

Impact of shrub encroachment on species and functional diversity in dry basiphilous grasslands in Transylvania

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1. Background and objectives

Transylvanian semi-natural dry basiphilous grasslands are among the most species-rich grasslands worldwide^{1,2}. Currently they are under threat due to land use changes and subsequential litter accumulation followed by invasion of native and non-native shrubs and trees. In recent years, shrub-encroached grasslands have progressively been set on fire by farmers to halt secondary succession³. Although shrub encroachment in these grasslands is widespread and prescribed burning as an alternative management measure is common, the effects of woody species establishment on plant species and functional diversity as well as the impact of fire on woody species establishment are still insufficiently studied for Transylvanian dry grasslands. In order to extend the scientific base for an improved and sustainable management of these grasslands, we collected data on vegetation composition and structure, topsoil, soil seed bank and light availability at 16 different grassland sites in the Transylvanian Basin (**Fig. 1**)

We ask in which ways woody species encroachment affects plant species and functional diversity, whether native and non-native woody species differ with respect to their impact on grassland species composition, functional diversity and structure and if controlled burning can be applied as a useful management tool to control woody species encroachment and to preserve biodiversity of these grasslands.

Here, we present preliminary data on the effects of woody species establishment on plant species diversity in Transylvanian grasslands.

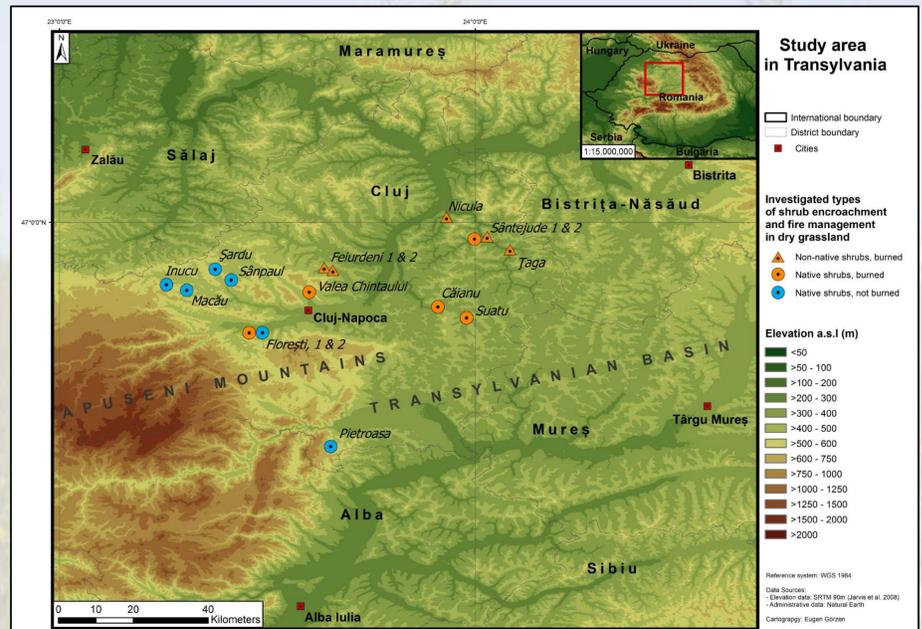


Fig. 1: Study area in the Transylvanian Basin and investigated site types of shrub-encroached grasslands

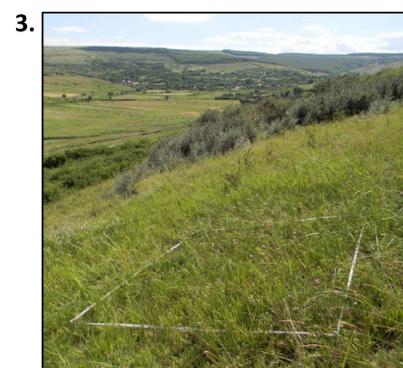
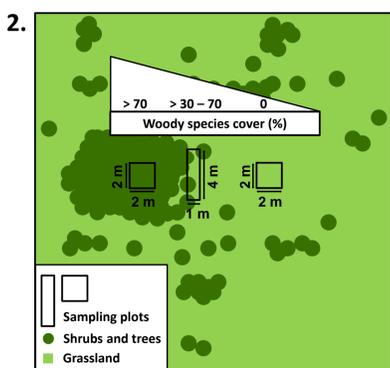


Fig. 2: Study design - sampling three degrees of shrub encroachment in grassland
Fig. 3: Grassland at Feiurdeni invaded by non-native *Hippophae rhamnoides*

3. Preliminary Results and Discussion

Plant species richness was significantly lower in plots exceeding 70 % woody species cover across all types of shrub encroachment and fire management compared to the plots with woody species cover degrees of 0 % and > 30–70 % ($p < 0.05$). In contrast, no significant difference in richness was detected between plots with 0 % and > 30–70 % woody species cover. Similar patterns were observed for the Shannon, Simpson and Evenness indices (data not shown). In unburned intact grassland plots (0 % woody species cover) plant species richness (mean = 51.2 ± 5.3 SD) was significantly higher compared to recently burned grassland (mean = 47.1 ± 5.6 SD, $p < 0.05$). The difference in species richness between native and non-native shrub encroachment in grassland (0 % woody species cover) was insignificant. These results indicate that shrub encroachment may pose a threat to plant species diversity in Transylvanian dry grasslands as soon as the woody cover exceeds a threshold, regardless whether the shrubs are of native or non-native origin. Fire management may repress secondary succession in grasslands in the short term but result in a loss of species richness in the long run. To detect the effects of fire, litter and competition by shrubs on the germination success of important grassland species, this project is also flanked by common garden experiments.

2. Materials and Methods

We investigated 16 shrub-encroached grassland sites ($46^{\circ}27' - 47^{\circ}0' N$, $23^{\circ}15' - 24^{\circ}5' E$) in the Transylvanian Basin from June to August 2016 (**Fig. 1**)

- Elevation between 274 and 575 m a.s.l.
- Three types of shrub encroachment and fire management in grasslands (native shrub encroachment + burned, native shrub encroachment + unburned, non-native shrub encroachment + burned)
- At each site sampling of three degrees of shrub encroachment in grassland in 4 m² plots (0 %, > 30–70 %, > 70 % woody species cover) (**Fig. 2 + Fig. 3**)
- Comparison of plant species richness (**Fig. 4**) between different combinations of the degree of shrub encroachment (see above), fire management (burned, unburned), and origin of woody species (native vs. non-native) using a Kruskal–Wallis one-way analysis of variance by ranks and post-hoc tests according to Nemenyi for pairwise multiple comparisons of the ranked data

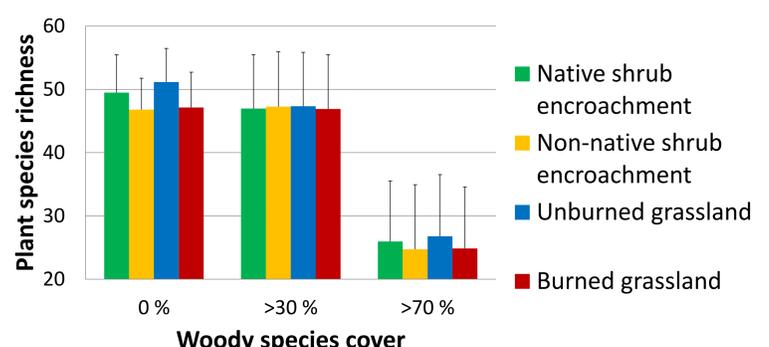


Fig. 4: Mean plant species richness and standard deviation (SD) in different types of shrub encroached grasslands, grouped according to the degree of shrub encroachment

References: 1. Dengler et al. (2012): *Tuexenia* Vol. 32 (319–359); 2. Wilson et al. (2012): *Journal of Vegetation Science* Vol. 23 (796–802); 3. Hartel et al. (2013): *Biological Conservation* Vol. 166 (267–275).