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The Impact of Past Human Activities on the Current State of Vegetation in Historical Settlements of a Wine-Growing Cultural Landscape (Svätý Jur, Slovakia)

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Abstract: The aim of our study is to reconstruct the human influence on the current vegetation in selected parts of the cadastral territory of Svätý Jur. Svätý Jur is a town with more than 700 years of winemaking tradition, located on the oak-hornbeam-forested slopes of the Little Carpathians and surrounded by terraced vineyards. Human activity has changed the natural landscape of Svätý Jur since the Neolithic period. It is possible to trace the influence of past human activities on current vegetation by mapping vegetation onto historical landscape structures. For our research, we chose two study sites—Biely Kameň Castle and Hillfort Neštich. Our research has shown that there are significant differences in plant communities as well as in their environmental requirements between the investigated sites. Nitrophilous species indicative of human activities were recorded at both sites. At Hillfort Neštich, we recorded the occurrence of an interesting combination of species of *Atropa*, *Phytolacca* and *Rubus*. We have recorded their current occurrence and searched for its causes. In addition, we evaluate the current state of the vegetation of the castle and the hillfort in relation to the human past and today's use.

Keywords: Svätý Jur; human impact; vegetation; cultural landscape

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1. Introduction

The formation of vineyard landscapes is related to the presence of suitable natural conditions for the development of viticulture, viticultural activities and settlement. The vineyard landscape has its historical value, which is the result of transformations and cultural practices over the centuries [1,2]. Through gradual formation, human activity has transformed the landscape, and these activities have influenced vegetation patterns and the evolution of ecosystems [3]. Remnants of abandoned vineyards [4], changes in vineyard management (traditional cultivation methods or new intensive cultivation methods) [5], as well as remnants of historical settlement are recorded in the landscape [6]. These changes affect the current state of the vegetation [7–9].

Humans have been spreading other species to new parts of the planet for centuries. The introduction of plants is as old as agriculture itself and it will continue for as long as people walk the earth's surface [10]. These non-native taxa have been introduced not just intentionally, but also accidentally. Species invasions can be documented throughout the fossil record, which can help understand the long-term impacts of invasive species on modern biodiversity [11]. Since the introduction of agriculture to Central Europe ca. 7000 years ago, synanthropic plants have become increasingly widespread in the area. Nowadays, permanently established non-native species constitute 10–20% of the local floras in Central Europe [12]. Cultural heritage sites such as historical or sacred areas provide suitable habitats for plants, but they also provide opportunities for invasive species, whose impact on these sites is causing increasing concern, to spread [13].

Several authors have studied vegetation on historic structures. Studies have analysed the recovery of natural vegetation on archaeological sites [14], vegetation on historic roads [15] and biodiversity conservation [16]. In wine-growing areas, vegetation studies have focused on research on abandoned vineyards [17,18]. Several studies confirm that past human activities have altered the chemical and structural quality of the soil and influenced the current state of vegetation [8,9], as many remnants of settlement and other human activities are often preserved below the surface of the current landscape [19]. However, there is still a gap in the research on non-native flora growing in heritage sites. Specific studies are needed to clarify this trend [13].

Through the occurrence of chemical compounds, it is possible to reconstruct past activities in a particular area (meat and fish processing, farmland, residential areas, midden, etc.) [20]. It has generally been assumed that phosphorus and its concentration in the soil is a crucial factor [8,21,22] but according to Hejcman [9], a pH change is particularly important. These soil changes are reflected in the current vegetation [9,23–25].

Grasslands and historic agricultural structures, which represent habitats with a higher species richness, are the most studied [9,25], but forests provide an exceptional environment that has the ability to preserve the remains of past human activities better than arable land and grasslands, which tend to be more affected by current human activities in the landscape [19].

The beginning of the formation of the wine-growing landscape in the area of the Little Carpathians in Slovakia can be placed in the Middle Ages. It is assumed that the cultivation of vines in this area began already in the 11th century [26]. Due to microclimatic influences on vine quality, vineyards are often established on hillsides, taking advantage of the hillside aspect to optimize solar radiation for yield [27]. The first significant settlement of Svätý Jur occurred in the period of Great Moravia, when the Neštich settlement was built at the foothills of the Little Carpathians as a military-administrative and production centre [28]. The hillfort area was inhabited until the 13th century. In this period, due to political changes and the need to protect the Kingdom's territory, the Biely Kameň Castle was built on the other side of the valley. Since the 13th century, the premises of Hillfort Neštich have been used only occasionally, as a refuge during wars and unrests. The castle and its surroundings served as the administrative centre of the area from the 13th century until the 17th century. The aristocratic family of Pálfi moved to a manor house in the town in the 17th century and the castle began to fall into ruin [29]. Nowadays the hillfort is overgrown with forest, and only the remains of protective ramparts and traces of archaeological research are visible. There are open archaeological probes in the forest and heaps of soil from research near them. The castle ruins, surrounded by the Little Carpathian Forest, have currently been preserved.

Changes in the composition of the current forest vegetation were studied on former agricultural land in America, and the results indicate that the current state of the forested landscape is influenced by the former use of the land [30–32]. These conclusions are also supported by research carried out in Belgium, which showed changes in the species composition that were influenced by past land use; the research also dealt with former agricultural land [33]. Similar conclusions were also proven in the case of forest vegetation at the site of a former Roman settlement in France. It has been shown that the current biodiversity increases towards the centre of the settlement [34]. According to Hejcman [9], who carried out research in Central Europe, biodiversity depends on the type of historical land use, and former buildings and settlements represent places with higher biodiversity compared to, e.g., abandoned gardens.

The vegetation on the remains of the medieval settlement has received less attention in Svätý Jur. Vegetation was only mapped at the site of Biely Kameň Castle in 2003 [35]. For this reason, we focused specifically on the historical sites of the castle and hillfort. The aim of our research was to record the current state of vegetation at the abandoned historical sites and to determine whether and how past human activities have affected the state of the current vegetation. For this research we have chosen sites that in the past functioned as the administrative centre of the area and had a great influence on the formation of the vineyard landscape. We hypothesize that past human activities may influence the current state of vegetation. To verify our hypothesis, we have mapped the current state of vegetation on these historical sites and analysed phytocenological relevés. By using Ellenberg's indicator values, we have assessed ecological conditions and compared the two study sites.

2. Materials and Methods

2.1. Study Area

The study area is located in the cadastral territory of Svätý Jur, where we focused on the area of Hillfort Neštich and Biely Kameň Castle. The area of cadastre is located in the northwestern part of Slovakia, in the Bratislava Region and Pezinok District (Figure 1). The territory of Svätý Jur is geographically situated partly in the Little Carpathian Mountains and partly in the Danubian Plain [36,37]. While a moderately humid climate dominates in the mountains, a moderately dry climate prevails in the lowland part of the cadastre [38]. The average temperature in January in the lowlands is −1.9 °C, while the temperature in the mountains is −3.8 °C. The average summer temperature, namely the average temperature measured in July, is 20.4 °C in the lowlands and 17.5 °C in the highlands [37]. The northern part of the territory has a geological substratum consisting mainly of Palaeozoic granite and granodiorite [39]. Acidic Cambisols have formed soils in forest communities of mainly oak-hornbeam forests. Neutral-to-alkaline soil types are found in areas where vineyards are nowadays common. The vegetation is influenced by agricultural activity to a large degree and includes hornbeams, linden and various fruit trees. Among the herbs, there are representatives of ruderal species typical mainly for vineyards and fields, e.g., *Galium aparine*, *Anthemis arvensis* or *Geum urbanum*. The southern part of the area extending into the Danube Plain consists of gley fluvisols. The nature reserve, Šúr, is located in the southern part of the area, on the Danube floodplain. This area is one of the 14 Ramsar sites on the List of Wetlands of International Importance in Slovakia [40]. The soil here consists of organosols, which allowed the formation of woodlands of ash–elm–oak forest [18,41].

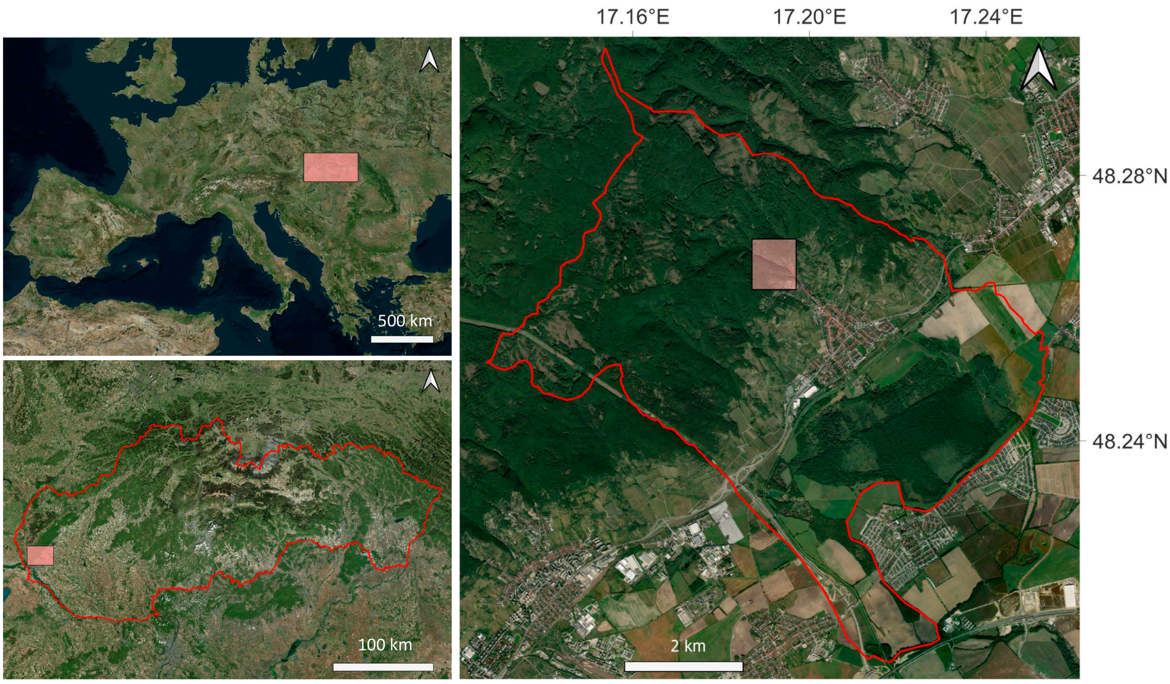

Figure 1. Geographical location of the study area Svätý Jur.

In our study, we focused on two historical sites—the areas of Hillfort Neštich and Biely Kameň Castle. The historical development of the researched area is described (Figure 2) [28,29].

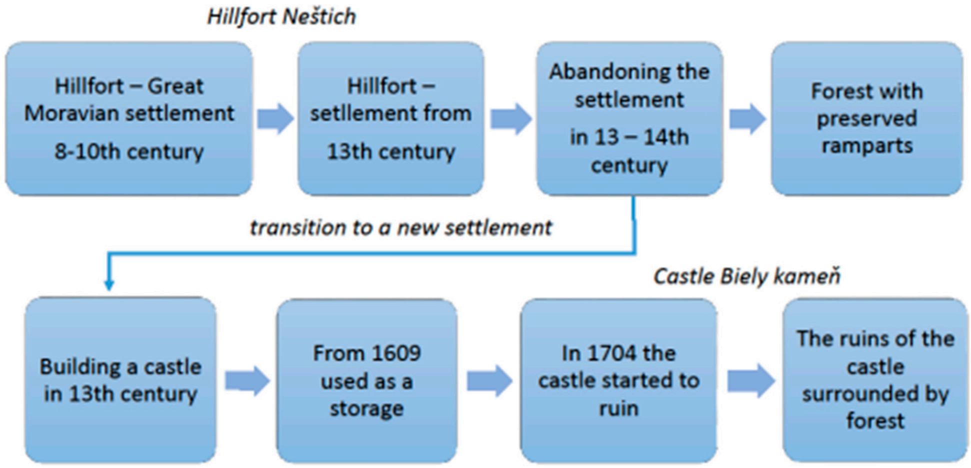

Figure 2. The historical development of the researched area.

Hillfort Neštich (342 m above sea level) is located above the populated part of the city Svätý Jur. Its area is approximately 20 ha. The hillfort reached its greatest growth during the period of Great Moravia, when a fortified system of ramparts and ditches was also created. Currently, the remains of ramparts have been preserved and former settlement is documented mainly thanks to archaeological research. The first archaeological research on this site was carried out in the 20th century. Since 2006, a new systematic study has been carried out, during which 16 archaeological probes were uncovered and various structures and buried objects were discovered [28]. Because the research is carried out systematically and individual parts of the original settlement are uncovered slowly, these probes are noticeable in the forest, and their immediate surroundings are affected by the activities of archaeologists. There are excavated probes in the area of the hillfort; if they are not currently being worked on, they are winterized with a canvas. During the excavation, piles of soil are concentrated around the probes; these remain open and thus provide new habitats for vegetation. As both sites are visited by archaeologists and tourists, it is possible that this increased number of visitors may cause the transport of ruderal or invasive species to the site.

The castle (300 m above sea level) is located on the other side of the valley opposite the hillfort. The castle was abandoned in the 17th century. Some of the remains of the castle walls and fortifications are preserved to this day. The castle walls were built of stone, laid on mortar. Currently, the castle area consists of the walls of the former castle, a large part of which is in ruins, but some parts, such as the part near the entrance gate, have been preserved. During the research, we also mapped the vegetation close to the castle walls, but most of the records come from places where the walls have already collapsed, meaning the stones and mortar form a component of the soil on which the mapped vegetation was present. The location is a popular tourist spot and is managed by the Castrum Sancti Georgii Association. The courtyard of the castle was deforested due to the start of reconstruction works [42]. The surroundings of the castle are wooded. Archaeological research has begun on this site, and in the coming years it is feasible to expect a significant impact of these activities on the composition of the vegetation.

2.2. Methods

Phytocenological research at the sites of Hillfort Neštich and Biely Kameň Castle was carried out between July and 31 August 2022. Relevés at the hillfort site were recorded. At the castle site, we recorded 11 relevés. The area of the relevés was set at 100 m^2. After a preceding exploration of the survey area, the sampling plots were placed in order to obtain the most representative data possible. Relevés were located on assumed typical, homogeneous, representative or undisturbed vegetation areas and the presence of building remains and archaeological probes were considered. GPS coordinates of each relevé were recorded.

Layer cover was recorded, and mosses were not collected in this research. We recorded the list of vascular plant species within each plot and the percentage of cover of each species using the modified Braun-Blanquet cover/abundance scale [43]. A large key to the determination of higher plants I. and II. was used for determination [44,45], and Slovak botanical nomenclature of vascular plants was used for terminology [46]. The relevés were stored in the TURBOVEG database [47] and Juice software version 7.1 [48] was used for further data processing and analysis.

We applied Ellenberg indicator values, as they are widely used indicator values in Central Europe, to define the habitat conditions. It is concluded that the Ellenberg indicator system provides a very valuable tool for habitat calibration, provided the appropriate parameters are considered [49]. Wamelink et al. [50] advise only using Ellenberg IVs for comparison within the same vegetation type. The relevés were recorded in the same vegetation type. Ellenberg's ecological numerical indices were evaluated for the following factors for each record: light, temperature, continentality, moisture, soil reaction and soil nitrogen content [51].

For better characterization of the sites, we determined residence time and invasive status for all species [52,53]. To determine the residence time and invasion status of all species, we used the publication inventory of alien flora of Slovakia [52]. To characterize this status, authors have used the definition of Richardson et al. [54]. Naturalized alien species were defined as species which reproduce regularly, forming stable populations lasting for many life cycles. Invasive species are naturalized aliens whose propagules are able to spread over a considerable area. To indicate the residence time of taxa, Medvecká et al. [52] have used the terms archaeophyte, alien species introduced to the region from the beginning of Neolithic agriculture up to the year 1500, and neophyte, introduced after this date. To indicate the invasion status of a taxon, the terms casual, naturalized and invasive were used. According to this, casual taxa are defined as alien taxa that may flourish and eventually reproduce in an area but do not form self-reproducing populations. Naturalized alien species reproduce regularly, and they are forming stable populations. Invasive species are defined as naturalized aliens able to spread over a considerable area. The results of the mapping were processed in Excel and Power Query.

To compare the plant species composition between the castle and hillfort, we conducted non-metric multidimensional scaling (NMDS). NMDS is an indirect ordination and gradient analysis method [55] showing the relationships among vegetation types.

Finally, the hillfort and castle sites were compared with each other based on plant community composition and this comparison was visualized based on Ellenberg's values with box plots. At the hillfort site, we recorded two types of relevés. Relevés marked with letters were recorded in the forest, and relevés marked with numbers were recorded on plots with ruderal vegetation, which were well-lit and more open. We also compared these two types of relevés. Maps showing the geographic location of each site were created in QGIS [56].

3. Results

Overall, 128 species of vascular plants were found in the study area. At the hillfort site, 38 plant species were recorded. At the castle site, the highest species richness was reached and 90 species were recorded.

3.1. Hillfort Neštich

In total, 31 phytocenological relevés were recorded at the hillfort site, while 29 relevés were coming directly from the area and 2 relevés from the ramparts behind the hillfort. At this site, we also recorded the occurrence of the lichen species *Phytolacca*, *Rubus* and

Atropa. Records with the occurrence of these species were marked with a number, and at sites where these species were absent, records were marked with a letter.

In the relevés marked with a number (Figure 3a), *Carpinus betulus* dominated significantly in the tree stages. The second dominant species was *Quercus petrea*, dominant directly on the acropolis of the hillfort. In lower abundance, we also recorded species such as *Acer campestre* and *Acer pseudoplatanus*, *Fagus sylvatica*, *Sambucus nigra* and *Tilia cordata*. *Ailanthus altissima*, an invasive woody plant, was also recorded. In the tree layer, *Rubus caesius* and *Melica uniflora* dominated in records. We have also recorded the occurrence of the species *Brachypodium sylvaticum* and *Dactylis glomerata* quite frequently at Hillfort Neštich. *Phytolacca americana* was recorded in the southeastern part of the acropolis. *Atropa belladonna* occurred in the acropolis in records together with *Phytolacca americana*, but also in records from the outer bailey. Hornbeam and common beech dominated strongly in the tree layer in the relevés marked with a letter (Figure 3b). In the herb layer, *Melica uniflora* was strongly dominant. In addition, we recorded a higher abundance of *Brachypodium sylvaticum* and *Hedera helix*. A significant difference between the records was in terms of species diversity. In the numerical relevés, we observed a higher number of species than in relevés marked with a letter.

(**a**) (**b**)

Figure 3. Hillfort example of relevé with number (**a**); hillfort example of relevé with letter (**b**).

3.2. Biely Kameň Castle

The tree species *Carpinus betulus*, *Quercus petraea* and *Acer campestre* are dominant in the area. The most frequently present species were *Melilotus officinalis*, *Poa nemoralis* and *Viola odorata*, *Euphorbia cyparissias*. Outside the area close to the castle, *Melica uniflora* was the most dominant species. Species from the tree layer reached higher cover around the castle site, which is related to the management of the site. The inner bailey with preserved remains of walls is deforested. The site has been cleaned up in recent years (Figure 4) due to the start of the castle reconstruction.

Figure 4. Castle locality.

From a residence time point of view, native species were dominant at all sites (Figure 5). At the castle, native species comprised 86.90 % and at Hillfort Neštich they comprised 81.08%. The proportion of archaeophytes and neophytes was similar at both sites (7.44%). More archaeophytes (8.33%; seven species) were present at the castle than at the hillfort. *Juglans regia* dominated at both sites. Of the herbs, *Melilotus officinalis*, *Viola odorata* and *Lactuca serriola* were the most frequent archaeophytes. Neophytes represented only 4.76% of the species (four species) at the castle. Trees were represented by invasive *Robinia pseudoacacia*. In the herb layer, invasive *Impatiens parviflora* had a relatively large spread. At the hillfort, the biggest difference between neophytes and archeophytes was recorded, and neophytes dominated at this site. The group of archaeophytes was represented by only two species, *Lactuca serriola* and *Viola odorata*. *Robinia pseudoacacia* was the only species that we classify as a neophyte in the records marked with letter. The other neophyte species occurred in records with a number. The most frequently occurring neophyte was *Impatiens parviflora*. Besides that, the *Phytolacca americana* was also quite abundant in the relevés. The most frequently occurring invasive species in the relevés was *Impatiens parviflora*. *Fallopia convolvulus* has the character of a domesticated non-native plant. We have recorded four invasive species in the area of the castle; in addition to the *Impatiens parviflora*, it was *Robinia pseudoacacia*, *Conyza canadensis* and *Erigeron annuus.* The other species were naturalized. Only *Avena sativa* belongs to the species that can occasionally become an escaped plant. A comparison of species based on invasive status showed that the highest percentage of invasive plants was recorded at the hillfort (10.81%). However, the number of species was the same as at the castle. The invasive plants at the castle were represented by *Robinia pseudoacacia* and *Ailanthus altissima* in the tree layer. Among the herbaceous plants, in addition to *Impatiens parviflora*, *Ambrosia artemisiifolia* and *Lactuca serriola* were also present. Other species such as *Phytolacca americana* are among the naturalized species.

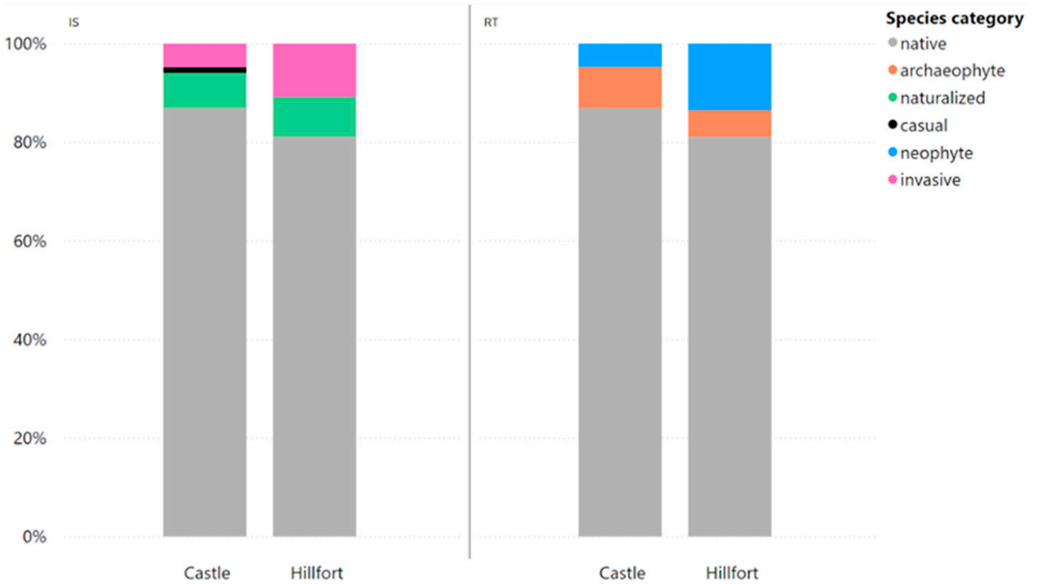

Figure 5. Residence time and invasive status of the species.

Non-metric multidimensional scaling (NMDS) was used to compare the composition of the plant communities between the castle and the hillfort sites (Figure 6). It indicated there are statistically significant differences between the castle and the hillfort at p values = 0.0001. It shows that the relevés from the edge of the hillfort (at the gate and rampart) are different and stand out from the analysis. Plant communities with the highest biodiversity were recorded on the acropolis and the courtyard. Surrounding forests have lower biodiversity and the transition between these two ecosystems create an ecotone.

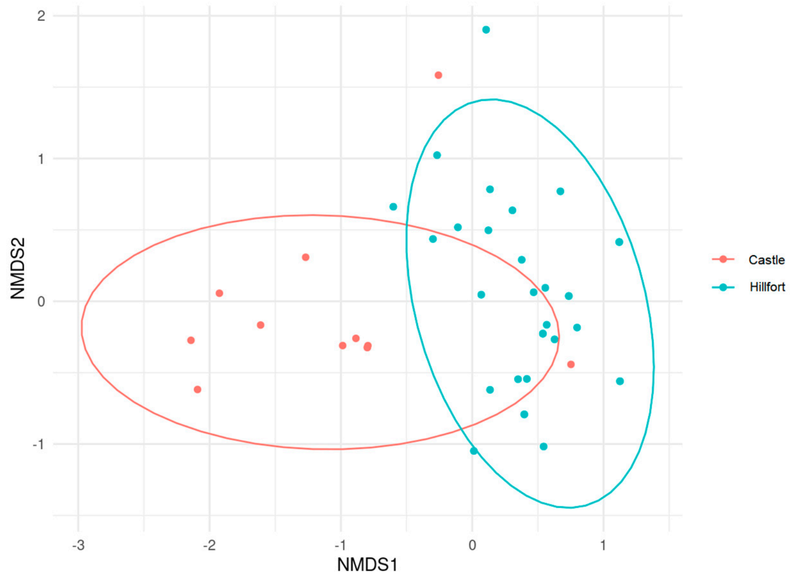

Figure 6. Non-metric multidimensional scaling of the composition of the plant community.

Similarly, analyses based on Ellenberg's values showed a significant difference between the castle and hillfort for soil reaction and moisture (Figure 7), $p = 0.0004652$ for soil reaction, and $p = 0.0000567$ for moisture. This showed that there are species that prefer acidic to mildly acidic soils, whereas the castle has mean Ellenberg's values that are more towards neutral to basic reaction. This may be due to the remnants of the castle walls decaying. The mortar from the walls decayed and became one of the soil components, raising its pH and creating suitable conditions for more alkaline species. Similarly, when analysing humidity, it appears that more hygrophilous species occur on the hillfort than on the castle. The remains, by being deforested, retain less water and create better conditions for more drought-tolerant species.

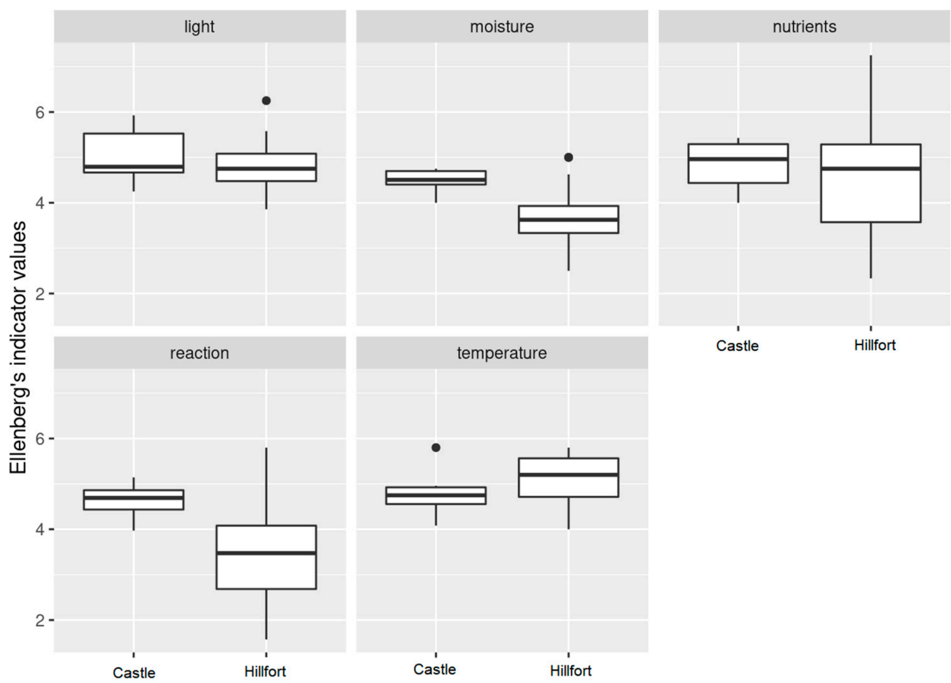

Figure 7. Box plots showing the difference between hillfort and castle based on Ellenberg's indicator values.

A closer look at two types of records at the hillfort reveal that according to the mean Ellenberg's values, they are statistically significantly different for moisture, light and nutrients (Figure 8). For light, $p = 0.0001729$; species in relevés marked with a number were more light-loving than species from relevés marked with a letter. The relevés marked with a number were recorded in the deforested part of the forest, whereas the relevés marked with a letter were from the forested part. When analysing humidity, the p-value reached 0.0327608. The more drought-tolerant species were found in the deforested parts of the forest and species that tolerate higher humidity occurred in the forested sites. However, it is interesting that nutrients also showed up as statistically significant at $p = 0.0009831$. Less nutrient-demanding species were recorded in the forested parts. Records from the deforested parts showed plants were more nutrient-demanding. We are also interested in the soil reaction, which seems to be slightly below the threshold of significance. The *p*-value for the soil reaction was 0.0741988. Species from the area, that prefer neutral to basic environments, include, e.g., *Rubus caesius* and *Atropa bella-donna*.

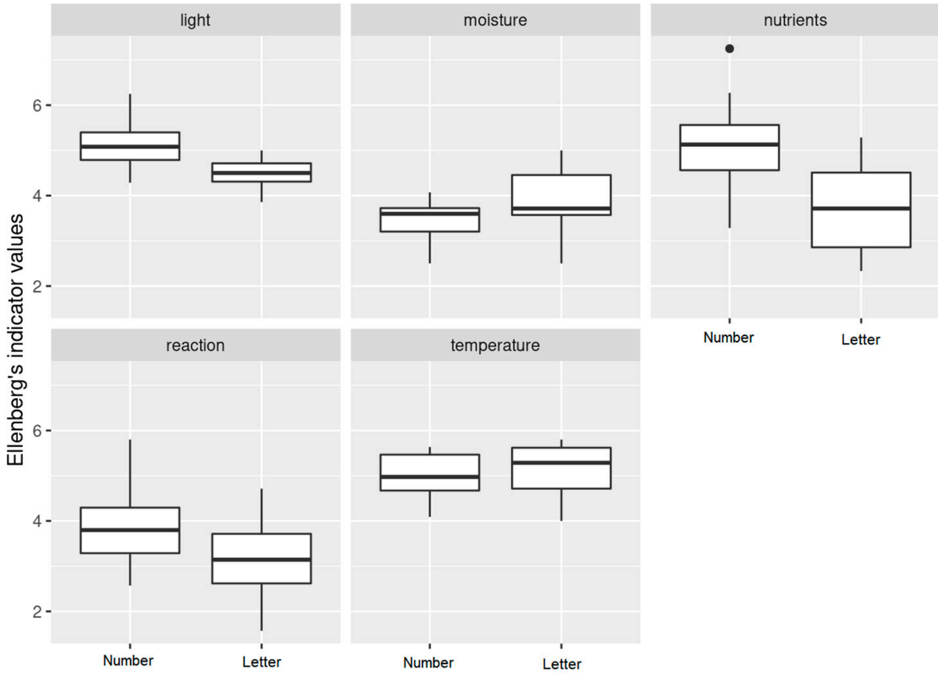

Figure 8. Box plots showing the difference between two types of records at the hillfort based on Ellenberg's indicator values.

The specifics of the castle vegetation are due to the different management of the site. The bailey of the castle has been deforested and the remains create different environmental conditions for vegetation than the other site. Comparing the two sites based on mean Ellenberg's indicator values, we have found significant differences. The differences are mainly related to soil reaction and moisture.

4. Discussion

By mapping the vegetation, we found that the castle and hillfort are distinct from each other. We compared species composition and Ellenberg's indicator values of each site. We demonstrated that past human activities at the castle site have altered environmental conditions in ways that affect the condition of the current vegetation. This was particularly evident in the case of soil reaction, where we recorded species at the castle that are characterized by growing in more basic soil than the typically slightly acidic soil in the vicinity. Studies of vegetation on castles and ruins describe anthropogenic influence on habitats. Castles create specific ecological conditions that are influenced by the degree of their preservation. They also represent places with higher biodiversity [57]. Human settlement activities are connected with the accumulation of nutrients in archaeological soils [58]. The higher pH of soil near the buildings and in locations with a high artifact content is probably related to the dispersal of lime mortar found in several ruins. Elements which can indicate past settlement activities are calcium (Ca) and magnesium (Mg). A higher accumulation of these elements on archaeological sites is caused by the use of Ca- and Mg-rich clay sediments for the construction of the buildings [9]. Also, deposition of mortar from the destruction of buildings can increase the amount of these elements [59], and the degree of their preservation or destruction influence their ecological conditions.

The impact of human activities on vegetation is reflected in the occurrence of nitrophilous and ruderal species. Such species in our case included *Aegopodium podagraria*, *Chelidonium majus*, *Galium robertianum*, *Viola odorata* and *Lamium purpureum*. The occurrence of nitrophilous species may be due to an increased concentration of people and animals, both in the past and nowadays (tourists) [35]. The occurrence of both ruderal and nitrophilous species was also observed to a lesser extent at the hillfort. Species such as *Urtica dioica* and *Atropa bella-donna* indicate human activities. We also recorded the occurrence of *Rubus caesius*, *Atropa bella-donna* and *Phytolacca americana*, which formed groups and inhabited the more lighted parts of the site, while the rest was a forest very similar to the forest behind the ramparts of the hillfort. It was therefore interesting for us to look at these groups separately. In particular, we looked at the soil reaction, where they could indicate traces of former (medieval) settlement. Archaeological research, after which excavated trenches will remain, is underway at the site. Vegetation reacts to this activity and therefore the presence of plants, such as *Phytolacca americana*, may also be ascribed to the increased movement of researchers. Research was carried out here in the second half of the 20th century; this has also significantly disturbed the site and could have an impact on the current vegetation. Modern research has been ongoing since 2006 and is carried out regularly, especially in the summer months [28]. We noticed ruderal species mainly on the acropolis of the hillfort and in the vicinity of excavated trenches.

Several studies have highlighted the impact of historical settlement on the soil, and consequently on the vegetation [8,21,60], as shown in research on a medieval village inhabited for only 60 years in the Czech Republic; even so, this short-term settlement 500 years ago had an impact on the soil pH [9]. In order to answer the question of whether past human activities at the hillfort have influenced the present state of vegetation, we analysed recorded species in terms of their ecological requirements (based on Ellenberg's values). We hypothesized that if the ruderal species relate to possible archaeological remnants in the ground, their soil reaction would show a statistical difference from the other group. The groups were statistically different in their light, moisture and nutrient values. The soil reaction was slightly below the threshold of significance. From the research to date, we cannot confirm with certainty that the occurrence of species that inhabit more basic soils with a higher concentration of nutrients (such as Urtica dioica, Rubus caesius and Atropa bella-donna) is related to changes in soil properties caused by medieval settlement. However, it is interesting that these species co-occur, for example, above the new archaeological probe, where the medieval building was found.

In the future, it would be appropriate to complement the research with soil chemical analyses [20,61,62], or to verify this with an archaeological trench. Both sites are part of tourist-visited places and are also affected by excavation works; therefore, the increased number of neophytes as well as invasive plant species can be attributed to the management of both sites. According to existing research [13], the presence of *Ailanthus altissima* on the monuments has constantly increased over the decades. Although this invasive plant is not frequent on archaeological sites, it is expected to become more and more widespread on them. The problem of invasive species in castles and historical sites is highlighted by Eliáš [57]. According to him, *Impatiens parviflora* is one of the most typical invasive species inhabiting such historical sites. This species was recorded in the hillfort. We also recorded the highest biodiversity at the castle. Due to the start of reconstruction works and archaeological research (in the season of 2022 and currently), it can be assumed that the composition of the vegetation will change. Research is limited by the current use of the land, which is evident in both locations. In the case of the hillfort, archaeological research and the movement and activities of researchers act as one of the factors influencing the territory. In the case of the castle, it is mainly a higher number of tourists and works related to reconstruction, which, however, began to have a significant impact on the castle only last year. Sites of historical importance in the Svätý Jur deserve more attention from botanists, also because of the occurrence of interesting species such as *Actaea spicata* in the castle site, the occurrence of which has radically decreased in the Little Carpathians [63] and the species *Ruscus hypoglossum* in the hillfort [64], which we also recorded in the area.

5. Conclusions

The phytocenological study of vegetation has shown that there are differences in species composition between two study sites, Biely Kameň Castle and Hillfort Neštich, located in the forested area of the Little Carpathians. Both sites are popular with tourists and both sites belong to protected areas. The difference character of the castle site in terms of vegetation composition can be explained by activities such as long-term archaeological research. Many ruderal species (*Urtica dioica*) have been recorded near the archaeological probes. The castle was deforested due to the beginning of reconstruction works. The vegetation is in direct contact with the preserved parts of the castle, which also presents different conditions (soil reactions) than at the hillfort. The differences in vegetation at the hillfort site can also be caused by the management of the site. In the overshadowed parts, there are different conditions, which cause colonizing by different plant species. In the well-lighted parts, more light-loving and more drought-tolerant species are concentrated. The well-lighted parts were especially formed after the uprooting of trees. Such places are most often colonized by species such as *Rubus caesius*. The character of the forest vegetation in the cadastre of the municipality of Svätý Jur is different on historical sites. Neophytes and invasive species were observed at both sites. Management at the sites influences the species composition and the occurrence of invasive plant species.

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