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The treatment of attacks by the ticks *Ixodes ricinus* in the selected areas in Żywiec and Silesian Beskids (Silesian province – southern Poland)

Introduction

The city of Bielsko-Biała, which performs functions of the main city of the Bielsko agglomeration, and which is the centre of culture, commerce, tourism and industry, together with the towns of: Ujszoły (49°28'56" N, 19°08'20" E) and Złatna (49°29'42" N, 19°10'26" E) are located in the southern Poland, near the border with Slovakia and are areas attractive to tourists. Both cities are located in the Żywiec Landscape Park, in the municipality of Ujszoły. Numerous mountain ranges and hiking trails, rivers, bicycle paths, forests and green areas create ideal places for resting, walking and trips, not only during the spring and summer periods.

Ixodes ricinus L. 1758 – a tick, occurs throughout Poland, mainly in deciduous forests, mixed, in wet habitats. Less frequently or not at all it isn't recorded in dry pine forests and in sunny areas, peat bogs or swamps (Siuda, 1993). Due to warmer winters, a large number of rodents and forest animals, the occurrence of *I. ricinus* increases in the spring and summer periods, what results in a higher risk of attacks of the parasite, especially for the forest workers, farmers, tourists and residents, as well as forest and household animals. In natural conditions in Poland *I. ricinus* is characterised by the presence of two peaks of seasonal activity: the largest, spring – at the turn of spring and summer, and the smaller one, autumn – between summer and autumn (Lachmajer et al., 1958; Kolpy, 1963; Siuda et al., 2001; Nowak et al., 2009). The constantly changing climatic conditions, e.g. lighting, humidity, temperature, affect the abundance of *I. ricinus* (Estrada-Peña, 2001).

This parasite is reservoir and a vector of pathogens, such as, e.g. the thick-borne encephalitis virus (TBE), *Borrelia burgdorferi* s.l. in summer causing the Lyme disease, *Babesia* sp., and other disease-causing microorganisms, e.g. *Rickettsia slovaca*, *Coxiella*

burnetti, *Anaplasma phagocytophilum* (Siuda, 1998; Nowak-Chmura, Siuda, 2012).

The areas of the Silesian province, including the mountain areas of the Żywiec, Silesian and Small Beskids, with diverse flora and fauna, a large number of forests, characterised by harsh mountain climate, are little explored in terms of risk of the tick attacks, therefore, studies were undertaken both in the urban and rural areas, which were then compared to the results of studies from the other parts of Poland.

Materials and methods

For the harvesting of ticks the so-called flagging method was used (Siuda, 1993). It is a commonly used method for studies on the occurrence and number of ticks in the given area. It is based on a collection, using a flannel flag with the dimensions of 100×70 cm, in places where we can find hungry and active ticks, occurring most often along the paths, trails, roads, forest passageways, everywhere where there is an easy access to the moving host. During each collection, the vegetation was swept to the height of about 1m, after several cuts the presence of ticks was checked on the fabric and they were removed using a pair of tweezers, and then placed into labelled tubes filled with 96% ethanol. The collected specimens were examined and diagnosed in morphological and taxonomic terms using a stereoscopic magnifying glass Olympus ZX and a light microscope Olympus. Keys were used for marking the ticks from the Polish fauna of Siuda (1993) and Nowak-Chmura (2013), their species affiliation and stage of development were marked. The laboratory tests were conducted in the Department of Invertebrate Zoology and Parasitology of the Institute of Biology of the Pedagogical University in Kraków.

For the studies of the seasonal activity of *I. ricinus* the method of research areas was used (Daniel et al., 1986), which consists of the collection with the method of flagging the ticks from the strictly determined areas with the area of about 100 m². Each separate research field has been previously tested for the presence of ticks. The live and hungry ticks were placed in dry tubes of fluid maintenance, then the ticks were counted, the species was determined, as well as the stage of development, and they were released back to the test area.

Observations of the occurrence and spread of the parasite in Bielsko-Biała and in Ujsoły and Złatna were performed on six selected stations in 2013 three times, and four times in two areas. In total 20 tests were performed, from April to October in the afternoon hours (4–7 pm) in dry, hot weather. The list of research positions is: (1) park in Wapienica in Bielsko-Biała – located near a busy Cieszyńska street, the Wapieniczanka river runs through the park, the silence there invites the residents to rest; (2) Włókniarz Park in Bielsko-Biała – the area located near the city centre, numerous playgrounds are visited by parents with children. It is also an attractive place



Fig. 1. The location of research to study the seasonal activity of *Ixodes ricinus* in Ujsoly. Field research: a) – forest meadow near the river of Biała Soła, b) – forest clearing in Danielka, c) – forest path in Ujsoly (Photo. A. Kocoń)

for cyclists and walkers; (3) Straceńskie Boulevards in Bielsko-Biała – the area near the creek, it is characterised by the presence of mixed forests, deciduous, it is often visited by the residents of the city, cyclists, tourists, as well as it is a place for people walking their dogs; (4) Błonia of Bielsko – a rest place for the parents with children, athletes, active people, numerous hiking trails are nearby; (5) the campsite in Złatna – a place often frequented by tourists, residents of the village, a pond is located nearby; (6) the forest path in Ujsoły – a forest habitat, a living habitat of many rodents, forest animals, the Bystra brook runs nearby.

Studies on the seasonal activity of *I. ricinus* were conducted in 2015 in the area of the town of Ujsoły, from April 15th to October 7th. Collections were recorded once a week from 3 pm to 7.30 pm in the hot and dry weather, conducive to the presence of the parasite. Three areas were selected for the observation: (1) the forest meadow near the river of Biała Soła – a position lying near the deciduous and coniferous complex, nearby there is the river of Biała Soła (Ujsoła), a place of living of the forest animals: wild boars, roe deer, deer, and many reptiles and rodents; (2) the forest glad in Danielka – there is a hiking trail nearby, the grassy area, and a mixed forest; (3) the forest path in Ujsoły – the area is seldom visited by the locals, but willingly by the collectors of the undergrowth, it is mainly the habitat for the forest animals and rodents, there is the Bystra stream nearby (Fig. 1).

Results

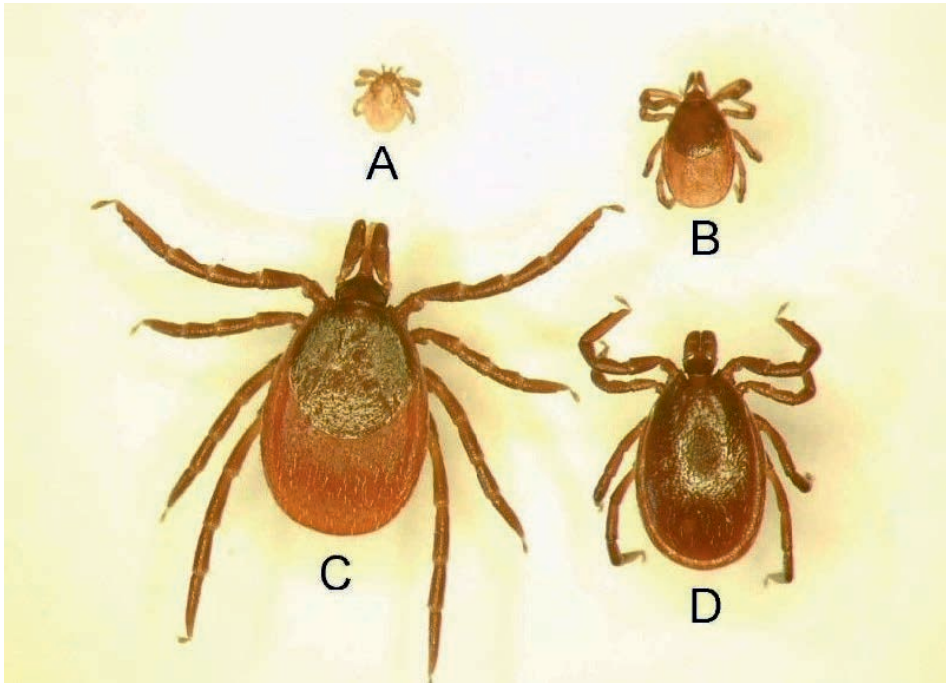
In the course of the study it has been demonstrated that all collected ticks belonged to the species of *Ixodes ricinus*. In studies of fauna of ticks in 2013, 60 specimens of *I. ricinus* were collected and in studies on the seasonal activity of *I. ricinus* the collected number was 875 specimens.

The occurrence of this species was found in all research areas, with the exception of one position: Włókniarz Park in Bielsko-Biała. During the research on the occurrence of *I. ricinus* in 2013, 60 specimens of ticks were collected, including 27 males, 23 females and 10 nymphs. No larvae was collected (Tab. 1, Fig. 2). *I. ricinus* was numerous in spring and summer periods, less frequent in summer and autumn periods (Fig. 3).

In the Wapienica Park the largest number of specimens of the parasite was collected: 19 females and 17 males; no nymphs and larvae were collected. No ticks were collected in autumn months. *I. ricinus* occurred among the shaded vegetation, close to the path in the park, near the river, playground. These were places frequented by people. No occurrence of *I. ricinus* was stated in the area of the Włókniarz Park. This may be due to the regularly mowed grass, as well as the presence of a large number of birds and dogs in this area, which are attacked by ticks, who carry them out from the park. However, the absence of the parasites in this area can not be excluded. Not many ticks

Tab. 1. The number of active specimens of *Ixodes ricinus* in studies on recreational areas of Bielsko-Biała and Beskid Żywiecki

| Research positions | Number of <i>Ixodes ricinus</i> | | | |
|------------------------|---------------------------------|-------|------|--------|
| | Larva | Nymph | Male | Female |
| Wapienica Park | 0 | 0 | 19 | 17 |
| Włókniarz Park | 0 | 0 | 0 | 0 |
| Straceńskie Boulevards | 0 | 1 | 2 | 2 |
| Błonia of Bielsko | 0 | 1 | 3 | 0 |
| Tent area in Złatna | 0 | 0 | 1 | 0 |
| Forest path in Ujsoły | 0 | 8 | 4 | 2 |
| Total | 0 | 10 | 29 | 19 |

**Fig. 2.** Developmental stages of *Ixodes ricinus*: a – larva, B – nymph, C – female, D – male (Photo. from the collections of the Department of Invertebrate Zoology and Parasitology IB PU in Kraków)

were collected in the Straceńskie Boulevards: there were only 2 males, 2 females and 1 nymph. The reason for the small numbers can be the large sunlight of the terrain. In the period of the greatest activity of ticks in May, in the research position in Błonie in Bielsko 3 males and 1 nymph were collected. In later studies no ticks were found; this area is also frequently mowed. In the campsite of Złatna during four studies the occurrence of only 1 male was stated. In order to determine the actual risk of tick attacks longer research should be conducted. This place is not too frequented by people and

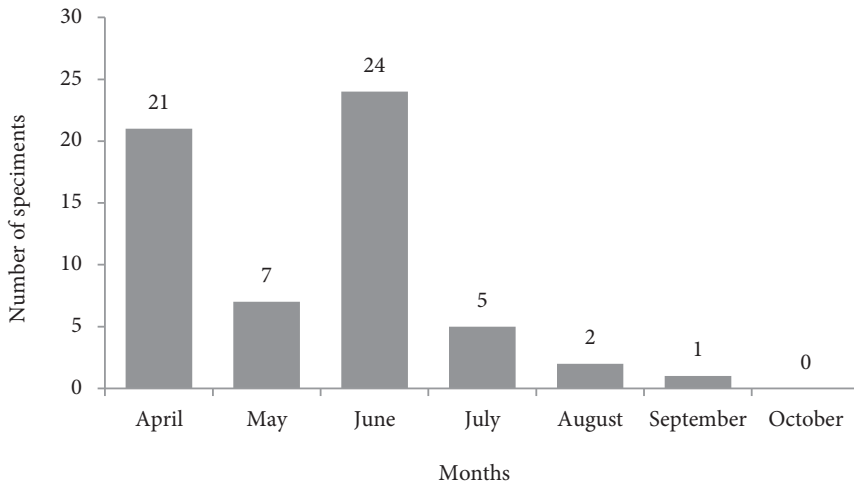


Fig. 3. The number of ticks common in individual months set

animals; it is characterised by a higher than average humidity of the area. The forest path in Ujsoly is the second region in terms of the number of collections of *I. ricinus*: 8 nymphs, 4 males and 2 females were collected. Numerous small rodents occur in the studied area, which are usually the hosts of *I. ricinus* nymphs and larvae.

In 2015, in the period from April 15th to October 7th, the weekly studies of the seasonal activity of *I. ricinus* were conducted on three selected positions in the town of Ujsoly (Fig. 1). Based on 26 test collections and observations of the course of the activity rhythm of the ticks, an increased activity was stated in the spring period and a slight increase of the autumn activity. A total of 875 hungry specimens of active ticks *I. ricinus* were collected (Tab. 2). Differences were registered in the occurrence and abundance of the development stages of the tick. Females accounted for the largest number of 328 specimens, then nymphs – 320, males – 226, larvae were the least numerous – only 1 specimen was noted (Tab. 2). The average temperature in the course of the studies was 22–21°C, the average value of atmospheric pressure was 1016 hPa, while the average air humidity was 40.5% (Tab. 3).

The rhythm of the seasonal activity of *I. ricinus* in individual research positions was as follows: (1) forest meadow near the river of Biała Soła (Fig. 1a) – a total of 258 ticks was noted, including 102 nymphs, 91 females, 64 males and 1 larva (Tab. 4). In this research field the smallest number of hungry and active parasites was collected; the reason may be that the area is sunny and there is a large availability of forest animals, such as: roe deer, deer, wild boars and a large number of reptiles, including lizards, as the main hosts, what creates a smaller probability of finding a tick with the

Tab. 2. The number of hungry collected specimens of *Ixodes ricinus* in Ujsoly in 2015

| Research field | Research time | The number of observed specimens of ticks | | | | |
|--|---------------|---|--------|-------|-------|-------|
| | | Male | Female | Nymph | Larva | Total |
| Forest meadow near the river of Biała Soła | 15.04–24.06 | 31 | 43 | 68 | 0 | 142 |
| | 1.07–26.08 | 21 | 33 | 23 | 1 | 78 |
| | 2.09–7.10 | 12 | 15 | 11 | 0 | 38 |
| Forest clearing in Danielka | 15.04–24.06 | 39 | 59 | 80 | 0 | 178 |
| | 1.07–26.08 | 26 | 36 | 23 | 0 | 85 |
| | 2.09–7.10 | 19 | 25 | 19 | 0 | 63 |
| Forest path in Ujsoly | 15.04–24.06 | 40 | 59 | 64 | 0 | 163 |
| | 1.07–26.08 | 25 | 41 | 21 | 0 | 87 |
| | 2.09–7.10 | 13 | 17 | 11 | 0 | 41 |

Tab. 3. Average climatic conditions for research positions in the course of research; Area 1 – a forest meadow near the river of Biała Soła, Area 2 – in the forest clearing in Danielka, Area 3 – a forest path in Ujsoly

| Environmental factor | Area 1 | Area 2 | Area 3 |
|----------------------------|--------|--------|--------|
| Air temperature [°C] | 22.00 | 22.00 | 21.00 |
| Humidity [%] | 40.50 | 40.50 | 40.50 |
| Atmospheric pressure [hPa] | 1016 | 1016 | 1016 |

lagging method. The increase of tick activity was noted in the period from May 8th to June 3rd. In the period from June 10th to July 22nd there was a decline in the parasite numbers. A slight increase of tick activity was observed in the period from July 29th to September 9th. The last collections, from September 16th to October 7th, show the drop in the activity of *I. ricinus* (Tab. 2); (2) forest clearing in Danielka (Fig. 1b) – the largest number of specimens was collected, a total of 326 specimens, including 122 nymphs, 120 females, 84 males and 0 larvae (Tab. 4). The proximity of the forest, hiking trails and shady places creates good conditions for the occurrence of the parasite in the whole area, waiting for its host. The increase in activity coincided with the spring and summer period – May 8th to June 24th. From July 1st to July 22nd the decline of the parasite numbers was observed. A slight increase of the parasite activity was noted in the period from July 29th to September 9th. From September 16th to October 7th the drop in the tick activity was observed (Tab. 2); (3) forest path in Ujsoly (Fig. 1c) – in total 291 tick specimens were collected: 117 females, 96 nymphs, 78 males, 0 larvae (Tab. 4). This area is covered with dense vegetation, there is a lot of low bushes, among which the parasite can wait for his host, mainly for rodents and small reptiles (lizards). The greatest increase of tick activity was observed in the period from May 8th to June 24th 2015. In July, from 1st to 22nd, a drop in the parasite numbers was noted. From July 29th to September 9th a slight increase in the tick activity was observed and the collections from September 16th to October 7th show a decrease in the activity of *I. ricinus* (Tab. 2).

Tab. 4. The number of active specimens of *Ixodes ricinus* in studies of seasonal rhythm of activity on area of the village Ujszoły

| Research area | Number of <i>Ixodes ricinus</i> | | | |
|--|---------------------------------|-------|------|--------|
| | Larva | Nymph | Male | Female |
| Forest meadow near the river of Biała Sola | 1 | 102 | 64 | 91 |
| Forest clearing in Danielka | 0 | 122 | 84 | 120 |
| Forest path in Ujszoły | 0 | 96 | 78 | 117 |
| Total | 1 | 320 | 226 | 328 |

Discussion

Ixodes ricinus, due to the medical and veterinary importance, is one of the most dangerous external parasites among the arthropods and the most frequently registered non-nest tick among 19 tick species that constantly occur in Poland (Siuda et al., 2000; Biaduń, Krasnodębski, 2007; Nowak-Chmura, Siuda, 2012), including the areas of southern Poland. The main places that favour the occurrence of this species include the shady and moist habitats, as well as deciduous and mixed forests; it is less often met in the mountains, it also avoids sunny and dry places, e.g. dry pine forests (Siuda, 1993). Areas attractive to tourists and recreational areas are particularly prone to the occurrence of this common tick, this is mainly due to the easy access to the hosts, who willingly spend time outdoor with their children, pets, they walk on the trails and forest paths. Given the particular risk of tick attacks and the risk of the transmission of the tick-borne diseases, such recreational areas were selected for the research in Bielsko-Biała and two smaller towns – Ujszoły and Złatna.

In Bielsko-Biała, Ujszoły and Złatna, located in Beskid Żywiecki, the sufficient research has not been conducted so far on the occurrence of *I. ricinus*. It results from the conducted own collections and observations, that *I. ricinus* occurs commonly both in the rural areas of Ujszoły and Złatna, and in the urban ones, in the city of Bielsko-Biała (Kocoń, 2014). The researches prove, that ticks are more often present in the Polish cities; it is slowly becoming a common phenomenon, moreover, they are potentially infected with disease-causing pathogens (Peťko et al., 1997; Karbowski, Siuda, 2001; Siuda et al., 2005; Kiewra, Sobczyński, 2007). Due to the fact that *I. ricinus* is a very good vector of pathogens of the transmission diseases, its medical and veterinary importance is very significant. The increasing spread of this species to new areas, as well as a large number of diseases transmitted by these parasites, is the result of the occupation of new habitats, and this is due to, among others, climatic changes (Wójcik-Fatla et al., 2009). The increase in temperature and air humidity may lead to the increased risk of contact with ticks, which play an important role in the transmission of pathogenic microorganisms and transferring of pathogens to humans and animals (Derdáková et

al., 2003; Cuber et al., 2010). Pathogens in the body of this parasite can stay for a long time, as well as they may also be transferred to its hosts. In Poland, the most dangerous diseases transmitted by *I. ricinus* include, among others: Lyme disease, tick-borne encephalitis, human granulocytic anaplasmosis and babesiosis (Nowak-Chmura, 2013).

The rhythm of the seasonal activity of *I. ricinus* depends largely on the geographical location. The one peak, autumn-winter-spring rhythm, occurs in the Mediterranean area (Senevet, 1937). Heading north, the seasonal activity of the parasite changes, the spring-summer period of activity increases, and the winter one can disappear (Siuda, 2002). In Poland there are two peaks of activity: the first one, the most prominent one – the spring peak (between spring and summer) and a less pronounced one – autumn (between summer and autumn) (Kolpy, 1963; Siuda et al., 2001; Nowak et al., 2009). Most studies on the course of the seasonal rhythm of activity of *I. ricinus* were conducted in the province of Lesser Poland (Urbanowicz, 2000; Siuda et al., 2001; Nowak, 2001; Góra, 2006; Solarz et al., 2007; Szubryt, 2014). The researchers found the presence of the clear spring peak in the months of April/May, and the lack or a small increase of the autumn activity of ticks. In the north part of the country, also two peaks of activity were observed: the largest one – spring, and the smaller one – autumn (Wegner et al., 1997; Humiczewska, 2007; Stańczak et al., 2012).

Own studies performed once a week in the afternoon in the area of Ujsoły from April to October confirm the occurrence of a clear increased tick activity in the spring and summer months (April, May, June), and a lower autumn activity (September, October). The research of the seasonal activity rhythm of *I. ricinus* is very important due to the growing epidemiological importance of this parasite in Poland, and can facilitate the identification of the areas, where the threat of tick attacks occurs in the country, and a better understanding of the mechanism of the circulation of dangerous pathogens in nature. Residents of Ujsoły and the surrounding area, as well as numerous tourists, workers of the forestry and agriculture, are exposed to the attack by the parasite during its highest spring activity and to a lesser degree in the period of the autumn activity. On the basis of such studies it is possible to determine when, at what time, there is a danger of meeting *I. ricinus* waiting for its host, what can increase the attention of people.

There is a possibility of protection against the attacks of the common tick, the following protections should be used for this: (1) use clothing suitable for going out into the countryside, thanks to which the tick will not be able to move to the bare body (long trousers, high shoes, long-sleeved blouse, head and neck protection), (2) avoid the typical places of the tick occurrence (forest paths, animal tracks, forest edges, mid-forest clearings), places overgrown with tall grass, lush vegetation, (3) use special measures in the form of sprays, creams, which repel ticks, both in humans and animals (collars, drops), (4) check the body and clothing, during the walk/trip and after

returning home, whether the ticks are not accidentally on our body and clothing, we remove the planted parasite using tweezers or special pliers available in pet stores and pharmacies. Remember also about looking at the body and fur of the pets.

In recent years, the number of people suffering from the tick-borne diseases has significantly increased. The fauna scientific research dealing with broadening knowledge on the occurrence, distribution of ticks, as well as the seasonal and daily activity of these parasites, largely contributes to knowledge of their biology, and thus the participation of ticks in spreading dangerous pathogens of the transmission pathogens.

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Abstract

Ixodes ricinus (castor bean tick) is a ruthless parasite with the greatest medical and veterinary significance out of all the ticks found in the Polish fauna. The research on the incidence and spread of this species was conducted in six selected research areas in the urban area of Bielsko-Biała and in the rural areas of Ujsoły and Złatna. Another variable covered by the research was the seasonal activity of *I. ricinus* in three selected research areas in Ujsoły. The researched locations include recreational areas near rivers, forests, and hiking trails. They are frequented by tourists and cyclists. In studies faunal a total of 60 tick specimens belonged to the *I. ricinus* and were collected with the flagging method. The ticks were stored in test tubes filled with 96% ethanol. The analysis focused on the parasite's taxonomic position and developmental stages. During the observation of the seasonal tick activity, the parasites were placed in dry tubes. Once their taxonomic position and developmental stages were diagnosed, they were released into the wild (a total of 875 ticks collected belonged to the *I. ricinus*). The observations and studies indicate the widespread and increasingly high incidence of this dangerous parasite, which means there is a high risk of tick-borne diseases in both urban and mountain areas of the Żywiec and Silesian Beskids.

Key words: *Ixodes ricinus*, seasonal activity, Silesian province, southern Poland, Żywiec and Silesian Beskids

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Zagrożenie atakami kleszczy *Ixodes ricinus* na wybranych obszarach w Beskidzie Żywieckim i Śląskim (województwo śląskie – południowa Polska)

Streszczenie

Ixodes ricinus (kleszcz pospolity) to bezwzględny pasożyt o największym znaczeniu medycznym i weterynaryjnym spośród wszystkich kleszczy występujących w polskiej faunie. Badania nad występowaniem i rozprzestrzenieniem tego gatunku były przeprowadzane na sześciu wybranych obszarach badawczych na terenie miejskim w Bielsku-Białej i na terenie wiejskim w miejscowościach Ujsoły i Złatna w województwie śląskim. Badaniami objęto również aktywność sezonową *I. ricinus* na trzech wybranych obszarach badawczych w Ujsołach. Wybrane do badań obszary reprezentują miejsca rekreacyjne, położone w pobliżu rzek, lasów, szlaków turystycznych, chętnie odwiedzane przez turystów i rowerzystów. W badaniach faunistycznych zastosowano metodę flagowania, dzięki której zebrano łącznie 60 okazów kleszczy należących do gatunku *I. ricinus*. Kleszcze przechowywano w próbkach wypełnionych 96% alkoholem etylowym, a następnie analizowano pozycję taksonomiczną i stadia rozwojowe pasożyta. W trakcie obserwacji sezonowej aktywności kleszczy, pasożyty umieszczano w suchych próbkach i po rozpoznaniu pozycji taksonomicznej i stadiów rozwojowych, wypuszczano je na wolność (łącznie zebrano 875 osobników kleszczy należących do gatunku *I. ricinus*). Przeprowadzone badania i obserwacje wskazują na powszechne występowanie tego groźnego pasożyta, a zarazem wskazują na duże niebezpieczeństwo wystąpienia chorób odkleszczowych, zarówno na terenach miejskich, jak i górskich Beskidu Żywieckiego i Śląskiego.

Słowa kluczowe: *Ixodes ricinus*, sezonowa aktywność, Polska Południowa, Beskid Śląski i Żywiecki

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