: *Ixodes ricinus* and *Rhipicephalus sanguineus*.

SOUTH EASTERN SERBIA  
Graph 1. Seasonal dynamics of established presence of ticks in southeastern Serbia



Milutinović et al. (1998a) conducted research on the tick fauna in the area of southeastern Serbia and established the presence of: *Ixodes ricinus*, *Dermacentor marginatus*, *D.pictus*, *Rhipicephalus sanguineus*, *R.bursa*, *Haemaphysalis punctata* and *He.inermis* in small ruminants. Similar results were obtained [24] during the research on the tick fauna in the autochthonous Zackel breed of sheep in the south of Serbia.

#### GENDER RATIO IN TICKS IN SOUTHEASTERN SERBIA

The gender ratio of the dominant species of ticks was as follows: of the total number of ticks collected, 52.35% were females and 47.65% were males. The gender ratio of the tick species found showed a larger number of females in four species *Ixodes ricinus*, *Haemaphysalis punctata*, *Rhipicephalus sanguineus* and *Dermacentor marginatus*, while a larger number of males were found in two species - *Rhipicephalus bursa* and *He.inermis* and an equal number in *D.pictus* ticks.

#### SEASONAL DYNAMICS OF TICK SPECIES FOUND

Graph 1 shows the seasonal dynamics of established presence of tick species

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