Lessons learnt: Wood-pastures in Transylvania, Romania

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1 Context

The AGFORWARD research project (January 2014-December 2017), funded by the European Commission, is promoting agroforestry practices in Europe that will advance sustainable rural development. The project has four objectives:

1. to understand the context and extent of agroforestry in Europe,
2. to identify, develop and field-test innovations (through participatory research) to improve the benefits and viability of agroforestry systems in Europe,
3. to evaluate innovative agroforestry designs and practices at a field-, farm- and landscape scale, and
4. to promote the wider adoption of appropriate agroforestry systems in Europe through policy development and dissemination.

This report contributes to Objective 3 and Deliverable 2.5 which describes the lessons learnt from innovations within agroforestry systems of high natural and cultural value. Within the project, there were ten stakeholder groups focused on such systems (e.g. grazed forests, semi-open pastures, wood pastures, and bocage). This report focuses on the issues addressed by the stakeholder group from Transylvania (Romania), namely the protection of large old trees in managed wood-pastures, integrating grazing and biodiversity in wood-pastures and the issue of lack of tree regeneration in wood-pastures.

2 Background

Oak wood-pastures from Southern Transylvania (Romania) are between the best wood-pastures from Central and Eastern Europe. Our surveys identified 10,234 hectares of wood-pastures only in the Saxon cultural region, with a total number of 2059 large old trees (Hartel et al., 2018), largely oaks. Table 1 presents a list of the largest ancient oak wood-pastures from Transylvania, including some of the largest ancient wood-pastures from Central-Eastern Europe (data extracted from Hartel et al. 2018). The lower thresholds for considering a tree large old for oak was set to 400 cm trunk circumference (Hartel et al. 2018).

Research and discussions with the members of ADEPT foundation highlighted the need for addressing the following issues related to the sustainability of the wood-pastures from this region:

1. The maintenance of large old trees on pastures.
2. The integration of grazing with biodiversity of pastures.
3. The lack of tree regeneration.

Our research therefore addressed these key issues related to the sustainability of oak wood-pastures from Transylvania. Below we present our results in these respects and also the future prospects rised from a stakeholder meeting from October 2017.

Table 1. The number of large old trees in the most important ancient oak wood-pastures from Transylvania (Romania). Ancient wood-pastures highlighted with bold were situated within the polygons selected for AGFORWARD biophysical assessments (Moreno et al. 2016).

Locality	GPS coordinates	Approximate surface estimated with Google Earth Pro (ha)	Number of large old oak trees	Other large old trees	Total number of large old trees
1. Mercheașa (Brasov)	46.058670 25.388754	1100	430	13	443
2. Dăișoara (Brașov)	45.959495 25.156429	1000	260	20	280
3. Ticușu (Vechi și Nou, Brașov)	45.909301 25.134362	800	264	9	273
4. Rupea (Brașov)	**46.015700 25.228640**	**300**	**80**	**8**	**88**
5. Casolt (Sibiu)	45.757800 24.268762	285	61	2	63
6. Lupșa (Brașov)	45.944939 25.343806	400	50	5	55
7. Șoarș (Brașov)	45.953806 24.903730	35	39	0	39
8. Hosman (Sibiu)	45.813829 24.451719	287	37	9	46
9. Bruiu (Sibiu)	45.869392 24.727156	105	32	11	43
10. Satu Nou (Haghita)	46.129464 25.423686	100	25	9	34
11. Fiser (Brașov)	**46.095792 25.152730**	**210**	**25**	**1**	**26**
12. Saschiz esstern wood-pasture (Mureș)	**46.209796 24.945852**	**175**	**15**	**19**	**34**

3 Valuing large old trees in wood-pastures

This study was published in *Agriculture, Ecosystems and Environment*, 2017, 236: 304-311 (Hartel, Réti and Craioveanu, 2017).

3.1.1 Goals

i. To explore the values associated with scattered, mature trees (hereafter 'mature trees') with intact crown on oak dominated wood-pastures as perceived by the farmers;
ii. To explore the values associated with large, old oak trees (hereafter 'old trees') with intact trunk and crown from wood-pastures, and finally
iii. To explore the perceptions of farmers related to the old trees which collapsed (hereafter 'collapsed trees') on pastures.

3.1.2 Methods

We showed interviewees characteristic pictures of oak wood-pasture features and large old trees at various states in order to make sure that interviewed persons had a good understanding of the landscapes and trees of interested. There were 22 pilot interviews followed by 92 interviews, the data were transcribed and analysed using qualitative and quantitative methods. Every interviewed person was a farmer and/or farming was part of his/her life.

3.1.3 Results

Appreciating mature trees

Figure 1 presents the values associated with mature trees by farmers. The scattered trees were most (disproportionatedly) appreciated for their shade value while the provisioning ecosystem services and the cultural ecosystem services were less appreciated. Based on this result, we conclude that while the overall diversity of attributes associated with scattered trees was high, the proportion of farmers recognizing a specific attribute, apart from the shade value, was small.

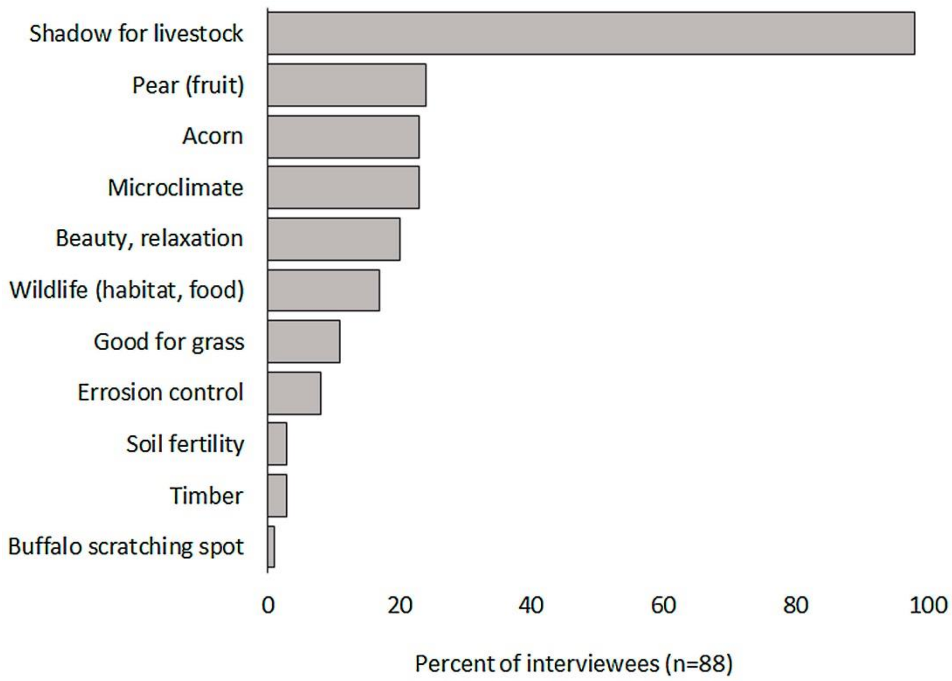

Figure 1. Attributes attached to mature trees by interviewees

Appreciating large old trees

Figure 2 presents the values associated to large old trees on pastures. These results suggest that large old trees have a high diversity of recognized attributes and contrary to the mature trees, the age and relational attributes (beauty, relaxation, cultural identity, history) were the most appreciated by the local community. Furthermore, nodes on the trunk and the need for cutting them (also the difficulties of cutting them) were also emphasized by some stakeholders. Based on these results, we conclude that the primary value of large old trees is historical and cultural. Furthermore farmers recognize certain tree related features which increases the vulnerability of these trees to be removed from pastures (e.g. hollowing). Habitat values of trees were less recognized.

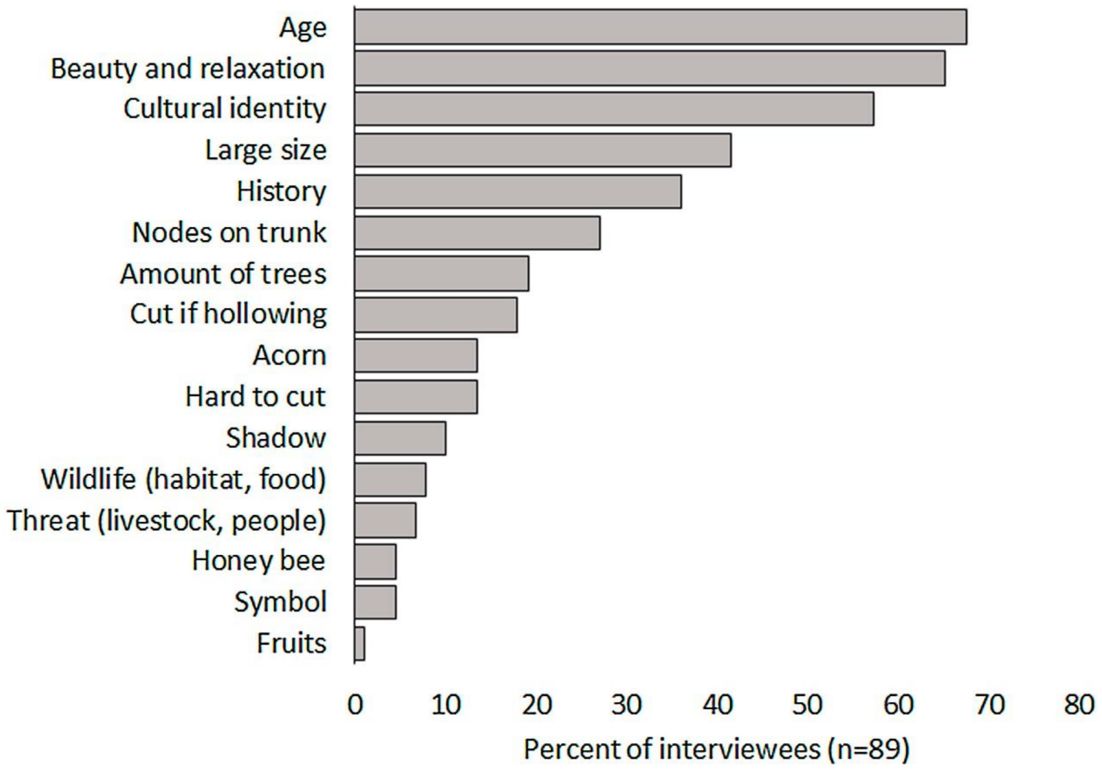

Figure 2. Appreciation of large old trees on pastures by interviewees

Appreciating hollowing, collapsed trees

Figure 3 presents the appreciation of old, drying trees by farmers on pastures. As suggested above, farmers recognize certain signs of 'unproductivity' in the large old trees, such as the hollowing parts and the difficulties of cutting/processing these trees. These appreciations were amplified when talking about hollowing trees.

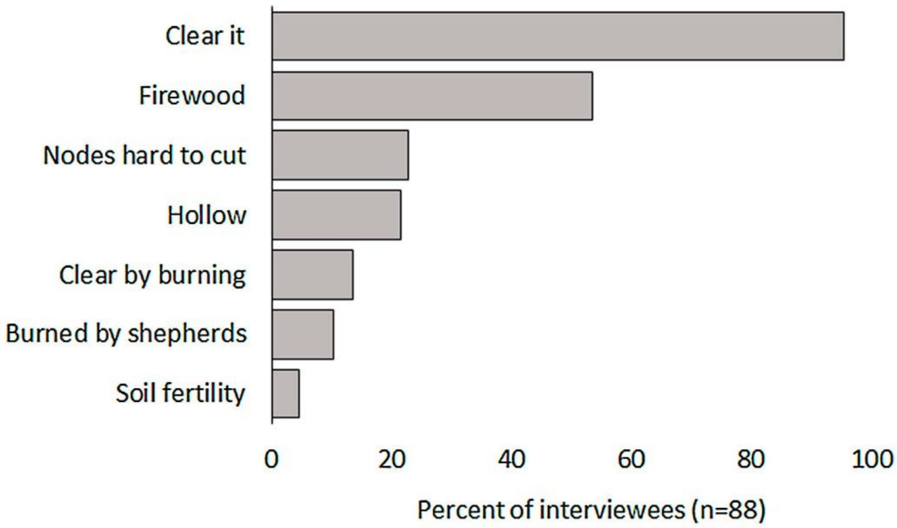

Figure 3. Appreciation of large old trees with substantial dry and hollowing parts by farmers

Exploring value networks around trees from wood-pastures

This exercise was made by Dr. Andreea Niță based on the dataset from the above mentioned research. Our goal was to explore the network typologies in values behind the appreciation of large old trees. Knowing the value networks we can develop proper discourses to communicate about the values of these trees to stakeholders. Above we present one result of this network analysis on large old trees, the manuscript resulting from a more comprehensive analysis is still in preparation. By analyzing the value network around trees from wood-pastures we hope to (i) gather insights on the resilience of the social-ecological system and (ii) to provide insights for developing proper communication strategies for the maintenance of these trees.

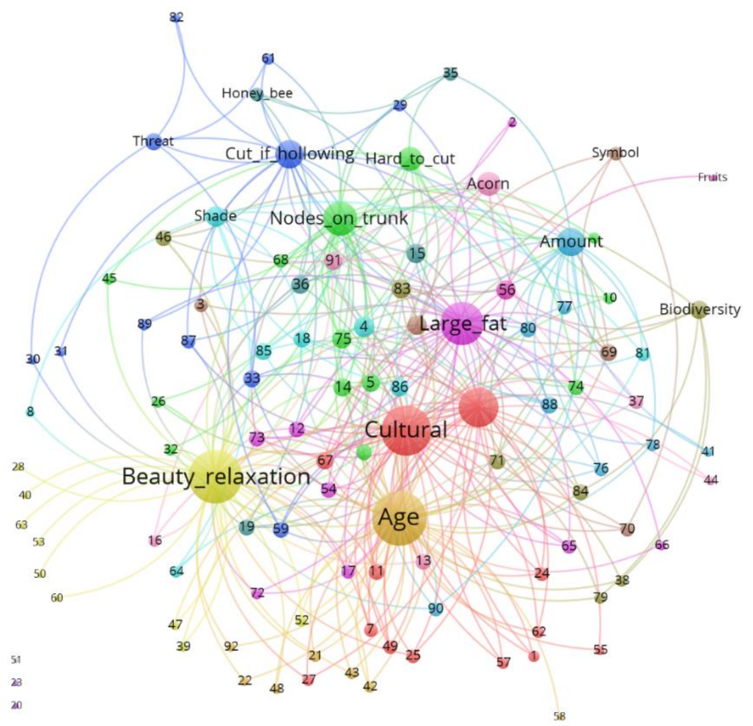

Figure 4. Attempt to visualize value network around large old trees (by A. Nita)

Discovering the optional values of large old trees in the Saxon Region of Transylvania (From Moga et al., 2016): Finding the largest living oak from Transylvania with a citizen educational project.

In 2009, the Mihai Eminescu Trust (MET) initiated a citizen-based project entitled 'Find the oldest tree', which involved primarily schools from over 20 villages from Southern Transylvania. Every pupil was asked to provide basic information about the trees including the trunk circumference, species, location, the existence of hollows and a picture about the tree (http://www.rezervatia-breite.ro/node/29). The large trees were verified by the personnel of the MET.

The largest oak (*Q. robur*) from this region, with a trunk circumference of 920 cm, was reported during this project by two pupils from the pasture nearby Mercheaşa village. The tree was highly publicized, including by local, regional, and national TV Channels, newspapers, and internet forums. The tree received a name, 'The Old of Carpathians'. Later, a local NGO (the Association Carpaterra) further documented the health and age of the tree, developing the formal documents to declare this oak a 'Natural Monument'. The Romanian Academy and the local authorities approved this request, currently the oak being formally protected. The oak and the spectacular wood-pasture where it is situated can be 'virtually visited' on Google Map using the 'Batranul Carpatilor' keywords in the 'Search' menu, showing that this monument was quickly updated on widely available satellite images. The tree also has a 'Facebook' page ('Bătrânul Carpaţilor') and was nominated for the 'European Tree of the Year' international competition.

The 'Old of the Carpathians' is currently the second largest known living oak from Romania. It is a wonderful example about the value of collaborative initiatives between local civil societies, communities and conservation scientists in building and complementing each other in order to achieve the recognition and protection of old trees.

3.1.4 Conclusions

Based on our results, we conceptualize what we learned about farmers perceptions and the diverse values of scattered trees on pastures (Figure 5). We will discuss out findings through a comparison with a recent study carried out in Transylvania using the PPGIS method (WP7, AGFORWARD); the PPGIS used a different methodology than the above cited study: using open questions, it aimed to map those place which have high cultural and aesthetic values. The manuscript is now under revision with *Nature Sustainability*; we are analysing the Transylvanian results and present the rough results here as comparision.

- The farmers from Transylvania attribute a wide range of provisioning ecosystem service values to the mature trees from wood-pastures. The shade value is most recognized, while the other provisioning ecosystem services are recognized by up to *ca* 20% of farmers. The most likely explanation for this is that the social system 'de-couples' from wood-pastures, several ecosystem services being on the way of abandonment. The cultural and natural values of these trees are less recognized.

- Large old trees have several cultural and historical values. However, farmers also recognize their hollowing, drying components as well as the nodes which are difficult to cut. The biodiversity and provisioning ecosystem service values of large old trees are less recognized.

- The drying trees, while their ecological values are high, will be removed from wood-pastures. Wood-pastures developed as farming landscapes. Farmers tolerate small natural features with high natural and cultural values on it but the main goal of these systems is still production.

- Figure 6 presents the 'cloud' of values attached by people to landscapes (generated by PPGIS survey, see above) as well as the 'cloud' of ancient trees (comprehensive inventory, Hartel et al., 2018) from that region. This study shows that wood-pastures with ancient trees are avoided by local communities when it is about culturally and aesthetically valuable places. We are working now to test a set of hypotheses regarding this finding: (i) the sheepdogs hypothesis, according to which people avoid these systems because there are sheepfolds with several sheepdogs on these wood-pastures. (ii) the distance hypothesis, according to which people do not reach these wood-pastures because they are distant, and (iii) the accessibility hypothesis, according to which people cannot access these wood-pastures because of low infrastructure.

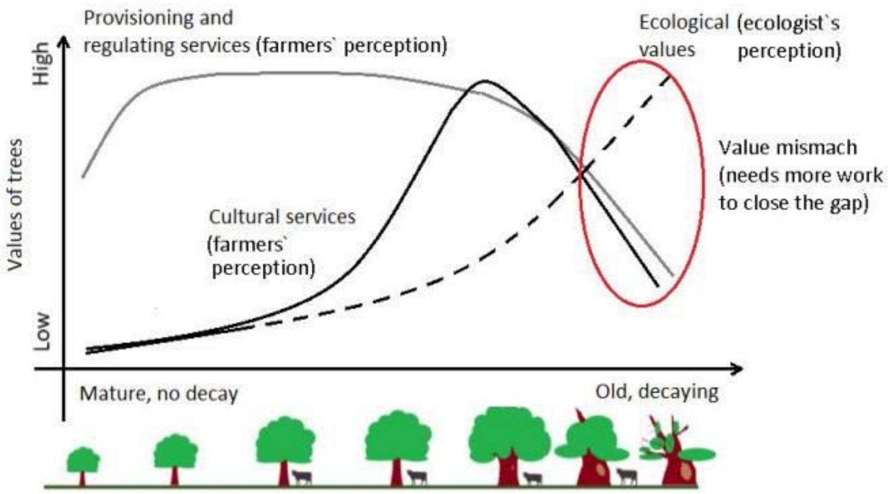

Figure 5. Hypothetical representation of various value types attached to trees from oak wood-pastures as they are undergoing changes in their age and condition.

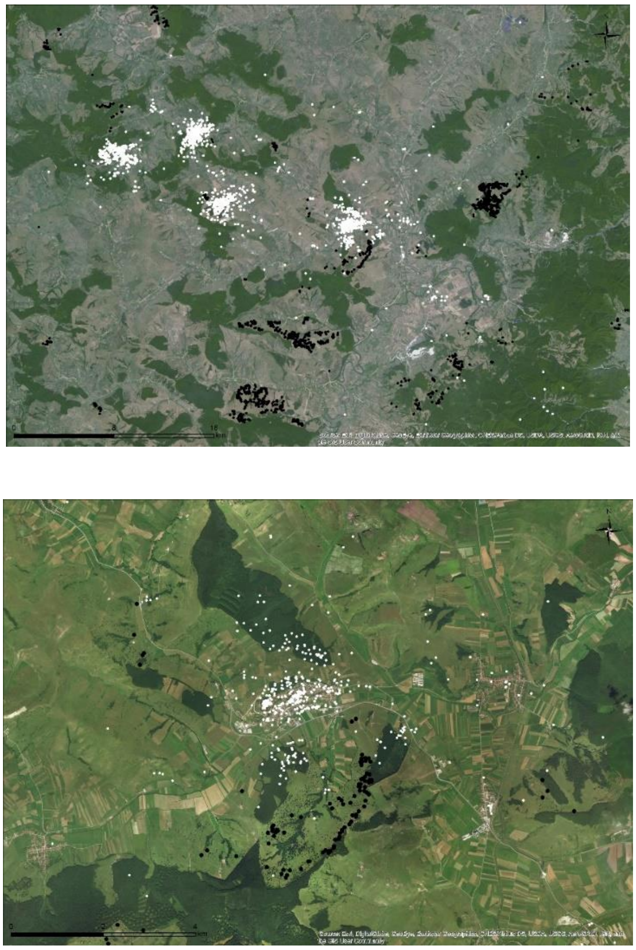

Figure 6. Value clouds (white) and ancient trees on wood-pastures (black dots) in Transylvanian cultural landscape. While the data are still in analysis, our preliminary results shows that ancient wood-pastures are not present in the landscape value hotspots of local communities. Our study was conducted in one of the richest regions on ancient oak wood-pastures from central, Northern and Eastern Europe (Hartel et al, 2018, see the first four wood-pastures in Table 1). The maps were generated by Cristi Malos based on the PPGIS survey and Hartel et al., 2018 data on ancient trees.

4 Integration of grazing with biodiversity of pastures

These studies were published in two papers: *PLOS ONE (*12(9): e0183465. https://doi.org/10.1371/journal.pone.0183465) and *Rangeland Ecology and Management:* online first (Gallé et al. 2017; Tölgyesi et al. 2017). Below we will provide the methodology and results of these studies.

4.1 Goals

To the best of our knowledge, traditional pastoral systems such are those from Eastern Europe are still not explored regarding the importance of sparse trees on pastures to spider and plant communities. The aim of the present studies was to assess the importance of scattered trees in an open grazed landscape for spider and plant communities. More specifically, we hypothesized that sparsely scattered trees and shrubs creates distinct spider and plant species assemblages compared to the pasture surfaces without these structural elements and thus confers a high beta diversity value for the grazed system.

4.2 Methods

The wood-pasture was grazed with sheep, cattle and buffalo (*ca* 1 Livestock Unit ha^{-1}) and no chemical fertilizers were applied in past decades. Sampling sites covered the open pasture as well as the existing fine-scale heterogeneity created by scattered trees and shrub. 40 sampling locations each being represented by three 1 m^2 quadrats were situated in a stratified design while assuring spatial independency of sampling locations. The study design and the landscape are shown in Figure 7 and 8. Table 2 presents the descriptive statistics of the four habitat types studied.

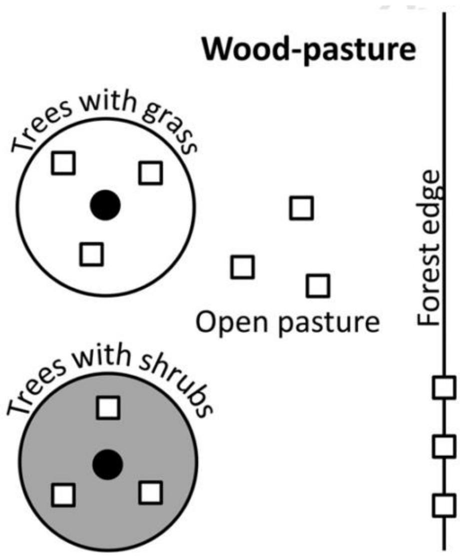

Figure 7. Illustration of the study design. Large and small circles are the projections of tree canopies and tree trunks respectively and the squares represents the 1 m^2 quadrates within which we assessed spiders and plants

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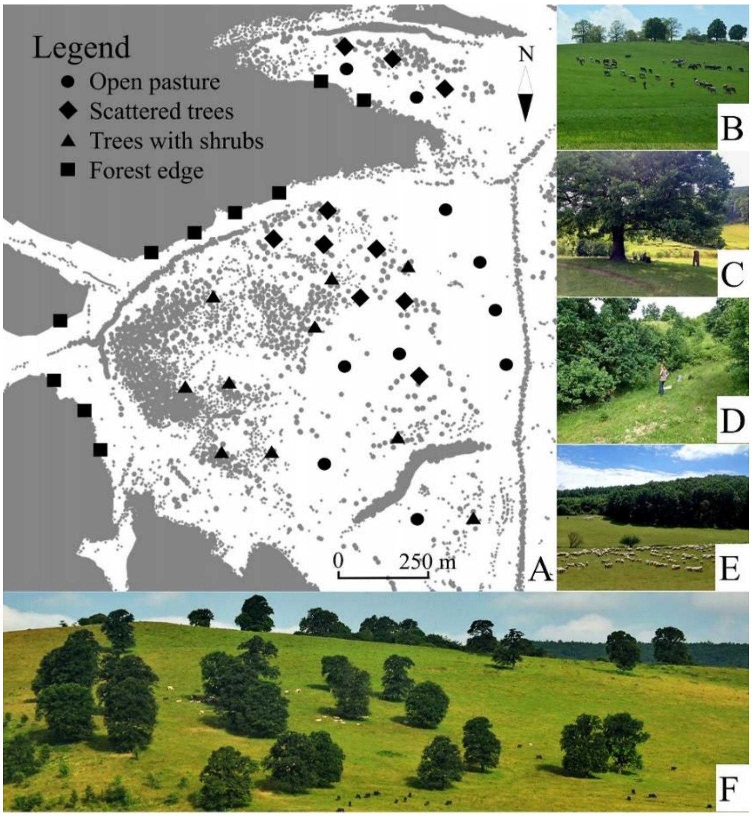

Figure 8. The general physiognomy of the studied wood-pasture (from Gallé et al., 2017). The four habitat types studied are also shown. A = the map of the area, B = pasture surface without trees and shrubs, C = pastures with scattered tree, D = pastures surface with scattered tree and shrubs under the canopy, E = Forest edge, F = general physiognomy of wood-pasture.

4.3 Results

4.3.1 Comparing the four habitat types

The average height of the herbaceous vegetation across the four habitat types varied very narrowly between 10 and 12 cm (Table 2). The herbaceous vegetation cover was highest as expected in the open pasture habitat (99%) and lowest (64%) in the forest edge (Table 2). The coverage of bare ground was highest on the forest edges (12%) while in the other three habitat types was below 5% (Table 2). Finally, the litter cover was highest in the forest edges (31%) followed by tree and shrub habitat (17%) and scattered tree habitat (5%), while the open pasture habitat had no litter (Table 2).

Table 2. Descriptive characteristics of the vegetation cover of the habitat types. Mean value; standard deviation and coefficient of variation are given in parenthesis.

Habitat type	Average herbaceous vegetation height (cm)	Herbaceous vegetation cover (%)	Bare ground cover (%)	Litter cover (%)
Open pasture	10.2 (7.8, 12.6)	99.4 (98.6, 100)	0.1 (0, 0.2)	0
Scattered oak	10.9 (8.8, 13.1)	90.8 (84.7, 96.9)	4.2 (2.1, 6.3)	5.2 (2.6, 1.3)
Scattered trees with shrubs	14.2 (12.4, 16.1)	85.5(79.9, 91.0)	4.2 (1.1, 7.2)	17.3 (12.1, 22.5)
Forest edge	11.1 (9.4, 12.8)	63.8 (56.5, 71.1)	12.0 (7.2, 16.8)	31.2 (19.4, 42.9)

4.3.2 Spider fauna

We collected 2697 spider specimens (1461 adults), belonging to 140 species from 21 families (Table 3). Two species of spiders were new for the Romanian fauna (*Synageles subcingulatus,* one specimen at scattered tree habitat and *Talavera parvistyla* one specimen at tree and shrub habitat). Two species (*Dipoena erythropus*, two individuals identified from open pasture and scattered tree sites habitats and *Philodromus praedatus,* two individuals from open pasture and forest edge habitats) with uncertain presence for the Romanian fauna were confirmed by the present study. We found 25 species of spiders which are considered rare (Table 3). These species are typically considered as preferring 'climax', 'non-disturbed' and 'natural habitats' in Europe (Galle et al. 2017). We found no significant effect of habitat type on species richness of rare species according to the Poisson GLM and the following pairwise comparisons. However sparse trees with shrubs had significantly higher abundance of rare species than scattered oaks ($z = 3.213$, $p = 0.006$).

Table 3. Abundances of species of conservation interest

	Open pasture	Forest edge	Oaks and shrubs	Scattered oaks	Sum
Endangered					
Drassyllus pumilus (C. L. Koch, 1839)	0	1	1	0	2
Mecopisthes silus (O. P.-Cambridge, 1872)	0	5	0	0	5
Vulnerable					
Agyneta simplicitarsis (Simon, 1884)	6	0	4	1	11
Dipoena erythropus (Simon, 1881)	1	0	0	1	2
Metopobactrus ascitus (Kulczyński, 1894)	0	0	1	0	1
Micaria dives (Lucas, 1846)	0	1	3	0	4
Micaria formicaria (Sundevall, 1831)	0	0	1	0	1
Microdipoena jobi (Kraus, 1967)	0	0	1	0	1
Zelotes electus (C. L. Koch, 1839)	0	0	0	1	1
Least concern					
Anelosimus vittatus (C. L. Koch, 1836)	0	0	0	2	2
Aulonia albimana (Walckenaer, 1805)	0	0	3*	0	3
Carrhotus xanthogramma (Latreille, 1819)	0	2	1	1	4
Dysdera hungarica Kulczyński, 1897	0	1	0	0	1
Erigonoplus globipes (L. Koch, 1872)	0	1	0	0	1
Nematogmus sanguinolentus (Walckenaer, 1841)	0	1	0	1	2
Neon valentulus Falconer, 1912	1	0	0	1	2
Panamomops mengei Simon, 1926	0	0	2	0	2
Pardosa monticola (Clerck, 1757)	2	0	0	0	2
Phlegra fasciata (Hahn, 1826)	1	0	0	0	1
Poecilochroa variana (C. L. Koch, 1839)	0	0	1	0	1
Synageles subcingulatus (Simon, 1878)	0	0	1	0	1
Talavera aperta (Miller, 1971)	0	2	8	1	11
Thanatus arenarius L. Koch, 1872	0	1	0	0	1
Titanoeca quadriguttata (Hahn, 1833)	0	1	0	0	1
Trichoncus affinis Kulczyński, 1894	0	2	8	0	10
sum	11	18	32	9	73

4.3.3 Spider communities

Tree and shrub sites had the highest spider species richness (19.3, 95% confidence interval [CI]: 16.3–22.2) followed by forest edge (17.3, 95% CI, 13.8–20.7), scattered tree (14.5 95% CI, 12.1–16.8) and open pasture (12.8, 95% CI, 9.58–16.01) habitats. The number of spider species detected exclusively in the open pasture habitat was seven (representing 16% of the species found in this habitat type), while for the scattered tree habitat this value was eight (13%), for tree and shrub 25 (32%) and for forest edge 25 (30%). The estimated species richness Shannon diversity and species accumulation curves also detected lower diversity of open pasture sites compared to sampling sites with woody vegetation).

Ordination by NMDS indicated a clear separation of species composition among the habitat types with relatively small overlap between the polygons grouping the four habitat types (Figure 9). The ANOSIM statistic highlighted significant difference among the four habitat types ($R = 0.611$, $P < 0.001$). Furthermore, the subsequent comparison of habitat types showed significant differences in spider community structure between all pairs of habitat types (ANOSIM, $P_{adjusted} < 0.01$).

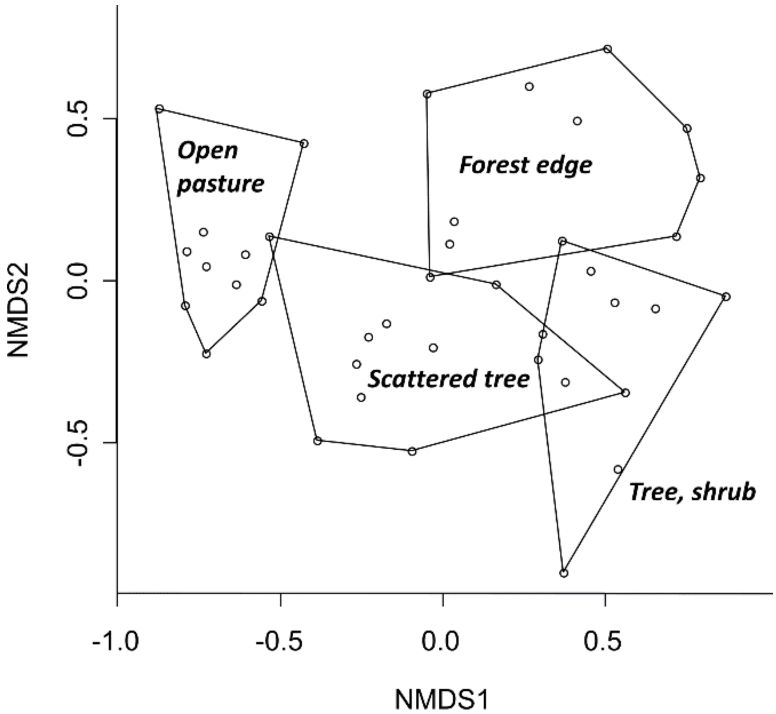

Figure 9. Non-metric multidimensional scaling of spider species assemblages of the four habitat types studied. Open circles represent the sampling sites. Stress: 0.201

4.3.4 Plant species

The total number of species recorded in the study was 195 (Table 1 in Tolgyesi et al. 2017). The greatest number of species was found under trees with shrubs (145), followed by forest edges (129). Trees with grass and open pastures had a similar but lower total number of species (82 and 87, respectively) than the other types. The GLMM of species richness was significant (*Chi-square* = 32.32, $P < 0.001$) and yielded a pattern similar to the total species numbers. Trees with shrubs had significantly higher values than any of the other types, which, in turn, did not differ from each other (Table 1 in Tolgyesi et al. 2017).

The analysis of diagnostic species (Table 3 in Tolgyesi et al. 2017) revealed that open pastures harbored 23 species with significant fidelity. These were mostly grazing-tolerant grasses (like *Cynosurus cristatus*), short, rosette-forming dicots (like *Leontodon* spp.) and legumes typical of mesic pastures (e.g. *Lotus corniculatus* and *Trifolium pratense*). Species specific to trees with grass included only disturbance-tolerant and ruderal species (like *Capsella bursa-pastoris* and *Poa annua*); their total number was 11. Forest edges had 19 diagnostic species, consisting of a mixture of low-growing, grazing-tolerant species (e.g. *Prunella laciniata* and *Veronica prostrata*) and taller, more grazing-sensitive forbs (e.g. *Centaurea phrygia* and *Hypericum perforatum*), some of which show a high fidelity to dry oak forests (e.g. *Cytisus nigricans* and *Hieracium murorum*). Trees with shrubs hosted the highest number of diagnostic species (36 species, equal to 18.5% of the total species pool of the landscape). These species included all sorts of species groups like ruderal species (e.g. *Cirsium vulgare*), short, grazing-tolerant species (e.g. *Ajuga genevensis* and *Lysimachia nummularia*), taller, grazing-sensitive species (e.g. *Galium mollugo* and *Linaria vulgaris*), as well as forest species (*Veronica officinalis* and *Geum urbanum*). There were also three spiny shrubs among the diagnostic species of trees with shrubs, including *Crataegus monogyna*, *Rosa canina* agg., and *Prunus spinosa*.

4.3.5 Plant communities

According to the NMDS, the herb layer of open pastures and trees with grass occupied distinct regions in the ordination space. Forest edges had rather diverse vegetation, entirely encompassing the assemblages of trees with shrubs and slightly overlapping with the open pastures and trees with grass. Trees with shrubs showed practically no overlap with trees with grass and open pastures (Figure 10).

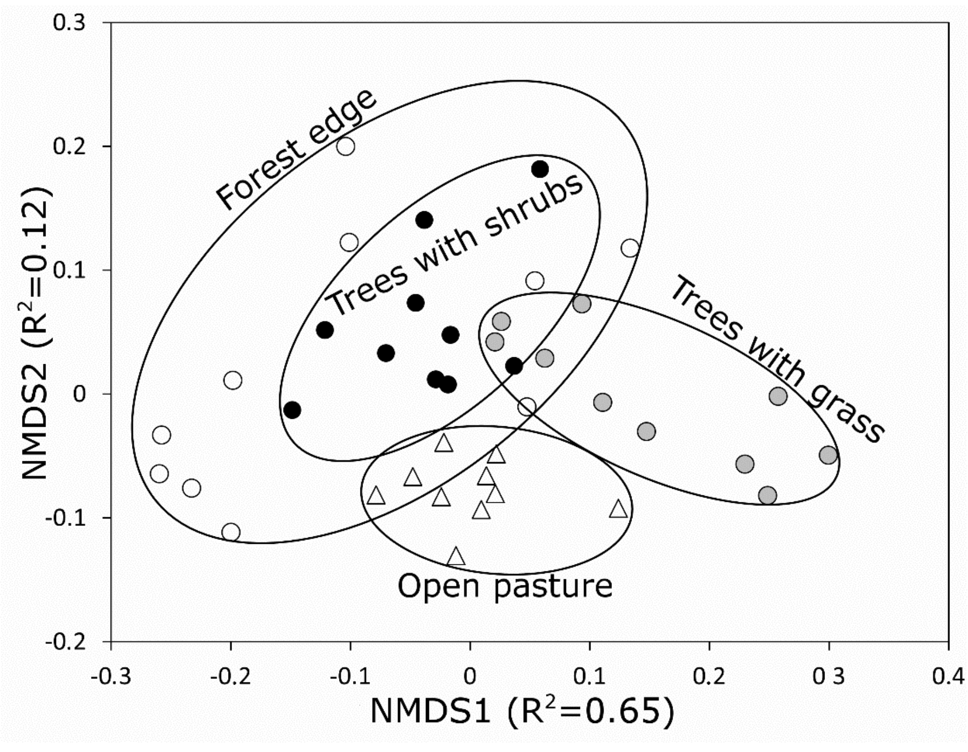

Figure 10. NMDS ordination of the herb layer of the typical landscape features of the studied wood-pasture. The three relevés of each site were averaged, resulting in 10 data points for each type of site. Stress factor: 0.181.

A total of 24 ruderal species were detected in the relevés; the most abundant species were *Poa annua*, *Polygonum aviculare* and *Stellaria media.* The GLM was significant (F = 3.34, P = 0.050) and indicated that trees with grass had a significantly higher overall coverage of ruderal species than forest edges. However, only marginal significance was found between trees with grass and trees with shrubs. Furthermore, no significant difference was found between the ruderal species cover in trees with shrubs and that of forest edges.

We recorded a total of 32 forest species, of which *Helleborus purpurascens*, *Luzula luzuloides* and *Veronica officinalis* were the most abundant. According to the GLMM of forest species (*Chi-square* = 8.03, P = 0.018), trees with shrubs and forest edges had similar amounts of forest species, while trees with grass had a significantly lower cover of forest species in the herb layer.

4.4 Conclusions

Our study shows that sparsely scattered mature woody vegetation and shrubs substantially increases the ecological value of managed pastures. The structural complexity provided by scattered trees and shrubs makes possible the co-occurrence of high spider diversity with a moderately high intensity grazing possible in this wood-pasture. Our results shows that the managed oak wood-pasture contains several rare species of spiders, which are characteristic for natural ecosystems. We suggest that the wood-pasture studied and presented here acts as ’wild’ landscape. Therefore systems such as this one could integrate the biodiversity conservation and ’wild’ drivers of landscape dyamics with the production of livestock. Our results are in line with recent empirical research showing that sparse trees and shrubs increases the biodiversity potential of pastures managed for commodity production.

5 Tree regeneration in wood-pastures

5.1 Natural regeneration

Field information and personal experiences from past projects was used to examine tree regeneration in Transylvanian wood-pastures. Between 2015 and 2016 97 wood-pastures were surveyed in Transylvania to inventory large old trees and find evidence for tree regeneration. Oak regeneration was associated with thorny shrubs in several wood-pastures. These areas were always marginal areas of wood-pasture, probably because these marginal areas were more free from scrub clearing. In some cases the manager of the pasture removed the scrubs while maintaining the young trees (Figure 11).

Figure 11. Oak and hornbeam regeneration in the thorny scrubs in an ancient oak wood-pasture managed by livestock grazing. Natural regeneration of oaks could be promoted via thorny scrubs.

5.2 Conclusions based on field assessment

Our field experience shows that the pasture surfaces with thorny scrubs as well as those pasture surfaces which were temporarily abandoned provides ideal environments for tree regeneration. We suspect that the regeneration from seeds is a key condition for the viability of saplings. In order to promote this, we applied for a conservation grant in order to implement a large scale tree regeneration project (see below).

5.3 The use of fences to protect planted trees in wood-pastures

An oak tree regeneration project partly by fencing 2000 naturally grown oak saplings, and by planting and fencing 600 oak saplings originating from acorns collected from the Breite ancient wood-pasture. Furthermore, over 65 ha of dense hornbeam (with a height of at least 1.5 m) were manually removed over three consecutive years and sparse oak trees were selectively maintained. Grazing with 300 sheep and 150 goats was reintroduced to stop the regeneration of hornbeam.

Our experience shows that fencing with thorny shrubs as well as artificial (metal) fences in the Breite ancient wood-pasture in 2009 suggests that these methods have a good potential to protect the young trees. However, the mortality of the planted trees was very large: in our case ca 70% of the planted trees dried at the end of the second growing season, without being injured by livestock or wildlife.

5.4 Conclusions

Fencing young tree saplings in order to allow tree regeneration in grazed wood-pastures requires major maintenance activities, either in terms of replanting to substitute the dead/dried tree saplings or the maintenance of fences. We suspect that using oak trees from nurseries requires a substantially larger care in order to not damage the roots of the saplings in order to avoid large mortality of trees.

6 Lessons learnt

The research on wood-pastures in Transylvania focused on old trees, tree regeneration and the integration of biodiversity with grazing.

Large old trees

In the study area covered by AGFORWARD in Transylvania, farmers associate mainly tangible values to the scattered trees.

- We found that large old trees are appreciated for cultural-historical values but they are removed when people perceive them as deteriorating (hollows, dry parts, ageing bark, large nodes). We believe that this happens because the tangible values are more important than the cultural values.
- Local communities perceive virtually no natural values related to large old trees; therefore we advise communication strategies to build on historical, cultural features of these trees.
- The Remarkable Trees of Romania (RToR) initiative was started to bring together knowledge on large old trees. Over 2500 trees from over 110 pastures were inventoried in 2015-2016. Each tree is uploaded in the www.arboriremarcabili.ro database, which is the first initiative of this kind in Romania.
- RToR inspired workshops and other initiatives in some villages of the Saxon region of Transylvania in order to increase the community`s attractively to large old trees on pastures.

Grazing and biodiversity

- Scattered trees and shrubs were the richest while the open pasture surfaces and the scattered trees were poorest in spider and plant species. Nevertheless, we find statistically distinct species assemblages in the four habitat types; hence scattered trees have substantial influence on the beta diversity of the pastures.
- We conclude that scattered trees and shrubs enhances the biodiversity potential of pastures. This result is congruent with new research across Europe. Since tree density is not a major limiting factor for production in systems such as those studied by us (Rivest et al. 2013), and the maintenance of those trees does not require special financial inputs, we advise for the maintenance of scattered trees across the pastures.

Tree regeneration

Table 4 on the next page summarizes our understanding on tree regeneration in pastures.

Table 4. Summary of the understanding of tree regeneration in pastures

Planting	Natural regeneration
Low survival rate of trees - replanting and maintenance may be needed for more (i.e. 5-6) years.	High survival rate of trees – it depends on the propagule sources in the landscape to form nurse shrubs
Fences are needed around each planted tree (in order to protect them from grazing), or if groups of trees are planted, these might need to be surrounded by one fence (grazing is excluded).	Fences may be needed to delineate pasture surfaces where grazing intensity would be reduced.
Planting is likely needed in the central, productive surfaces of the pastures – which are more attractive for livestock and where grazing intensity is high.	Likely work in the marginal – less accessible – less attractive surfaces of the pasture.
	Shrubs will also enrich after the short term abandonment; this may decrease the quality of pasture in short term (including injuries on sheep/goat)

7 Further prospects

On 2 October 2017 we had a meeting with the local community representants (mayor, local councilor, NGO representants, forestry representants and the representants of cultural initiatives) from Saschiz to share our knowledge with them and to identify further needs of interventions for the sustainability of wood-pastures (Figure 12). Based on this meeting, we identified key interventions and developed a conservation grant submitted to Whitley Fund for Nature entitled: '*Ancient wood-pastures of Transylvania: restoring habitat of global concern'.* The project proposal was developed by T. Hartel and it is currently under review. We have the full support of the local community to implement tree regeneration and monitoring actions on that wood-pasture, while we will generate a zonation of the system which is based on natural and cultural values. This map will be used by the local council to guide management actions on that wood-pasture.

Figure 12. Stakeholder meeting in early October 2017 for discussing about priority needs for management interventions in an ancient wood-pasture near the village Saschiz.

8 Acknowledgements

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