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Shrub Encroachment Under the Trees Diversifies the Herb Layer in a Romanian Silvopastoral System[☆]

Csaba Tölgyesi^{a,*}, Zoltán Bátori^a, Róbert Gallé^a, István Urák^b, Tibor Hartel^{b,c}^a Department of Ecology, University of Szeged, Szeged, Hungary^b Environmental Science Department, Sapiientia Hungarian University of Transylvania, Cluj-Napoca, Romania^c Department of Taxonomy and Ecology, Faculty of Biology, Babes-Bolyai University, Cluj-Napoca, Romania

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ABSTRACT

Rangelands with scattered trees are complex and dynamic systems with a long history in Europe. Generally referred to as “wood-pastures,” they are considered to have outstanding conservation value. Thorny shrubs are important for supporting the biodiversity of these wooded rangelands, as well as facilitating the regeneration of trees by acting as nurse species. We assess the direct effects of temporary shrub encroachment under the cover of mature sparse trees on overall plant and habitat diversity. We surveyed the herb layer of the main landscape features of a wood-pasture: open pasture, trees with a grass understory, trees with shrubs, and adjacent forest edges. The herb layer under trees with shrubs resembled that of forest edges more than open pastures and trees with grass. Trees with grass had a higher cover of ruderal species than trees with shrubs, while forest edges and open pastures had a lower cover of them. Forest species were absent from open pastures but were well represented in the other sites. The herb layer of trees with shrubs and forest edges had similar cover values, while trees with grass had a significantly lower cover of herbs than the other types. Trees with shrubs had higher species richness than any of the other three landscape features and had a much higher proportion of diagnostic species. We conclude that the scattered trees and shrubs of the studied silvopastoral system have additive facilitative effects on their understory, probably through modifying the microenvironment and grazing pressure, leading to the formation of temporary diversity hot spots with distinct vegetation. Thus maintaining a moderate level of shrub-encroachment under sparse trees is recommended for not only creating safe havens for tree recruitment but also increasing the overall species and habitat diversity of wood-pastures.

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Introduction

Silvopastoral systems are among the most ancient land-use forms, with the earliest known examples dating back to the Neolithic (Mosquera-Losada et al., 2009; Bergmeier et al., 2010; Hartel et al., 2013). They can have a range of physiognomies from closed canopy grazed forests to “savanna-like” open woodlands (Rackham, 1980). The focus of our research is on the savanna type of wooded rangeland (or as referred to in Europe, wood-pasture) system, where the landscape is dominated by grassland and the trees are sparsely distributed.

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* Correspondence: Csaba Tölgyesi, Dept of Ecology, University of Szeged, Közép fasor 52, Szeged, Hungary.

E-mail address: festuca7@yahoo.com (C. Tölgyesi).

Scattered trees in these wooded rangelands are keystone structures as their ecological role is disproportionately large relative to their spatial extent (Manning et al., 2006; López-Sánchez et al., 2016). The trees and other woody vegetation break up the structural homogeneity of open pastures and provide microhabitat for a variety of organisms otherwise not typical of grasslands (Lindenmayer, 2017). Several forest-specific plants can thrive under the canopy of scattered trees (Bergmeier et al., 2010), various woodland birds use them as feeding and nesting places (Tucker and Evans, 1997; Hartel et al., 2014), and the trees sometimes host more forest invertebrates, especially saproxylic insects, than adjacent forests (Sebek et al., 2016). As a result, wood-pastures may harbor a significantly higher biodiversity than either treeless pastures or closed forests (Plieninger et al., 2015).

Besides their outstanding conservation role, scattered trees provide a variety of ecosystem services (Hartel et al., 2013; Hartel and Plieninger, 2014; López-Santiago et al., 2014). Their canopy gives shelter for the grazing livestock from the heat of the sun (Higgins and Dodd, 1989), and their foliage is also used for fodder, especially in drought conditions, when forage yield is low (Varga et al., 2015). Fruits,

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like acorns, are an important supplementary food source for grazers, while the trees are also sources of timber, harvested mostly by pollarding (Rackham, 1980; Kirby et al., 1995).

Taking all the ecological and economic benefits of scattered trees into account, wood-pastures are among those land use forms where humans and nature can still mutually profit in a sustainable fashion (Bignal and McCracken, 1996; Plieninger, 2007). Despite this, their long-term survival is uncertain. Wood-pastures are forced into the categories of forest or pasture by policymakers, but the multifunctional system of wood-pasture rarely exists as a legal category and therefore often remains unprotected. As a result socioeconomic trends like intensification of livestock production through tree removal or land abandonment threaten wood-pastures all over Europe (Manning et al., 2006; Bergmeier et al., 2010). Similarly to other extensive land-uses like hay meadows, pastures, and orchards, both intensification and abandonment can have negative effects. If grazing intensity is too high in wood-pastures, tree recruitment is hindered, leading to a decrease of tree cover in the long run (Gillet et al., 1999; Dimopoulos and Bergmeier, 2004). Conversely, underuse leads to shrub and subsequent tree encroachment, and finally conversion to forest (Gillet et al., 1999; Miklín and Cizek, 2014), leading to the decline of the ecological and agricultural benefits described earlier (Plieninger et al., 2015).

Shrub encroachment is a typical indicator of underuse not only in wood-pastures but also in many seminatural (grazed or mowed) grassland types of economic importance (MacDonald et al., 2000; Eldridge et al., 2011). However, shrubs have a crucial role in wood-pastures, as

they serve as nurse plants for tree saplings by protecting them from grazers (Callaway, 1995). A certain amount of shrub cover is, thus, vital to sustain tree regeneration in pace with tree mortality. At the same time, shrubby patches also represent a third type of landscape features in these rangelands, so the question arises of whether they have other effects on the diversity and conservation value of wood-pastures besides allowing for tree regeneration.

The purpose of this study was to characterize the herb layer of trees with shrub-encroached undergrowth in an extensively used Romanian wood-pasture. Specifically, we asked the following three questions: 1) Does the herb layer composition differ among the four main landscape features (i.e., open pasture surfaces, scattered trees with a grassy understory, shrub-encroached scattered trees, and the ecotone between the wood-pasture and adjacent forest?) 2) What successional changes (with a special focus on ruderal and forest-specific species) take place once the understory is encroached upon by shrubs? 3) Do such successional foci add any extra conservation value to the wood-pasture, or are shrubs only needed for tree regeneration?

Materials and Methods

Study Site

The study was carried out in central Romania near the village of Deusu (N46.92 E23.50, 420–480 m a.s.l.), 15 km to the north of Cluj-Napoca (Fig. 1). The climate is continental with a mean annual

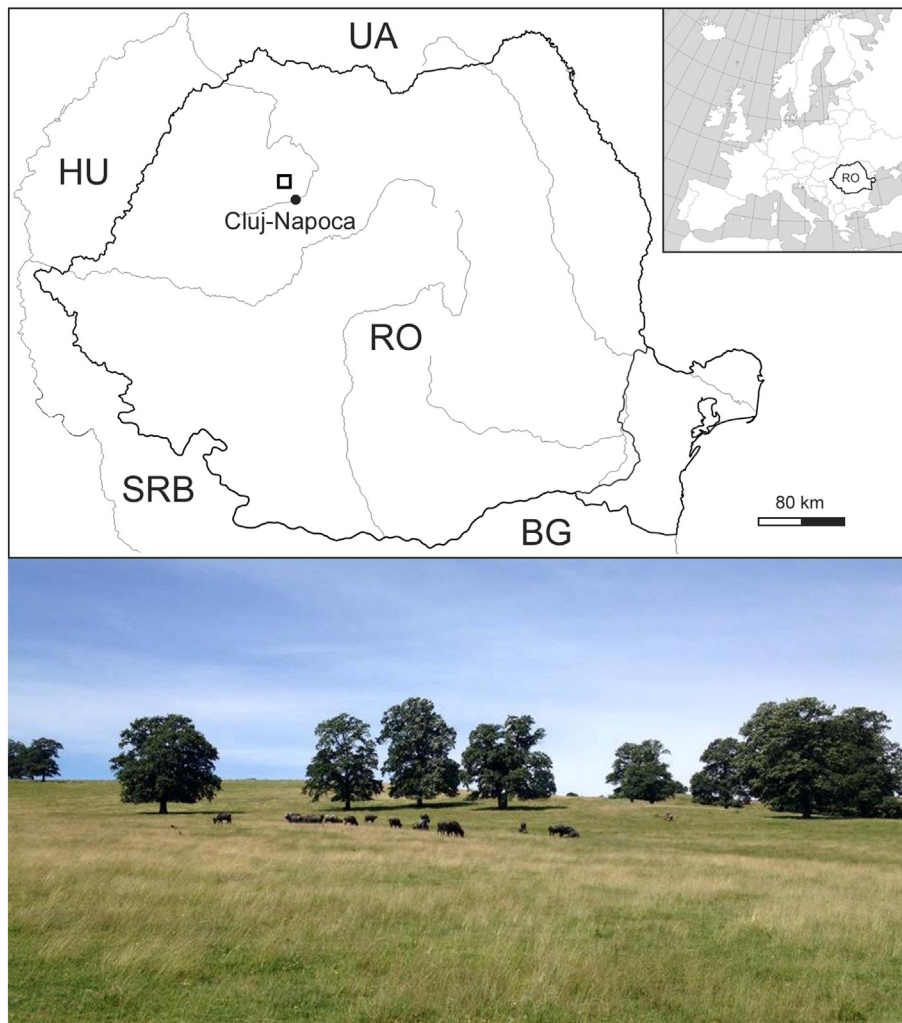


Figure 1. Location of the studied wood-pasture (empty square) near Cluj-Napoca (black circle) in NE Romania and its general physiognomy.

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