TRADITIONAL COPPICE MANAGEMENTS AT THE LANDSCAPE LEVEL ALONG WITH RECREATIONAL USE

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Abstract
Our current goals in forestry involve safeguarding the land and environment, optimizing the forest's ability to absorb CO_2, maintaining the health and integrity of forest ecosystems, and preserving biodiversity and landscape variety. Ensuring the long-term productivity, socio-economic viability, and environmental functions of European forests and woodlands, including coppice woodlands, is crucial. Addressing these challenges can be effectively achieved by utilizing a combination of various management methods. The main focus of this study is on traditional forms of management such as coppicing, grazing, and litter raking. To facilitate this research, designated plots were established within the Training Forest Enterprise Masaryk Forest Křtiny. These plots, where sheep grazing and litter raking have been implemented since 2018, are exceptional and provide exemplary illustrations of diverse coppice management practices in Central European coppices.

Key words: standards, grazing, litter raking, biodiversity, recreational value

Introduction

Numerous cultural landscapes throughout Europe have been molded by centuries of coppice forest management. As the oldest form of forest management, coppicing has a long and rich history. Today, it is estimated that over 20 million hectares of forest in Europe are currently managed using coppice techniques. In the Czech Republic, coppicing was once a prevalent form of forest management, along with grazing and litter raking. However, this practice was eventually abandoned in the 19th century due, in part, to the shift towards using fossil fuels. Following World War II, coppicing was completely discontinued. During the early Communist period in the 1950s, many forestry researchers viewed coppicing as a "capitalist" approach that focused solely on maximizing wood production, even if it meant depleting soil nutrients and ultimately leading to soil degradation and decreased wood production capacity. Consequently, this led to the demise of the three traditional non-timber forest uses: coppicing, grazing, and litter raking, which were once widely practiced.

Today, with new information and perspectives, many European countries view coppicing differently. Coppice management practices are now recognized for their numerous benefits, including minimal soil damage during harvest (in the case of coppice with no standards), reduced need for weed management, physical protection of the site on sloping terrains, reduced risk of windthrow, and long-term soil stability. Additionally, where markets for coppice products exist, this management method can provide a financial return for landowners, particularly for those who own small forest properties.

Coppicing also provides crucial environmental benefits such as carbon sequestration, as well as conservation of water, soil, and biodiversity. This management practice supports a diverse range of forest species, and it also holds significant cultural and spiritual value. Furthermore, we should not overlook the recreational value of coppicing and grazing, which have become increasingly important in recent years. It is worth noting that tourist and recreational use of forests is one of the newest forest functions. Tourism and recreational activities in forests are highly popular in the Czech Republic. However, forest visitors are often conservative in their views and lack an understanding of new forest management practices. To address this, efforts are being made to educate both the public and professional communities about coppicing and to shift their perspectives towards this management method. According to Stanturf (2015), reintroducing sheep grazing in forests can be viewed as a means of restoring a mosaic landscape, and it may enhance the appeal of specific forested areas. There is now a growing effort throughout Europe to maximize the benefits of this currently underutilized management system.

Coppicing is a valuable form of forest management that should be recognized as such. By promoting a diversity of forest management practices over space and time at the landscape level, biodiversity can be significantly enhanced, and heterogeneity can be restored to production forest landscapes. In fact, increasing the diversity of forest management practices is an effective approach to adapting to global change, according to Duflot et al. (2022).

The primary objective of this research is to assess the effects of traditional forest management practices on forest ecosystems, with a particular focus on biometric, pedological, and geobiocenological perspectives.

Materials and methods

The study conducted at the Training Forest Enterprise Masaryk Forest Křtiny involved the establishment of 15 plots, each measuring 40 × 30 m. These plots were established to evaluate the effects of traditional forest management practices and differ from each other based on the type of management treatment applied. The prevailing slope aspect and inclination at the study site is W-N and 5-10°, respectively, at an altitude of 275-325 m above sea level. Due to differing loess admixture (even more than 0.5 m of continuous layer on steeper western slope) in granodiorite bedrock, soil protection includes minimization of mineral soil exposure and continual plant cover. The set of research plots was established in 2017. Twelve of the plots were subjected to strong thinning, resulting in only 80 trees per hectare being retained as standards. Three plots were left without any further intervention as control plots. Dendrometrical measurements of the circumference of oak standards at breast height were carried out at the beginning and end of each growing season. The relative growth ratios (RGR) were computed using the formula provided by Cotillas et al. (2009), as shown below:

$$RGR = \frac{x_i - x_{i-1}}{x_{i-1}} * 100 \quad (1)$$

where x_i is the circumference at breast height in time i (end of the growing season) and x_{i-1} is the circumference at breast height in time $i-1$ (beginning of the growing season).

The study compared the RGRs of oak standards among five different treatments (control plots, plots with only coppice, and three treatments with coppice combined with litter raking, grazing, or both) over six years (with 2017 used as a control year before any treatments were applied). The ANOVA and post hoc multiple comparison Tukey tests were used to analyze and compare the RGRs.

Parametric ANOVA and post hoc multiple comparison Tuckey tests were used to analyze the concentrations of soil mineral nitrogen forms (ammonia NH_4^+ and nitrates NO_3^-) in fresh samples collected during 2017-2021, as assessed by Kučera et al. (2013). The statistical analysis was conducted at a significance level of 0.05.

Geobiocoenological sampling, as described by Randuška et al. (1986), was conducted on all the plots. The sampling was carried out on permanent geobiocoenological plots measuring 15 × 15 m and mainly included the composition of plant species and their estimated cover.

Results and Discussion

The dendrometrical measurements of oak standards in the coppice plots revealed that there was an increase in the circumference growth, as expected. The maximum increment in circumference was observed four years after the start of the experiment, following which there was a decline in the increment (Figure 1). This could be attributed to the release of canopy and reduced competition resulting from the initial harvesting of trees. The results were consistent with the hypothesis proposed by Jones and Thomas (2004), which suggests that the diameter increment of trees released from competition is initially high but later becomes similar to the values before the release.

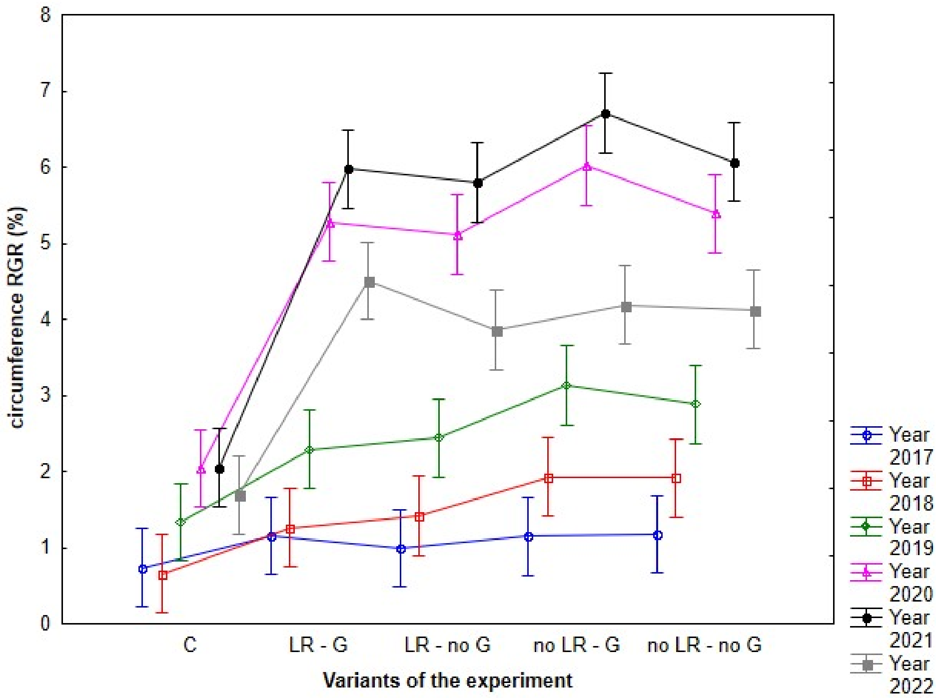

Fig. 1: Mean values (significance level α=0.05) of circumference relative growth ratio of oak standards in years 2017-2022 compared between different treatments. RGR (%) – relative growth ratio of oak standards, C – control plots, LR – litter raking plots, G – grazing plots (Adamec et al., 2022).

Pedologically, the results indicate an increase in ammonia nitrogen concentration during the first year after disturbance, as shown in Figure 2. The most intensive treatments, involving coppicing, litter raking, and grazing, resulted in concentrations more than five times higher compared to the control plot. From 2019 to 2021, the concentrations of ammonia nitrogen, as well as the differences among treatments, systematically decreased to the same level as in 2017. In contrast, nitrate nitrogen concentrations were consistently higher in 2018, with the highest concentration observed in the treatment combining all three management practices. Over time, nitrate concentrations continued to increase systematically. The concentrations of nitrate form result from the mineralization process following disturbance and inputs through faeces from grazing. Both forms can be utilized by nitrophilous plants, but nitrates are susceptible to leaching.

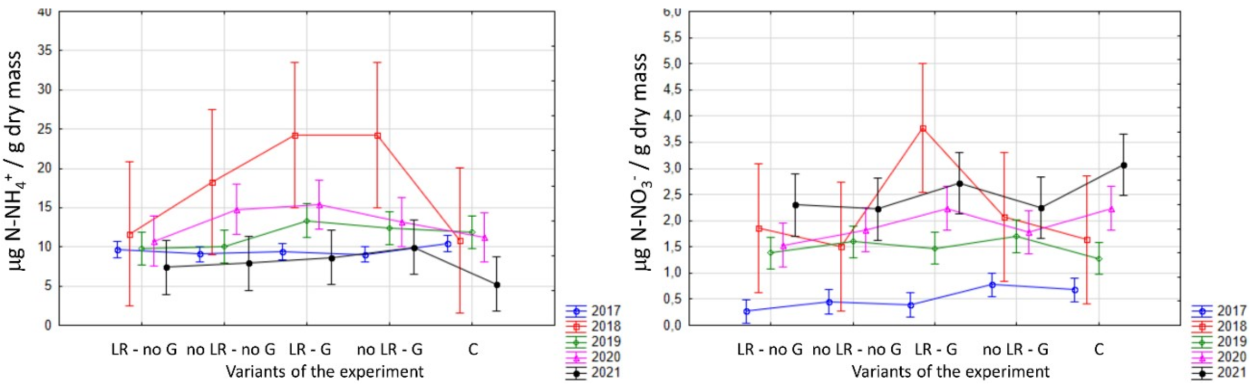

Fig. 2: Mean values of ammonia (left) and nitrate (right) forms of nitrogen in years 2017-2021. C – control plots; LR – litter raking; G – grazing (Adamec et al., 2022).

From a geobiocoenological perspective, our findings indicate that the reintroduction of traditional management practices resulted in a significant increase in the number of species in the herbaceous layer. Prior to the treatments, the number of species identified ranged from 7 to 26, with an average of 17 species per plot. Following the treatments, this number increased to between 61 and 117 species (excluding control plots) with an average of 86 species per plot in 2018, and to between 75 and 103 species with an average of 88 species per plot in 2019.

Figure 3 displays the average number of species per plot over time for each of the different treatments. The figure clearly shows that the combination of all three treatments (coppicing, grazing, and litter raking) resulted in the greatest increase in the number of species in the first year, followed by a decline in subsequent years. In contrast, the other treatments (coppicing alone, coppicing and raking, or coppicing and grazing) resulted in a lower increase in the number of species in the first year, but this increase continued in the following year. Two years after the treatment, the number of species, regardless of the treatment, started to converge. However, the most intensive treatment (i.e. the combination of coppicing, grazing, and raking) still maintained a higher species richness compared to the other treatments (see Fig. 3 and 4).

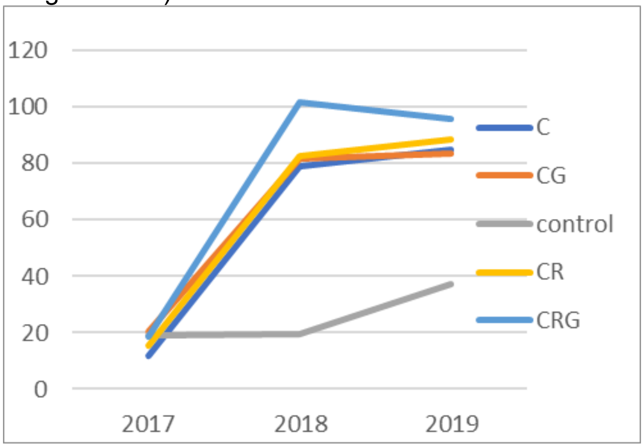

Fig 3: Growth of the mean number of species according to treatments between years 2017–2019. C = coppicing, R = litter raking, G = grazing.

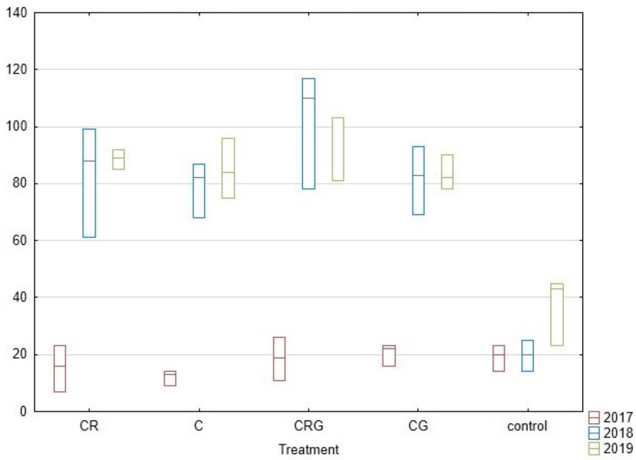

Fig. 4: Change in the median number of species according to treatments between years 2017–2019. C = coppicing, R = litter raking, G = grazing.

Conclusion

This contribution presents the results of an experiment conducted at Training Forest Enterprise Masaryk Forest Křtiny in the southeastern part of the Czech Republic. The experiment involved applying coppicing, litter raking, and grazing to research plots. The results indicate that the released oak standards showed an increase in circumference increments during the first years of the experiment. The treatments also increased the concentrations of ammonia and nitrate forms of nitrogen, which can be beneficial to nitrophilous plants. Furthermore, the treatments increased the number of species in the herbaceous layer. However, further monitoring is needed to determine if the treatments differ from the control plots in the long term. Overall, these management practices can help increase the diversity of forest types at the micro-scale level and contribute to landscape diversity.

The ongoing project at TFE Masaryk Forest not only provides valuable insights into the effects of traditional forest management methods on forest ecosystems, but also offers a unique opportunity for visitors to witness practices that are no longer common in Czech forests due to legal restrictions. The project also aims to raise awareness about the importance of traditional forest management methods and their potential for enhancing forest biodiversity. With the research plots located near popular tourist routes, it is expected that the project will attract a larger number of visitors to the area, thereby increasing public awareness about sustainable forest management practices.

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Souhrn

Daný příspěvek vznikl v rámci probíhajícího projektu na ŠLP ML Křtiny, kde se zkoumá vliv řízené pastvy a hrabání opadu na stav pařezin. Dílčím cílem je separace těchto vlivů a kvantifikace jejich účinku na stav pařezin. Přičemž pařezina (les nízký) může být vnímána jako jeden z tvarů lesa se specifickým managementem, který vede k diverzifikaci způsobů hospodaření v čase a prostoru, a to na úrovni celé krajiny. Projektem sledované faktory (pastva a hrabání opadu a jejich vzájemné ovlivnění) v minulosti přispěly k negativnímu povědomí o pařezinách u odborné, ale i laické veřejnosti. V současné době se snažíme o nový náhled na tyto tradiční způsoby hospodaření.

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