

Sylwia Koczanowicz\*, Magdalena Nowak-Chmura

Department of Zoology, Institute of Biology, Pedagogical University of Krakow,  
Podchorążych 2 St., 30-084 Kraków, Poland; \*sylvia.koczanowicz@doktorant.up.krakow.pl

## Exposition to ticks in the Poprad Landscape Park – short faunistic note

### Introduction

The Poprad Landscape Park is one of the biggest landscape parks in Poland. It covers the large part of Beskid Sądecki and the Polish part of The Czerchów Mountains. It is the place of unmatched natural, landscape and historical values. The Park has the area of 53 419.3 ha, where 70% is the forest with the majority of fir, beech, linden and alder trees. Within the Park, there are 13 nature reserves with a total area 600.6 ha. It has got a lot of educational-environmental paths, tourists trails and cycle lanes. There are also resorts famous for medicinal water. It is willingly visited by tourists (on average – 65 thousand tourists each year – data from 23 sensors located in the park) and its hiking trails are very popular (Zawartka, 2013; Boguś et al., 2020).

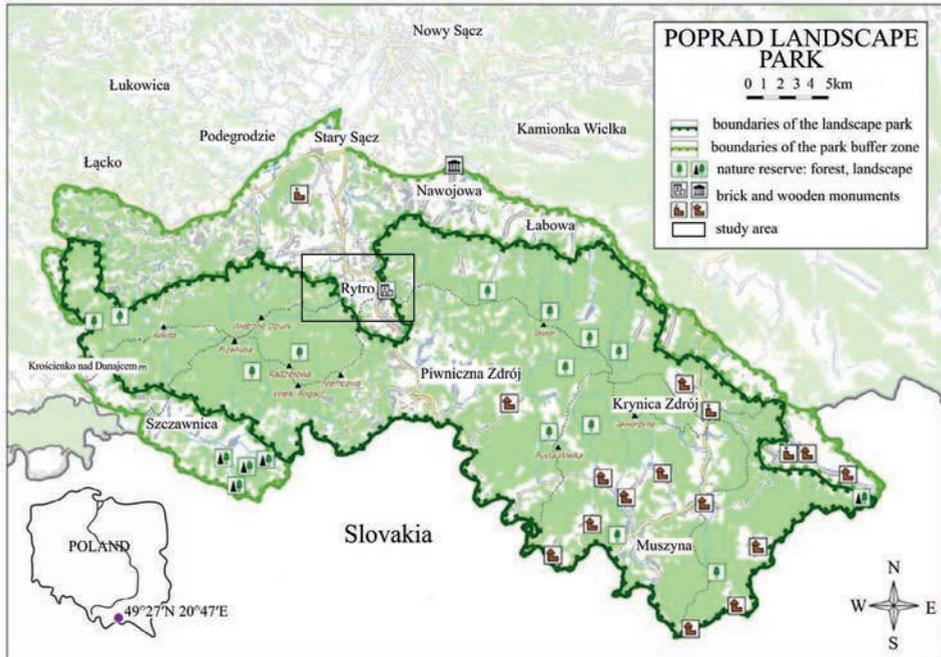
In Lesser Poland, the occurrence and the number of ticks, especially *Ixodes ricinus* L. have been examined for years (Siuda, 1993). Nevertheless, there are still a lot of places that have not been examined yet. The Poprad Landscape Park is one of them. Ticks are vectors of many bacteria, viruses, protozoa. These pathogens are an etiological agents of various dangerous human and animal diseases. Therefore, it is very important to conduct research in tourist areas to assessment of the human potential risk of exposure to ticks and tick borne diseases (Nowak-Chmura, 2013). Due to this knowledge we can improve people's awareness of ticks and the epidemiological threat they represent.

The main aim of the study is to confirm the occurrence of ticks *I. ricinus* in the Poprad Landscape Park and to describe the potential risk of tick attacks on locals, tourists and park rangers.

### Materials and methods

Ticks (species of *Ixodes ricinus* L.) were collected on two educational-environmental paths and one tourist trail in the Poprad Landscape Park (Fig. 1). The first collection

was conducted on 9th May 2020 on the educational-environmental path “Rogasiowy Szlak” in Rytro (from 49°29'05.4"N 20°38'51.1"E to 49°28'24.5"N 20°38'04.3"E). It is a 12 km educational-environmental path and has 14 theme stands. It is mostly visited by children, school trips and families. There are two drinking water springs and a quarry on this area. The area is covered by beech-fir-pine forest. 4 stands (I–IV) were marked on the path. Collecting started at 10.00 a.m., the temperature was 19°C, and it was sunny.

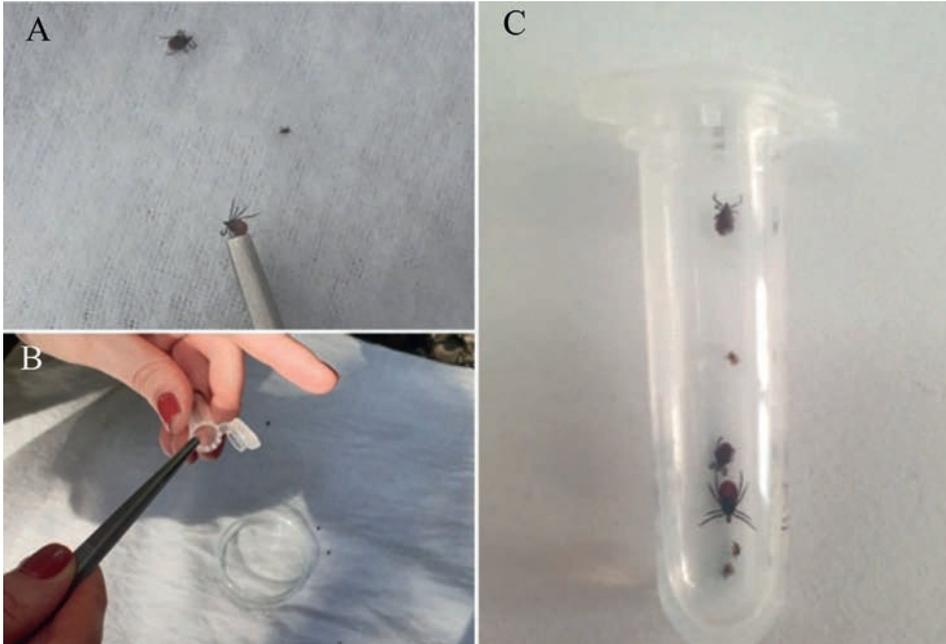


**Fig. 1.** The location of study area in the Poprad Landscape Park

The next collection was conducted on 6<sup>th</sup> June 2021, along the tourist trail “Barani szlak” (from 49°25'04.5"N 20°53'49.7"E to 49°24'41.4"N 20°55'19.5"E). Ticks were collected from the area between the ruins of Rytro Castle and the shelter “Chata Górská Cyrła”. The trail is very popular with tourists. The shelter is usually full of locals and tourists. Ticks were collected from 4 stands (I–IV). Collecting started at 3 p.m.; the temperature was 23°C; it was sunny.

The last collection was conducted on 19<sup>th</sup> June 2021 in Krynica-Zdrój, on the educational-environmental path “Na stoku Jaworzyny Krynickiej” (from 49°25'04.5"N 20°53'49.7"E to 49°24'41.4"N 20°55'19.5"E). It is a 4.5 km path, really picturesque and very touristy. It contains 14 theme information tables. Ticks were collected from 5 stands (I – V). Collecting started at 3 p.m., the temperature was 28°C, it was hot and sunny.

Ticks were collected using the flagging method (Siuda, 1993). A flannel flag 60 cm × 40 cm was attached to a stick. Then, this stick was used to sweep low vegetation up to 1 m high. Each time the flag was checked for ticks. The ticks were carried out by tweezers to the test-tubes filled 1/3 with 70% ethanol (Fig. 2). The test-tubes were described: the place of collection, date, time, weather. Ticks were designated according to the species and developmental stage using a stereoscopic microscope. To identify of ticks, guides by Siuda (1993) and Nowak-Chmura (2013) were used.



**Fig. 2.** The collecting of ticks: A–B – transfer of the ticks using tweezers to test tubes 1/3 filled with 70% ethanol, C – ticks secured in a test-tube (Photo. S. Koczanowicz)

## Results

A total of 213 specimen of *I. ricinus* were found at all analysed research stands including: 59 ♀, 62 ♂, 91 nymphs and 1 larva. The percentage comparison of these results is shown in figure 3. The highest number of ticks (111) was collected on 6 June 2021 on the tourist trail “Barani Szlak” in Rytro. The lowest number – only 32 ticks were collected on 19 June 2021 on the educational-environmental path “Na stoku Jaworzyny Krynickiej”. In May, the highest number of nymph forms was recorded at the stands on “Rogasiowy Szlak”. On the other hand, in June at the stands on “Barani Szlak” – most adult males and females were found. At the stands of “Na stoku Jaworzyny Krynickiej”, the structure of the share of individual forms of *I. ricinus* was similar to that recorded in May at “Rogasiowy Szlak”.

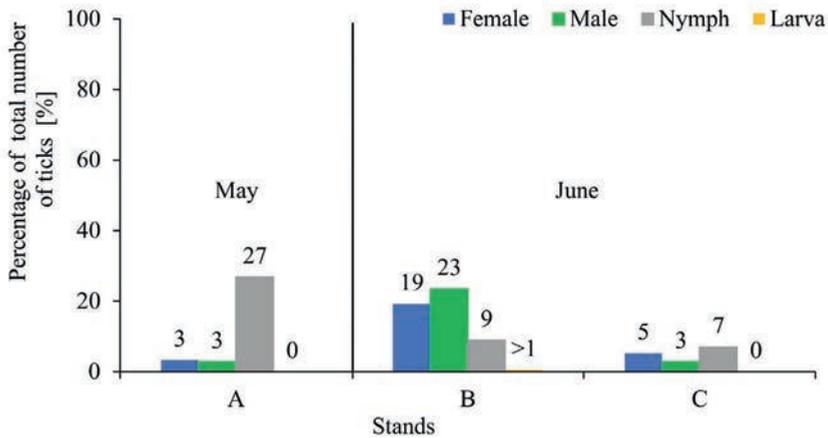


Fig. 3. Percentage comparison of the total number of collected *Ixodes ricinus* L. specimens by sex and developmental stage: A – “Rogasiowy Szlak”, B – “Barani szlak”, C – “Na stoku Jaworzyny Krynickiej”

Below is a list of stands and a numerical list of the collected on study area specimens of *I. ricinus* L.

1) The educational-environmental path “Rogasiowy Szlak”:

In total on this area, 70 individuals of *I. ricinus* were collected: 7 ♀ (10%), 6 ♂ (9%), 57 nymphs (81%). No larval forms were found.

Stands:

I – 1 ♀; 3 ♂; 13 nymphs.

II – 1 ♀; 2 ♂; 4 nymphs.

III – 4 ♀; 1 ♂; 22 nymphs.

IV – 1 ♀; 18 nymphs.

2) The tourist trail “Barani szlak”:

In total on this area, 111 individuals of *I. ricinus* were collected: 41 ♀ (37%), 50 ♂ (45%), 19 nymphs (17%) and 1 larva (1%).

Stands:

I – 1 ♂; 7 nymphs, 1 larva.

II – 10 ♀; 25 ♂; 3 nymphs.

III – 10 ♀; 6 ♂; 4 nymphs.

IV – 21 ♀; 18 ♂; 5 nymphs.

3) The educational-environmental path “Na stoku Jaworzyny Krynickiej”:

In total, on this area 32 individuals of *I. ricinus* were collected: 11 ♀ (34%), 6 ♂ (19%), 15 nymphs (47%). No larval forms were found.

Stands:

I – 1 ♂.

II – 1 ♂; 3 nymphs.

III – 2 ♀.

IV – 5 ♀; 2 ♂; 12 nymphs.

V – 4 ♀; 2 ♂.

## Short discussion

*Ixodes ricinus* L. is the most common tick in Poland and Europe (Cuber, 2009; Nowak, Siuda, 2006). It is the main vector of transmitted pathogens. It occurs unevenly, mainly in leafy and mixed forests, shrubs places and on wet pastures. Optimal humidity for this species is 80–100%. This tick occurs often along the trails frequented by wild animals, paths and trails for tourists. It is getting more common in wooded urban areas such as parks and allotments (Cisak, Zwoliński, 2010; Nowak, 2013; Nowak, Siuda, 2012).

In Poland, *I. ricinus* is active from early spring to late autumn. We can talk about two peaks of activity: a spring peak and an autumn peak in late summer and autumn (Siuda, 1991, 1993). While piercing the skin ticks inject the anesthetic substance so the victim does not feel pain or irritation. Mature stages of *I. ricinus* feed on blood of big and medium size mammals (cattle, dogs, cats, wild animals, humans). Younger ticks attack mainly small mammals, birds and reptiles. All developmental stages of mostly females and nymphs can feed on humans (Wilhelmsson et al., 2013). Before attacking, ticks look for the best place to take blood from. They tend to choose areas where epidermis is thin and wet: areas behind ears, armpits, knees, shanks and groins (Bartosik et al., 2011). With children, they prefer areas of face or head (Keklikçi et al., 2009).

The Małopolska Voivodship is constantly monitored for the presence of ticks (Siuda et al., 2001; Nowak et al., 2009). One of them is the buffer zone of the Poprad Landscape Park, where field research was conducted in Barcice and Barcice Dolne in 2018 (Janiczek, 2019). In the area designated for this study, there are favourable conditions for the development and spread of different tick species. In the vicinity of the designated stands, within all three trails, there are areas potentially favoured by *I. ricinus* and migration routes of wild animals, often visited by them. Together with the presence of educational and hiking trails, all these factors favour the presence and easy spread of this species. This is confirmed by the relatively large number of ticks (213 individuals) found in total in all 13 examined stands.

The preliminary research carried out here has shown that in the spring period, nymphs, i.e. juvenile developmental stages, dominate among the collected forms of this species (Fig. 3), while in the early summer period – mature males and females. This is consistent with the information about this species known from the literature (Siuda, 1991, 1993, 2008). The path “Na stoku Jaworzyny Krynickiej” has conditions favoured by ticks: it is touristy, near meadows, mixed forest, with traces of wild animals; not very

high number individuals occur here was probably due to the high temperature – when the collecting started it was very hot (28°C), and the humidity was over 41%. On the other hand, the negligible share of larval forms can be explained by a different time of their appearance in the analysed area (weather and vegetation season), which certainly requires further, more detailed exploration.

Scientific research conducted recently in Poland confirms that the most dangerous vector of tick-borne diseases for humans and animals is *I. ricinus*. In the Słowiński National Park registered the presence of *I. ricinus* on tourist trails and the threat to park rangers and tourists. Ticks carried pathogens of *Anaplasma phagocytophilum* Dumler et al., *Babesia microti* França, *Borrelia burgdorferi* s.l. Johnson et al. emend. Baranton et al. and *Toxoplasma gondii* Nicolle & Manceaux (Semla et al., 2014; Asman et al., 2017). In the Bieszczady National Park and neighbouring areas, among 148 examined individuals of *I. ricinus* 25.7% carried a similar pathogens (Nowak-Chmura, Siuda, 2016). The research conducted in the Polish Jurassic Highland indicated that the foresters who spend a lot of time in natural tick habitat are more likely to get infected with spirochaete of *B. burgdorferi* (Nowak-Chmura, 2013).

The risk of being attacked by ticks depends on many factors, i.e. geographical area, climate, temperature, humidity and how long one is exposed to ticks. Another factor is the method of prevention – the basic method is to wear proper clothes, long trousers, long-sleeved shirts, high socks and boots. It also helps to use repellents and check the body for ticks each time one comes back from a walk (Dutkiewicz et al., 2014).

## Conclusions

There are favourable habitats for *Ixodes ricinus* L. in the Poprad Landscape Park. A total of 213 specimens of this species were found at 13 sites, located within 3 educational and tourist routes. There are more nymphs in the spring, and adult males and females in the early summer. The presence of larvae is likely to depend on weather conditions, season or the places where the collections were carried out. However, these issues require more careful research. Local people, tourists and park rangers are in danger of tick-borne diseases that can threaten their health and lives.

## Conflict of interest

The authors declare no conflict of interest related to this article.

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## Ekspozycja na kleszcze w Popradzkim Parku Krajobrazowym – krótka notatka faunistyczna

### Streszczenie

W Popradzkim Parku Krajobrazowym występują dogodne siedliska dla *Ixodes ricinus* L. Łącznie na 13 stanowiskach, zlokalizowanych w obrębie dwóch szlaków edukacyjno-turystycznych i jednej ścieżki turystycznej, znaleziono 213 osobników tego gatunku. W okresie wiosennym jest więcej nymf, a wczesnym latem dorosłych samców i samic. Obecność larw może zależeć od warunków pogodowych, sezonu lub charakterystyki miejsc, w których został przeprowadzony zbiór. Zagadnienia te wymagają jednak dokładniejszych badań. Miejscowa ludność, turyści i strażnicy parków są narażeni na choroby odkleszczowe, które mogą zagrażać ich zdrowiu i życiu.

**Key words:** *Ixodes ricinus*, protected area, ticks

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