EXPLORATION OF THE RECREATIONAL POTENTIAL OF THE NATURAL MONUMENT SIXOVA STRÁŇ ON THE SURROUNDING EPIGEON

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Abstract
During seven months in 2020, we studied the epigeic component of arthropods in the Sixova stráň Nature Monument, Krupina District (Slovakia). The aim of this work was to determine the influence of recreational and tourist potential of the Sixova stráň Nature Monument on the epigeon. We used baited ground traps to collect epigeic material, and the study area consisted of three sites (andesite (A), marsh (M) and forest (L)); we distributed 15 change traps with 24-h exposure. We obtained 1,233 epigeon representatives. Site A showed the highest variability in the number of species. Plot L had the highest number of individuals (483) followed by plot A (347) and plot M (303) contained the fewest individuals. We found a statistically significant difference in the abundance of beetle species detected, between sites A and L ($p \leq 0.01$) and between sites A and M ($p \leq 0.05$). There was no statistically significant difference between sites M and L. Species identity of beetles according to Jaccard was 30% between sites A and M, 23.8% between sites A and L, and 25.9% between sites M and L. We did not confirm an effect of recreational and tourist potential on epigeon in that site.

Key words: Coleoptera, tourism, swamp, ground traps

Introduction
Forest landscapes, in addition to being a biodiversity heritage, are a typical part of Mediterranean mountain landscapes (Cillis et al., 2019). These landscape types have been shaped by human activities over the centuries. The Six hillside is characterized by a forested montane habitat and an oval-shaped marsh, formed from the extraction of high-quality andesite and the subsequent partial flooding of this abandoned pit quarry. From a forestry point of view, the site is classified as a loess beech woodland and has significant tourist and recreational value, due to its ecological and standing characteristics that make the hiking trails very suggestive and accessible (Bily et al., 2014). If at the beginning of the century, the ecosystems of mountain forests were threatened by excessive economic exploitation, nowadays the problem concerns the recreational use by people (Picuno, 2016). Tourism is associated with excessive human movement, noise, waste production, soil erosion, etc. (Bhat et al., 2014; Braunović & Perović, 2017; Gössling & Hickler, 2006). Soil arthropods are just one of the multifaceted dominant indicators found in all habitats. Soil arthropods respond very rapidly to individual changes in the environment. As a result, information obtained from arthropod studies can be used to accurately characterize almost all aspects of the ecosystem (Shakir & Ahmed, 2015). Many authors use them to monitor the status of an area as well as to determine the factors that influence it (Palacios-Vargas & Mejía-Recamier, 2007; Peterkova et al., 2021; Tuf, 2013; etc.). In the small-scale site of the Sixova stráň Natural Monument in the cadastre of the town of Krupina, no research work has yet been carried out to detect the component of the epigeon in its species distribution. In this paper, we investigated the influence of the recreational and tourist potential of the Sixova stráň Natural Monument on epigeon. Each recreational area is specifically burdened by tourism; in this context, it is necessary to monitor these forest landscapes, both to assess their evolution for detailed analysis and restoration, and to assess their current status and future development. This analysis is essential for assessing the forest landscape in the light of ongoing recreational and tourist use.

Materials and methods
The Sixova stráň natural monument (fig. 1) is located in the southeastern part of the Štiavnické vrchy protected landscape area in central Slovakia and falls within the cadastral territory of the town of Krupina (48°22'41" N, 19°00'59" E). The site lies approximately 500 m above sea level with an area of 0.83 ha and an altitude of 549 m above sea level. It was designated as a Protected Natural Feature in 1985 to protect an outstanding example of columnar detachment of andesites, and Level 4 protection is in place at the site (Bily et al., 2014). These habitats are crossed by major hiking trails, so they are also the most attractive for tourists. The long-term average monthly air temperature is 7.83 °C, the

monthly atmospheric precipitation averages 59.46 mm and the average annual wind speed is 1.74 m.s-1 (Diviaková, 2011).

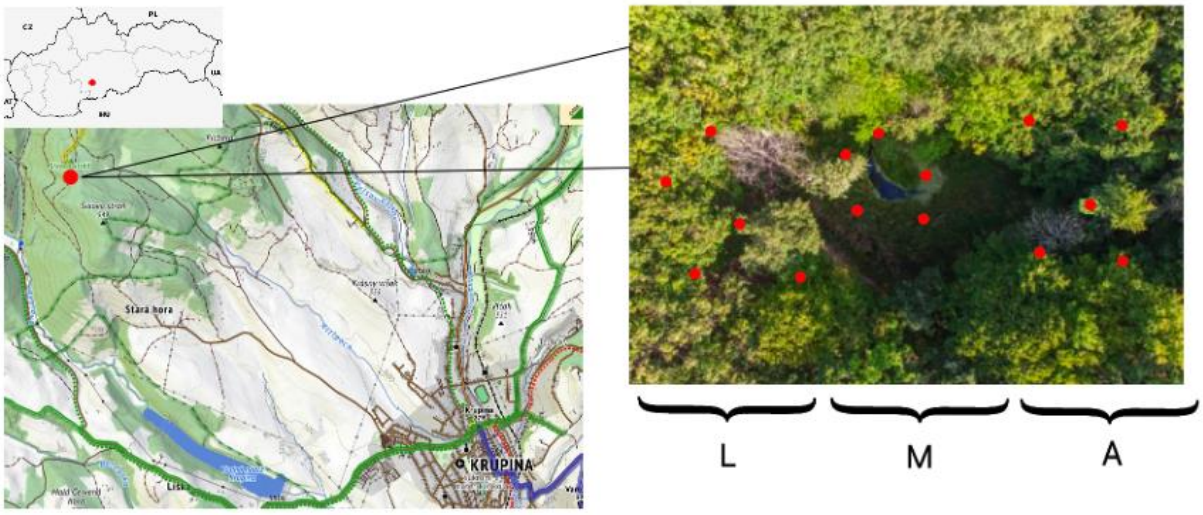

Fig. 1: Location of study area in Slovakia (L- forest, A- andesite, M- swamp)

The analysis of epigeic species in the area of the Sixova stráň was carried out on the basis of collections of epigeic material. For the collection of epigeic material, we used ground traps with meat bait (fine ham), thus focusing mainly on predatory individuals, which is a well-established method in this type of research (Bani et al., 2016; Gajdoš et al., 2019; Peterkova et al., 2021; Porhajašová & Šustek, 2011). The collection was carried out in the months of March to September, during one year 2020. The ground traps consisted of glass 7dcl jars, with a 75 mm diameter opening. The traps were buried in the soil, with the rims of the jars reaching the same height as the relief height. Fifteen traps were deployed at three sites (L- forest, A- andesite, M- swamp) and distributed once a month with a 24 h exposure (Fig. 1). We divided habitats into recreational (A and M) and non-recreational (L). Determination of epigeic species was done in situ using identification keys and atlases (Brtek, 2001; Záhradník & Severa, 2007). The statistical set obtained by the analyses had a normal distribution. To determine normality, we used the Shapiro-Wilks test. We further subjected the obtained data to statistical processing, using the paired Wilcoxon test to compare recreationally used areas and non-recreationally used areas in terms of the abundance of individuals.

Results

During seven months in 2020, we collected material consisting of 1233 specimens, of which 17 groups were arthropods, 3 groups were other invertebrates and one group was vertebrates. Further, we dealt only with the phylum Arthropoda. Eudominant groups of arthropods in the study areas were Formicoidea (42.89%) and Coleoptera (10.22%). The dominant groups were represented by Araneae (6.89%) and Collembola (6.65%). The subdominant groups were Opiliones (4.30%), Isopoda (2.35%) and Diplopoda (2.19%). We found a statistically significant difference in the abundance of beetle species detected, between sites A and L ($p \leq 0.01$) and between sites A and M ($p \leq 0.05$). There was no statistically significant difference between sites M and L. Species identity of beetles according to Jaccard was 30% between sites A and M, 23.8% between sites A and L, and 25.9% between sites M and L. We did not confirm an effect of recreational and tourist potential on epigeon in that site. The number of representatives of each group at the site in the recreation area was (andesite- 347 individuals, swamp- 303 individuals), while the representation of individuals in the non-recreation area was (forest- 483 individuals). Figure 1 is based on the mean values of recreation and non-recreation areas. The mean value of the recreation area (andesite and swamp) consisted of 10 ground traps and the non-recreation area forest consisted of 5 ground traps.

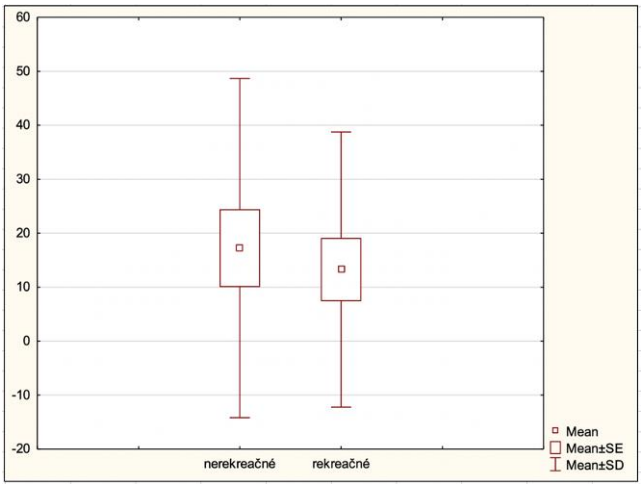

Chart 1: Average number of individuals in recreational and non-recreational areas

We did not observe a statistically significant difference between the recreational and non-recreational area (p= 0.08).

Discussion

Although many papers report the impact of humans during tourism and recreation on biodiversity, the data we collected are not consistent with these findings (Bhat et al., 2014; Braunović & Perović, 2017; Gössling & Hickler, 2006). The Sixa Strana Nature Monument shows no signs of waste pollution and is also subject to a high level of nature protection. On the other hand, the area is sought after for its interesting nature and recreation, which is likely to appeal especially to visitors who are interested in respecting the rules of nature conservation. Okello and Kiringe (2004) state that tourism is not the primary threat to biodiversity. Fanini et al. (2014) investigated the impact of small-scale non-commercial beach parties, which are commonly held in Greece, by analysing the impact of trampling stress, through captures obtained using traps placed at research and control sites. The results indicate the sustainability of small, time-limited parties. Based on the present work and other works mentioned, we conclude that there is a certain sustainable level of recreation and tourism, without disturbing the epigeon of the landscape. To more accurately track the sustainability of recreation and tourism, it is necessary to expand the monitoring to include more plant and animal species with regular repetition.

Conclusion

The Six Slopes Natural Monument represents a recreation and tourism area that has been impacted by human activities over a long period of time. As the area contains an andesite deposit, a marsh and a forest, all of which are differentially impacted by tourism, it represents a suitable site for investigating changes in the epigeon. Our research showed a statistically insignificant difference between the area visited by people and the area not used recreationally. Epigeic representation as well as abundance of individuals were not significantly different. Since the research was carried out for only one year, it is advisable to repeat the investigation. The present work can inform sustainable recreation in the studied Sixa Strana Nature Monument.

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Souhrn
Přírodní památka Sixova stráň představuje rekreační a turistickou oblast, která je dlouhodobě ovlivněna lidskou činností. Vzhledem k tomu, že se v oblasti nachází andezitové ložisko, mokřad a les, které jsou různě zatíženy turistickým ruchem, představuje tato oblast vhodnou lokalitu pro studium změn u epigeonu. Během sedmi měsíců v roce 2020 jsme pomocí zemních pastí nasbírali materiál čítající 1233 jedinců. V následujícím textu jsme se zabývali pouze fylogenezí Arthropoda. Počet zástupců jednotlivých skupin na lokalitě v rekreační oblasti (andezit, bažina) byl 650 jedinců, zatímco zastoupení jedinců v nerekreační oblasti (les) bylo 483 jedinců. Zjistili jsme statisticky významný rozdíl v početnosti zjištěných druhů brouků mezi lokalitami A a L a mezi lokalitami A a M. Mezi lokalitami M a L nebyl zjištěn statisticky významný rozdíl. Nebyl zjištěn statisticky významný rozdíl mezi rekreačními (lokality A, M) a nerekreačními oblastmi (lokalita L). Náš výzkum ukázal statisticky nevýznamný rozdíl mezi oblastí navštěvovanou lidmi a oblastí, která není určena k rekreaci. Předkládaná práce může sloužit jako podklad pro současnou udržitelnou rekreaci a cestovní ruch v přírodní památce Šest svahů. Předpokládáme také, že rozšíření cestovního ruchu a rekreace do dalších podobných lokalit nebude mít vliv na místní entomofaunu.

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