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Are Hungarian Grey Cattle or Hungarian Racka Sheep the Best Choice for the Conservation of Wood-Pasture Habitats in the Pannonian Region?

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Abstract: Wood pastures have been characteristic farming types in the Pannonian biogeographical region over the centuries. In the present work, we studied wood-pastures of typical geographical locations in the North Hungarian Mountain Range of Hungary characterized by similar environmental conditions but grazed by different livestock. The sample area of Cserépfalu was grazed by Hungarian Grey Cattle, while the Erdőbénye was grazed by Hungarian Racka Sheep. Coenological records of the sites were collected from 2012 to 2021 in the main vegetation period according to the Braun-Blanquet method with the application of 2×2 m sampling quadrats, where the coverage estimated by percentage for each present species was also recorded. To evaluate the state of vegetation, 'ecological ordering' distribution, diversity, and grassland management values were used. Between the two areas, the grazing pressure of the two studied livestock produced different results. Based on the diversity values, woody–shrubby–grassland mosaic diversity values were high (Shannon diversity: 2.21–2.87). Cattle grazing resulted in a variable and mosaic-like shrubby area with high cover values. Based on our results, grazing by cattle provides an adequate solution for forming and conserving wood-pasture habitats in the studied areas of Hungary. However, if the purpose is to also form valuable grassland with high grassland management values, partly sheep grazing should be suggested.

Keywords: grassland management value; grazing; Pignatti life form; ruminant; land-use

1. Introduction

Wood pastures are among the oldest land-use types in Europe where livestock grazing occurs in mosaic habitats characterized by open grasslands with scattered trees and shrubs [1,2]. Over the centuries, wood pastures have been important traditional components of the Pannonian landscape as one of the dominant farming types of the region [3–7].

During extensive management, livestock farmers have maintained optimal semi-natural habitats for farm animals in harmony with nature [8–11], making wood pastures regional hotspots of biodiversity. Therefore, wood pastures are archetypes of High Nature Value Farmlands in Europe, with high ecological, social, and cultural importance [3]. Recognizing their importance, wood pastures have received increasing scientific attention in the last few decades [2,12–18]. However, they are in rapid decline in the Carpathian basin and throughout Europe due to land-use changes, tree cutting, under- or overgrazing, and lack of regeneration [9,12]. In this regard, further research is urgently needed on both local and regional scales [9].

Öllerel et al. [19] conducted a complex review of the effects of domestic livestock grazing on temperate forest vegetation. They concluded that successful wood-pasture conservation largely depends on the choice of grazing livestock species and that a lack of grazing can negatively affect biodiversity and forest management.

Although grazing by large ungulates reduces vegetation biomass, it can increase diverse habitats and the regeneration of selected canopy tree species [20,21]. Research shows that grazing by sheep [22–24] and goats [25] for vegetation management is also common. However, other researchers have reported that grazing by cattle and goats [26], and by cattle and horses together were better alternatives [27]. Based on a study by Fűrész [28], domestic water buffalo may be suitable for habitat management in controlling tree and shrub encroachment.

Wild herbivore species should be considered when treating wood pastures as semi-natural habitats [29,30]. Large herbivore animals have had a significant role in the formation of forests, shrublands, and grasslands [13,31,32]. Thus, by supplementing wildlife activity, grazing animals can also contribute to the conservation of present forest–grassland mosaics [13,29,33–35]. In addition, livestock grazing influences wild herbivore populations in different ways due to their physiology, diet, behaviour, and stocking rate [29,30]. Various native and introduced livestock, such as cattle, sheep, and ponies, can substitute for wildlife activity [36,37]. However, uncontrolled grazing by large ungulates can lead to overgrazing, which spreads less preferred [38] and/or low forage value species [39]. Nevertheless, moderate grazing is needed to avoid considerable spreading of shrub species [29,31,40,41] since restraint from a loss of species diversity after abandonment is one of the main aims of wood-pasture conservation [42,43]. Herbivore grazing has changed the primary production [44], spatial heterogeneity [45,46], structure [47], composition [48], and diversity [42,49–51] of grasslands. Furthermore, the type of pastoral grazing affects the community structure of vegetation and the yield of grasslands [52,53]. Forage value and natural conservation of wood-pastures should be investigated in the future.

Regarding the complexity of the studied plant–animal–environment system, we aimed to collect data about the appearance and traceability of different factors on the species richness and diversity of vegetation. Based on preliminary examinations of species richness in wood pastures conducted in different regions of Hungary [54–56], two sample areas characterized by similar environmental conditions (exposure, parent rock, topography, climate) but grazed by different livestock (Hungarian Grey Cattle and Hungarian Racka Sheep) were selected in the North Hungarian Mountain Range.

Based on the parameters of the sampling sites, we sought answers to the following questions in our research:

(1) Is there any difference in vegetation structure between (a) woody shrub and grassland mosaic habitats and (b) simple grassland habitats? Which trends in species numbers and diversity prevail between these two different habitats?
(2) Is grazing by Hungarian Grey Cattle or Hungarian Racka Sheep more effective at habitat conservation under similar environmental conditions? How does their grazing affect grassland management values differently?

Our preliminary hypothesis:

(1) Grazing pressure results in significant differences between vegetation groups important for grassland management. There are differences between sheep grazing and

grey cattle grazing, in which grey cattle grazing provides better plant components for grassland management and nature conservation.

2. Materials and Methods

2.1. Data Collection and Surveyed Areas

The Cserépfalu (C) sample area is located at the Bükk hillfoot of the Eger micro-region of the North Hungarian Mountain Range (Figure 1) [57]. Approximately 60–70 Hungarian Grey Cattle graze annually on the wood pasture from April to November; however, the exact duration of grazing periods depends on annual weather conditions. The Erdőbénye (E) sample area is situated in the Hegyalja micro-region of the North Hungarian Mountain Range [57] and is grazed by Hungarian Racka Sheep.

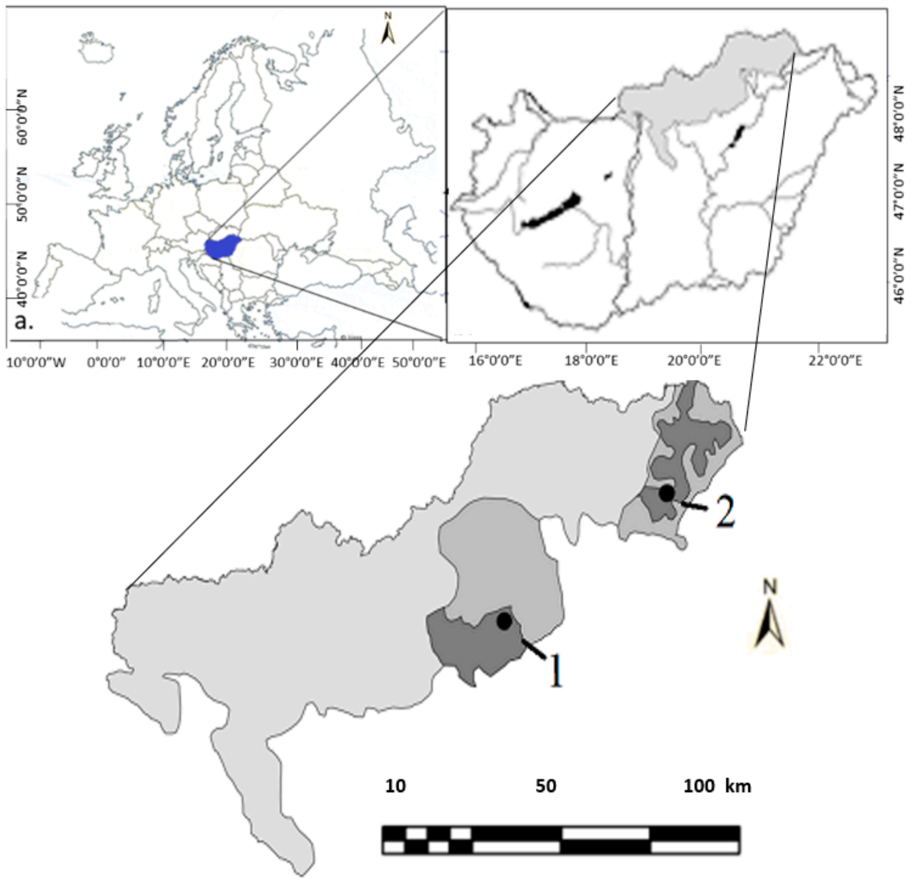

Figure 1. Location of sample areas in Hungary (a: Location of Hungary in the map of Europe, 1: C: Cserépfalu, 2: E: Erdőbénye).

Based on the first military survey of Hungary (1783–1874), both sample areas were covered by forest in the XVI century [58]. However, it is possible that they were already grazed at that time and formed an open woodland habitat, as described in the works of Holl and Smith [18] and Geiger et al. [59]. Based on the second (1858) [60] and third (1883–1884) military surveys [61,62], topographical maps from the Second World War (1940s) [62], and the history of grazing on wood pastures and grasslands [63–66], the studied areas have been grazed continuously for 150 years.

Habitats of shrubby–woody patches (W) and grassland areas (G) were studied separately. We conducted six coenological surveys of the woody sample areas (CWA, CWB, CWC, EWA, EWB) and ten in the grassland sample areas (CGA, CGB, CGC, EGA, EGB) each year from 2012 to 2021 in the vegetation period (May, June, and September) based on the Braun-Blanquet method [67] in 2×2 m quadrats. The coverage was estimated by percentage for each present species. Plant layers were also considered, resulting in values over 100%. The name of the species was recorded based on the nomenclature of Király [68].

The sample areas mentioned above were identified and coded based on differences in location and grazing livestock (first digit of the code), habitat type (second digit of the code), and intensity of land use (third digit of the code).

The grassland areas were grazed intensively or less intensively. The stocking rate was the same but the length of the grazing period was different. Animals spent almost twice as much time in the intensive grazing zones with high grazing pressure (A) than in zones with low grazing pressure (B). We also identified abandoned zones (C).

The vegetation type of grasslands (G) was *Agrostio-Festucetum rubrae*. The vegetation type of the pasture with low grazing pressure (B) was *Potentillo-Festucetum pseudovinae* and the pasture with high grazing pressure (A) was *Nardetum strictae*.

The following sample areas were investigated:

Hungarian Grey Cattle pasture (C: Cserépfalu):

- CWA: *Agrostio-Festucetum rubrae* grassland and shrubby and woody patches, mosaics, stocking rate was 2.5 cattle/ha;
- CWB: *Agrostio-Festucetum rubrae* and shrubby and woody patches, mosaics with low grazing pressure, stocking rate was 0.5 cattle/ha;
- CWC: abandoned pasture, *Agrostio-Festucetum rubrae* and shrubby–woody patches, mosaics, grassland, stocking rate was 1 cattle/ha;
- CGA: intensively grazed *Agrostio-Festucetum rubrae* grassland, stocking rate was 2.5 cattle/ha;
- CGB: *Agrostio-Festucetum rubrae* (*Potentillo-Festucetum pseudovinae*) grassland with low grazing pressure, stocking rate was 0.5 cattle/ha;
- CGC: abandoned pasture, *Agrostio- Festucetum rubrae* (*Potentillo- Festucetum pseudovinae*), stocking rate was 1 cattle/ha.

Hungarian Racka Sheep pasture (E: Erdőbénye):

- EWA: *Agrostio-Festucetum rubrae* and *Nardetum strictae* grasslands, shrubby and woody patches, mosaics, stocking rate was 10 sheep/ha;
- EWB: *Agrostio-Festucetum rubrae* and *Nardetum strictae* grasslands, shrubby and woody patches, mosaics with low grazing pressure, stocking rate was 2 sheep/ha;
- EGA: intensively grazed *Agrostio-Festucetum rubrae* and *Nardetum strictae* grassland, stocking rate was 10 sheep/ha;
- EGB: grazed *Agrostio-Festucetum rubrae* and *Nardetum strictae* grasslands with low grazing pressure, stocking rate was 2 sheep/ha.

2.2. Analysis of Biomass

The vegetation of the sample areas was also examined for grassland management purposes. Biomass measurements were conducted in June and September only in the grassland (G) areas. Parallel with the coenological recordings, a 1 × 1 m grassland plot was mowed by grass shears leaving a 4-centimetre high stubble for model grazing. Sampled biomass was sorted based on important grassland management groups. The following values and notations of grassland management categories were applied [69]:

1. *Poaceae* species important for grassland management;
2. *Fabaceae* species for grassland management;
3. Other *Poaceaae*, *Carex* and monocotyledons;
4. Neutral dicotyledonous species;
5. Woody species;
6. Thorny species;
7. Litter.

The coverage values of each grass species were calculated from the total coverage percentage per mass ratio.

The forage values of various plots were calculated by the following formula [70,71]:

$$\mathrm{FV} = ((\mathrm{a} \times \mathrm{A} + \mathrm{b} \times \mathrm{B} + \mathrm{c} \times \mathrm{C} \ldots)/100 \times \mathrm{x}$$

FV: Forage value of the vegetation plots;
a, b, c. . .: categories of forage values of species;
A, B, C. . .: coverage of species;
x: total coverage of species.

Grassland production was estimated by the Balázs method [72,73] using the following formula:

$$\mathrm{P} = ((\mathrm{M} - \mathrm{s}) \times \mathrm{BM} \times \mathrm{b})/100$$

P: yield [Kg/ha]
M: grass height [cm]
s: stubble height [cm]
BM: grass 400 [kg/ha]; alfalfa 470 [kg/ha]
b: coverage [%]

With knowledge of the average grass height and total coverage, the annual yield and animal capacity of the grasslands were estimated. The following data were considered: 60 kg/day green weight and a 210-day grazing season for cattle, 7 kg/day green weight and a 210-day grazing season for sheep. The 'ecological ordering' and evaluation of species was performed according to Pignatti [74,75] because Raunkiær's main life forms could not represent the distribution of the species, whereas Pignatti's life forms adequately reflect grazing effects.

Pignatti's life forms:

Perennial species

- H scap: scapose hemicryptophytes
- H caesp: caespitose hemicryptophytes
- H ros: rosulate hemicryptophytes
- H rept: reptanthe micryptophytes
- H bienn: biennal hemicryptophytes
- G bulb: bulbose geophytes
- G rhiz: rhizome-geophytes
- G rad: root-budding geophytes

Annual species

- T scap: scapose therophytes
- T caesp: caespitose therophytes
- T rept: reptant therophytes

Dwarf shrub species

- Chfrut: frutescens chamaephytes
- Chrept: reptant chamaephytes
- Chsucc: succulent chamaephytes

Subshrub species

- Chsuffr: sufruticose chamaephytes

Woody species

- P scap: Scapose phanerophytes
- P caesp: Caespitose phanerophytes
- NP: Nanophanerophytes
- MP: Macrophanerophytes

2.3. Statistical Analysis

Plant diversity was analysed by applying the two most frequent diversity indexes (Shannon–Wiener and Simpson) [76] and the diversity application of the Chang Bioscience web page (http://www.changbioscience.com/genetics/shannon.html, accessed on 3 March 2023). The results are represented in diagrams. To compare the Shannon–Wiener and Simpson's diversity indices of areas and biomass properties, the non-parametric Kruskal–Wallis test (α = 0.05) was used. The non-parametric post hoc Dunn's test with Bonferroni correction was used for multiple pairwise comparisons [77].

3. Results

3.1. Species Composition and Structure of Vegetation

There were 135 species in the plots of the examined areas. Among the species, 61 species were frequently present. A higher proportion of species was noted in the woody habitats of Cserépfalu (CWA, CWB, CWC), with 23 species such as *Arrhenatherum elatius*, *Astragalus glycyphyllos*, *Berteroa incana*, *Campanula bononiensis*, *Betonica officinalis*, *Carex caryophyllea*, *Carex praecox*, *Centaurea indurata*, *Centaurea micranthos*, *Centaurium erythraea*, *Danthonia alpina*, *Conyza canadensis*, *Cruciata laevipes*, *Dianthus armeria*, *Geranium columbinum*, *Inula britannica*, *Potentilla arenaria*, *Prunella laciniata*, *Sanguisorba minor*, *Setaria viridis*, *Ventenata dubia*, *Verbascum phlomoides*, *Vulpia myuros*. Six species were associated only with the low-pressure pasture zone in Cserépfalu independent of the habitat (CWB, CGB): *Carex pairae*, *Cirsium eriophorum*, *Lathyrus nissolia*, *Phleum phleoides*, *Helianthemum nummularium*, *Hypericum maculatum.* Fifteen species were only present in Erdőbénye, such as *Oxalis corniculata*, *Plantago major*, *Polygala amarella*, *Veronica officinalis*, *Stachys germanica*, *Scrophularia nodosa*, *Mentha pulegium*, *Nardus stricta*, *Juncus tenuis*, *Gypsophila muralis*, *Dipsacus laciniatus*, *Danthonia decumbens*, *Cruciata pedemontana*, *Campanula rapunculoides*, *Calamagrostis epigeios*.

Four species present only in the grassland were found in both sample areas. The common species were mainly natural disturbance-tolerant species or weeds. Among the weeds, we also found thorny species due to grazing pressure, such as *Eryngium campestre*, *Ononis spinosa,* or *Carduus acanthoides*. Several weeds (*Conyza canadensis*, *Setaria viridis*) were also present within species that occurred only in Cserépfalu (C) or Erdőbénye (E). As an indicator of grazing pressure, for example, *Poa humilis* appeared in Erdőbénye.

Our results for Simpson and Shannon's diversity indices showed similar trends (Table 1); however, a deeper evaluation revealed disparities. The woody habitat with intensive sheep grazing (EWA) differed significantly from the woody habitat grazed by sheep with low pressure (EWB) and from the abandoned cattle pasture (CWC) and the area grazed by cattle with low pressure (CWB), according to Simpson's diversity index. Nevertheless, in terms of Shannon's diversity index, the woody habitat with intensive sheep grazing (EWA) did not differ significantly from the abandoned cattle wood pasture (CWC). In addition, the woody habitat with low sheep grazing pressure (EWB) had significantly lower values than the woody habitat with high cattle grazing pressure (CWA) in terms of Simpson's diversity index. However, in the case of Shannon's diversity index, the abandoned cattle pasture (CWC) was also significantly different. Simpson's diversity index for intensively grazed woody habitats (CWA) did not differ significantly from the other two cattle-grazed zones (CWB, CWC). By contrast, the abandoned wood pasture (CWC) had significantly higher values than the area with low pressure (CWB), according to Shannon's diversity index. In the grassland (G) plots, there was no significant difference between the values of the two diversity indices. The cattle pasture with lower grazing pressure (CGB) significantly differed from the other areas except for the sheep pasture with high grazing pressure (EGA) in Simpson's diversity index and the abandoned cattle pasture (CGC) in Shannon's diversity index. Moreover, sheep pastures significantly differed from each other (EGA, EGB). The rest of the pastures had similar properties.

Table 1. Diversity means and standard deviations values of sample areas in Cserépfalu and Erdőbénye.

Woody (W) Plots	**CWA**	**EWA**	**CWB**	**EWB**	**CWC**
Simpson diversity *	0.89 ± 0.02 BCD	0.91 ± 0.02 D	0.85 ± 0.02 ABC	0.74 ± 0.02 A	0.86 ± 0.01 ABC
Shannon diversity	2.74 ± 0.05 CD	2.87 ± 0.05 D	2.46 ± 0.04 ABC	2.21 ± 0.03 A	2.82 ± 0.10 D
Grassland (G) Plots	**CGA**	**CGB**	**CGC**	**EGA**	**EGB**
Simpson diversity	0.89 ± 0.01 BCD	0.83 ± 0.02 A	0.89 ± 0.02 BCD	0.83 ± 0.02 AB	0.89 ± 0.02 CD
Shannon diversity	2.66 ± 0.05 BCD	2.23 ± 0.04 A	2.66 ± 0.05 ABCD	2.23 ± 0.6 AB	2.66 ± 0.03 CD

* Based on the Kruskal–Wallis and Dunn's post hoc tests with Bonferroni correction. Bonferroni-corrected significance level: 0.005. Stand-alone letters indicate homogeneous groups (A or B or C or D) that significantly differ from each other. When heterogeneous groups have at least two different letters, they are not significantly different from groups with a common letter.

Two categories, important grass species and legume species, were highlighted in the grassland management analyses (Figure 2). The amount of important grass species for grassland management was significant in the sample areas. Among the dominant grasses, species of the genus *Agrostis* and *Festuca* had high cover values. Other important grass species were *Dactylis glomerata*, *Elymus repens*, *Poa angustifolia*, *Cinosurosus cristatus*, *Alopecurus pratensis*, and *Arrhenatherum elatius*. Among the important legume species for grassland management, the abundance of *Lotus corniculatus* was outstanding, and *Trifolium* species such as *Trifolium campestre*, *T. pratensis*, and *T. ochroleuca* were present in high proportions. In intensively grazed zones, the cover of *Trifolium repens* was also significant.

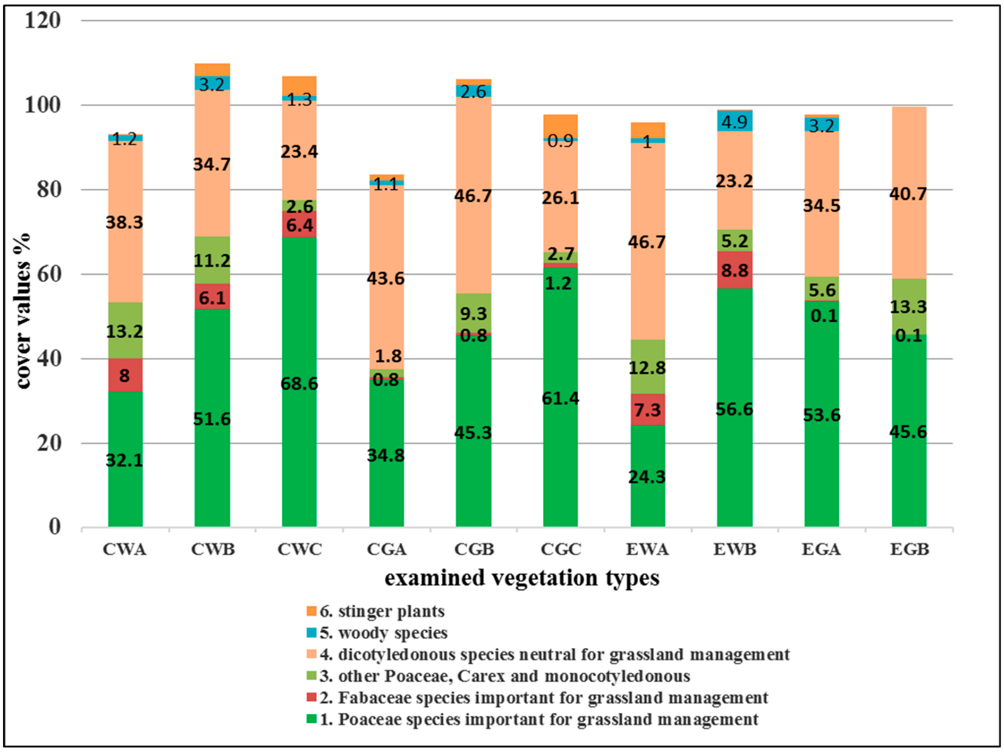

Figure 2. Distribution of species classified by grassland management in each sample area.

Shrub and tree species occurred mainly in the shrubby–woody complex (WA, WB). The abundance of shrubs showed contradictory results in the two sample areas. In Cserépfalu (C), the proportion of shrubs increased in the intensively grazed areas by Hungarian Grey

Cattle, both in woody (CWB) and grassland (CGB) habitats. By contrast, the proportion of shrubs was reduced in both woody (EWB) and grassland (EGB) habitats in Erdőbénye (E).

Neutral dicotyledonous species for grassland management may also be important because they contain herbs, such as *Thymus* taxa. These thorny plants were mainly represented by two species, *Ononis spinosa* and *Eryngium campestre*, which had the highest proportion in the woody habitats of Cserépfalu (CWA, CWB), whereas the grassland habitat (G) plots had lower amounts characterized by 1–2% cover values. The abundance of other grasses, *Carex* and monocotyledonous species, grew as a consequence of increased grazing pressure and are well-represented in the plots from Cserépfalu.

Grass cover was highest in woody habitats with low grazing pressure (CWB) and in grasslands with low-pressure grazing (CGB). The lowest cover was found in the intensively grazed area (CGA). The abandoned pasture (CGC) also had low values. The proportion of important grasses for grassland management increased in the woody habitats and the grassland with low sheep grazing pressure in Erdőbénye (EWB), but the proportion of these useful grasses declined in the intensively sheep-grazed grassland area (EGA).

3.2. Assessment of Areas Based on Life Form Distribution

In terms of Pignatti's life form distributions, herbaceous species were particularly dominant, especially perennial rosette (H ros) and perennial creeping stem plants (H rept), which were good indicators of grazing pressure (Figure 3). However, their proportions were different: creeping perennial species (H rept) and rosette perennial species (H ros) were usually more abundant in the sheep pasture than in cattle pasture. The abundance of shrubby (M, N, P caesp) species was naturally high in woody habitats (WA, WB, WC). Their quantity was lower in the sheep pasture (EWA, EWB) than in the cattle pasture. Caespitose hemicryptophytes (H caesp) were the dominant life forms in the sample areas. In addition to grassland species, the proportion of scapose hemicryptophyte species (H scap) was also significant. The number of species showing the reptanthe micryptophyte life form (H rept) indicated the intensity of grazing pressures with an average value of around 20%. The abundance of scapose therophyte (T scap) species was significant in grazed woody habitats (W).

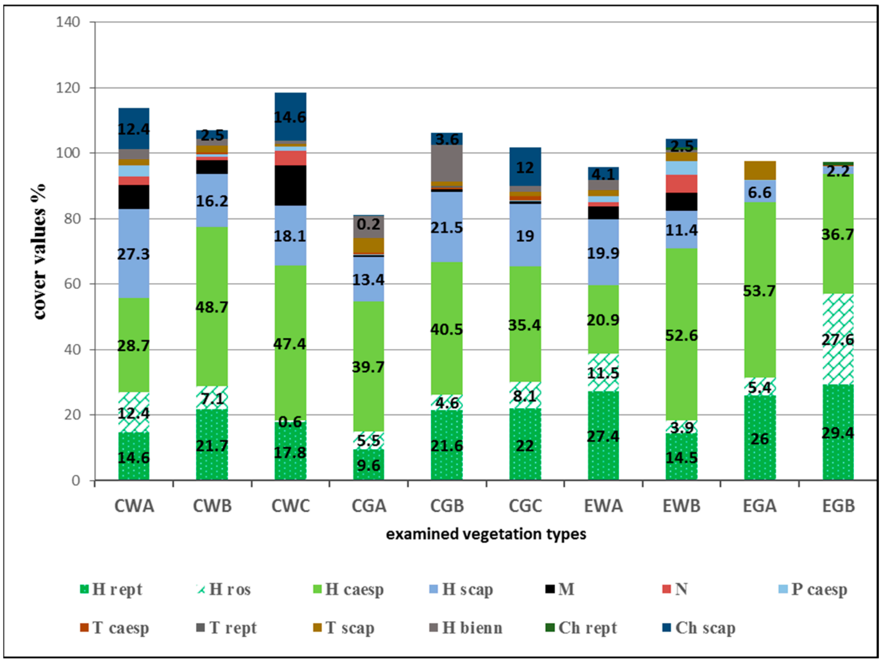

Figure 3. The distribution of the species according to Pignatti's life forms in the sample areas.

3.3. Results of Biomass

Grassland management assessment was only applied to grassland (G) areas. Based on the results (Table 2), all sample areas were closed, multi-level pastures. The most intensive grazed zone (CGA) provided the highest yield with an estimated green weight of 14.4 t, whereas the lowest yield of 10.6 t/ha was in the grazed zone with lower pressure (CGB). The values of the abandoned pasture (CGC) were in between, but with the best forage quality (Table 2, Figure 4). The same pattern was observed in sheep-grazed pastures as grassland with higher pressure (EGA) provided a higher yield of 11 t/ha compared with the lower pressure zone (7.5 t/ha).

Table 2. Total cover, total yield, quality, and height of the grassland (G) in the sample areas (means and standard deviations).

	CGA	CGB	CGC	EGA	EGB
Σ cover (%) *	116 ± 8.9 AB	103.6 ± 17.4 A	125.1 ± 10.2 B	121.8 ± 15.3 AB	107.6 ± 8.4 AB
Σ relative yield	3589 ± 334.9 C	2656.5 ± 578.1 B	2856 ± 293.6 BC	2750 ± 481.4 BC	1866 ± 116.4 A
Σ quality relative yield	4217 ± 1548.8 BC	2621.4 ± 1890.9 AB	4053 ± 786.5 BC	4427 ± 959.6 C	2323 ± 568.4 A
quality	1.15 ± 0.35 AB	1.06 ± 0.75 A	1.43 ± 0.28 AB	1.61 ± 0.22 B	1.24 ± 0.25 AB
height	30.91 ± 1.04 C	25.47 ± 1.91 BC	22.82 ± 1.19 AB	22.44 ± 1.41 AB	17.38 ± 0.83 A
yield (t/ha)	14.4 ± 1.3 C	10.6 ± 2.3 B	11.4 ± 1.2 BC	11.0 ± 1.9 BC	7.5 ± 0.5 A

* Based on Kruskal–Wallis test and Dunn's post hoc test with Bonferroni correction. Bonferroni-corrected significance level: 0.005. The standalone letters indicate homogeneous groups (A or B or C) and those that significantly differ. When heterogeneous groups have at least two different letters, they are not significantly different from groups with a common letter.

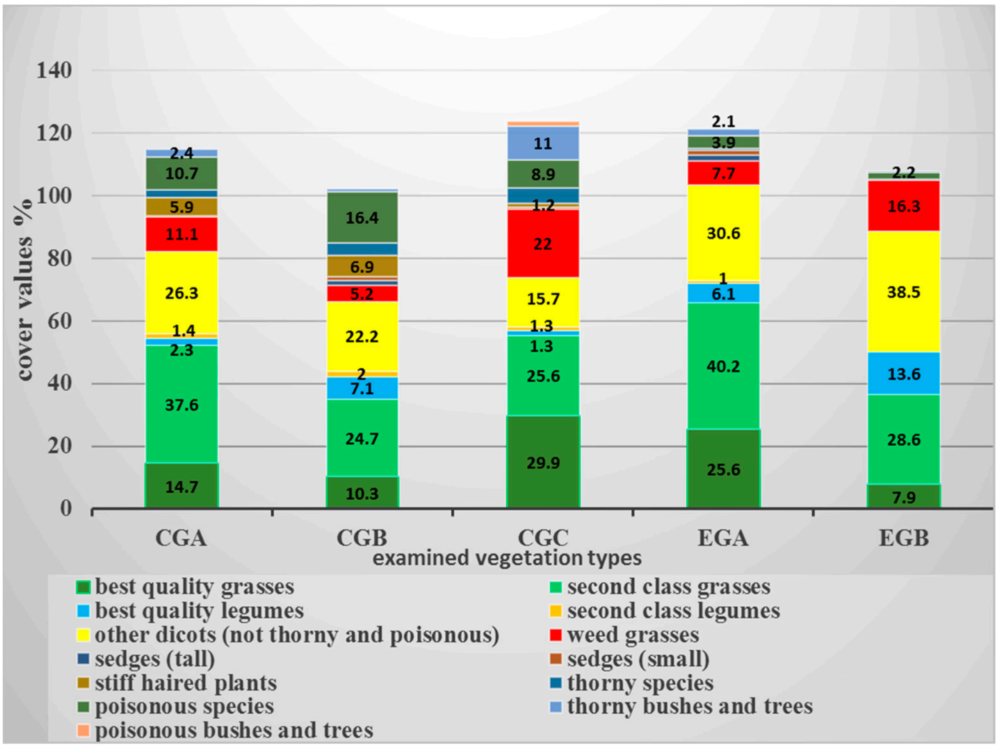

Figure 4. Distribution of grassland species grouped by grassland management.

In the statistical evaluation, most grassland sample areas had total cover values that did not differ substantially. However, values for grassland with low grazing pressure (CGB) and abandoned pasture (CGC) in Cserépfalu differed significantly. For relative yield and yield values, the grassland with low grazing pressure in Erdőbénye (EGB) was significantly lower than the other grassland sample areas. Besides the grassland with low grazing pressure in Erdőbénye (EGB), the grassland with high grazing pressure in Cserépfalu (CGA) differed from the grassland with low grazing pressure in Cserépfalu (CGB). Nevertheless, these two sample areas did not differ significantly from the abandoned pasture (CGC) and the grassland with high grazing pressure in Erdőbénye (EGA). For quality relative yield, the grassland with low grazing pressure in Erdőbénye (EGB) had significantly lower values than the other sample areas, except for the grassland with low grazing pressure in Cserépfalu (CGB). The sheep pasture with high grazing pressure (EGA) had significantly higher quality relative yield than the cattle pasture with low grazing pressure (CGB) and the sheep pasture with low grazing pressure (EGB). The statistical results for the quality of the grassland sample areas showed that the values of the grassland with low grazing pressure in Cserépfalu (CGB) and the grassland with high grazing pressure in Erdőbénye (EGA) differed significantly. For the evaluated quality values (Table 2, Figure 4), the cattle pasture with low grazing pressure (CGB) and the sheep pasture with high grazing pressure (EGA) differed significantly, whereas the other sample areas did not differ significantly from each other. For examined height values, the grassland with low grazing pressure in Erdőbénye (EGB) had significantly lower values than the grasslands with low and high grazing pressure in Cserépfalu (CGA, CGB), whereas the cattle pasture with high grazing pressure (CGA) resulted in significantly higher values than the abandoned pasture (CGC) and sheep pastures (EGA, EGB).

4. Discussion

Several weeds and natural disturbance-tolerant species [78–80] were found in our study areas as a result of permanent grazing. Several plant species were valuable in terms of grassland management [70,81]. Some weeds were thorny species such as *Eryngium campestre*, *Ononis spinosa,* and *Carduus acanthoides*, which hampered grazing. There were numerous weed species in both Cserépfalu (C) and Erdőbénye (E), such as *Conyza canadensis* and *Setaria viridis*, which had low grassland management value. *Poa humilis* was present in Erdőbénye as an indicator species of grazing [82]. Some categories [69,83,84] were used to represent groups of grassland management importance as grasses are important protein and fibre sources [85].

Pignatti's life forms [74] were found to be a better indicator of grazing intensity than Raunkiær life forms [86]. Caespitose hemicryptophyte species (H caesp) were especially dominant life forms in the investigation; however, it was also clearly shown that the proportion of rosette species was higher in sheep pastures because these plants quickly and efficiently adapted to sheep grazing. Sheep chew the grass short and are more species-selective in grazing, suggesting that sheep-grazed grassland vegetation adapts to appropriate life form species as a defence [87]. Due to the grazing habits of various livestock, their restoration effects differ and may have significantly different effects on grasslands and grazed areas [17,70]. The number of shrubs in the two sample areas was inverse. The proportion of shrubs increased in Cserépfalu (C), where cattle grazed intensively, and decreased in Erdőbénye (E), where sheep grazed. Our preliminary expectations were that sheep would consume more shrubs, thereby influencing their decreasing trend [29,88–93], but this did not occur in each sample plot. As grazing intensity increased, the abundance of reptanthe micryptophyte and rosulate hemicryptophyte species (H rept, H ros) increased, indicating an increase in grazing pressure. These trends were similar to those found in previous research [92]. The abundance of scapose therophyte (T scap) species was more significant in grazed woody habitats and grazed grassland areas due to intensive grazing and trampling, causing weed species encroachment. Several studies [43,94–97] showed that grazing positively affects plant biodiversity, leads to higher species richness [63], and increases diversity [98] in the woody–shrub–grassland mosaic system.

Considering the potential vegetation of the investigated areas, wood pastures can only be conserved through management. They represent a high landscape value formed by centuries of farming [99–102]. Since wood pastures consist of fragile ecosystems, overgrazing can cause major problems with their conservation [18,103]. Vegetation appearance and grassland yields are a good representation of the effects of grazing type and grazing management [99,104–106]. The changes caused by grazing depend on the grazed vegetation type, as different plant species may respond differently to "disturbance" [107]. In many instances, abandonment can be interpreted as a type of disturbance. Reviewing studies on the impact of grazing, it is clear that grazing is an important management practice to sustain grassland species diversity and landscape-level processes [108].

5. Conclusions

Overall, the studied wood pastures grazed by Hungarian Grey Cattle and Hungarian Racka Sheep produced different results. There were differences in diversity, proportion of Pignatti's life forms, and grassland management values. The shrubby–woody and grassland mosaics were diverse at both studied locations. Hungarian Grey Cattle played a significant role in the conservation and formation of these patches by not consuming the shrubs. They also conserved the woody–shrub–grassland mosaic patches and habitat diversity. Based on our results, we concluded that cattle grazing significantly contributes to the dynamic development and long-term maintenance of pastures' woody habitus. Sheep grazing, however, is important to grassland utilization and management, resulting in high values for important grass and legume species.

Therefore, we recommend selecting the most appropriate choice for each objective, even concerning zonation, because the most optimal wood–pasture management maintains vegetation for multiple purposes and ensures both ecological and economic benefits.

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References

1. Moreno, G.; Aviron, S.; Berg, S.; Crous-Duran, J.; Franca, A.; García de Jalón, S.; Hartel, T.; Mirck, J.; Pantera, A.; Palma, J.H.N.; et al. Agroforestry systems of high nature and cultural value in Europe: Provision of commercial goods and other ecosystem services. *Agrofor. Syst.* **2018**, *92*, 877–891. [CrossRef]
2. Burgess, P.J.; Rosati, A. Advances in European agroforestry: Results from the AGFORWARD project. *Agrofor. Syst.* **2018**, *92*, 801–810. [CrossRef]
3. Plieninger, T.; Hartel, T.; Martín-López, B.; Beaufoy, G.; Bergmeier, E.; Kirby, K.; Montero, M.J.; Moreno, G.; Oteros-Rozas, E.; Uytvanck, J.V. Wood-pastures of Europe: Geographic coverage, social–ecological values, conservation management, and policy implications. *Biol. Conserv.* **2015**, *190*, 70–79. [CrossRef]
4. Szabó, P. *Woodland and Forests in Medieval Hungary*; Archaeolingua: Oxford, UK, 2005; 187p.

5. Rotherham, I.D. (Ed.) *Trees, Forested Landscapes and Grazing Animals: A European Perspective on Woodlands and Grazed Treescapes*; Routledge: Abingdon Oxon, UK, 2013; 432p.
6. Gillet, F. Modelling vegetation dynamics in heterogeneous pasture-woodland landscapes. *Ecol. Model.* **2008**, *217*, 1–18. [CrossRef]
7. Garbarino, M.; Lingua, E.; Martinez Subirá, M.; Motta, R. The larch wood pasture: Structure and dynamics of a cultural landscape. *Eur. J. For. Res.* **2011**, *130*, 491–510. [CrossRef]
8. Joffre, R.; Rambal, S.; Ratte, J.P. The dehesa system of southern Spain and Portugal as a natural ecosystem mimic. *Agrofor. Syst.* **1999**, *45*, 57–79. [CrossRef]
9. Hartel, T.; Dorresteijn, I.; Klein, C.; Máthé, O.; Moga, C.I.; Öllerer, K.; Roellig, M.; von Wehrden, H.; Fischer, J. Wood-pastures in a traditional rural region of Eastern Europe: Characteristics, management and status. *Biol. Conserv.* **2013**, *166*, 267–275. [CrossRef]
10. Hartel, T.; Plieninger, T. (Eds.) *European Wood-Pastures in Transition: A Social–Ecological Approach*; The Earthscan Readers Series; Routledge: Abingdon, UK, 2014; 322p.
11. Hartel, T.; Plieninger, T.; Varga, A. Wood-pastures in Europe. In *Europe's Changing Woods and Forests: From Wildwood to Managed Landscapes*; Kirby, K.J., Watkins, C., Eds.; CABI: Wallingford, UK, 2015; pp. 61–76. [CrossRef]
12. Vandenberghe, C.; Freléchoux, F.; Moravie, M.-A.; Gadallah, F.; Buttler, A. Short-term effects of cattle browsing on tree sapling growth in mountain wood-pastures. *Plant Ecol.* **2007**, *188*, 253–264. [CrossRef]
13. Varga, A.; Demeter, L.; Ulicsni, V.; Öllerer, K.; Biró, M.; Babai, D.; Molnár, Z. Prohibited, but still present: Local and traditional knowledge about the practice and impact of forest grazing by domestic livestock in Hungary. *J. Ethnobiol. Ethnomedicine* **2020**, *16*, 51. [CrossRef]
14. Rackham, O. *Trees and Woodland in the British Landscape*; Weidenfeld & Nicolson: London, UK, 1996; 234p.
15. Rois-Díaz, M.; Mosquera-Losada, R.; Rigueiro-Rodríguez, A. *Biodiversity Indicators on Silvopastoalism across Europe*; EFI Technical Report 21; European Forest Institute: Joensuu, Finland, 2006; 66p.
16. Mosquera-Losada, M.R.; Santiago Freijanes, J.J.; Pisanelli, A.; Rois, M.; Smith, J.; den Herder, M.; Moreno, G.; Malignier, N.; Mirazo, J.R.; Lamersdorf, N.; et al. *Extent and Success of Current Policy Measures to Promote Agroforestry across Europe*; Deliverable 8.23 for EU FP7 research project: AGFORWARD 613520; EURAF: Montpellier, France, 2016; 95p.
17. Vera, F.W.M. *Grazing Ecology and Forest History*; CABI: Wallingford, UK, 2000; 506p.
18. Holl, K.; Smith, M. Scottish upland forests: History lessons for the future. *For. Ecol. Manag.* **2007**, *249*, 45–53. [CrossRef]
19. Öllerer, K.; Varga, A.; Kirby, K.; Demeter, L.; Biró, M.; Bölöni, J.; Molnár, Z. Beyond the obvious impact of domestic livestock grazing on temperate forest vegetation—A global review. *Biol. Conserv.* **2019**, *237*, 209–219. [CrossRef]
20. Kirby, K.J.; Mitchell, F.J.; Hester, A.J. A role for large herbivores (deer and domestic stock) in nature conservation management in British seminatural woodlands. *Arboric. J.* **1994**, *18*, 381–399. [CrossRef]
21. Lamoot, I.; Meert, C.; Hoffmann, M. Habitat use of ponies and cattle foraging together in a coastal dune area. *Biol. Conserv.* **2005**, *122*, 523–536. [CrossRef]
22. Zhang, H.M.; Wang, Y.; Zhang, Z.B. Domestic goat grazing disturbance enhances tree seed removal and caching by small rodents in a warm-temperate deciduous forest in China. *Wildl. Res.* **2009**, *36*, 610–616. [CrossRef]
23. Hester, A.J.; Mitchell, F.J.G.; Kirby, K.J. Effects of season and intensity of sheep grazing on tree regeneration in a British upland woodland. *For. Ecol. Manag.* **1996**, *88*, 99–106. [CrossRef]
24. Fraser, E.C.; Kabzems, R.; Lieffers, V.J. Sheep grazing for vegetation management in the northern forests of British Columbia and Alberta. *For. Chron.* **2001**, *77*, 713719. [CrossRef]
25. Sharrow, S.H.; Leininger, W.C.; Osman, K.A. Sheep grazing effects on coastal Douglas fir forest growth: A ten-year perspective. *For. Ecol. Manag.* **1992**, *50*, 75–85. [CrossRef]
26. Papachristou, T.G.; Platis, P.D. The impact of cattle and goats grazing on vegetation in oak stands of varying coppicing age. *Acta Oecol.* **2011**, *37*, 16–22. [CrossRef]
27. Popp, A.; Scheibe, K.M. The ecological influence of large herbivores behavior—And habitat utilization of cattle and horses. *Appl. Ecol. Env. Res.* **2014**, *12*, 681–693. [CrossRef]
28. Fűrész, A.; Penksza, K.; Sipos, L.; Turcsányi-Járdi, I.; Szentes, S.; Fintha, G.; Penksza, P.; Viszló, L.; Szalai, F.; Wagenhoffer, Z. Examination of the Effects of Domestic Water Buffalo (Bubalus bubalis) Grazing on Wetland and Dry Grassland Habitats. *Plants* **2023**, *12*, 2184. [CrossRef] [PubMed]
29. Bernes, C.; Macura, B.; Jonsson, B.G.; Junninen, K.; Müller, J.; Sandström, J.; Lõhmus, A.; Macdonald, E. Manipulating ungulate herbivory in temperate and boreal forests: Effects on vegetation and invertebrates. A systematic review. *Environ. Evid.* **2018**, *7*, 13. [CrossRef]
30. Burrascano, S.; Keeton, W.S.; Sabatini, F.M.; Blasi, C. Commonality and variability in the structural attributes of moist temperate old-growth forests: A global review. *For. Ecol. Manag.* **2013**, *291*, 458–479. [CrossRef]
31. Mitchell, F.J.G. How open were European primeval forests? Hypothesis testing using palaeoecological data. *J. Ecol.* **2005**, *93*, 168–177. [CrossRef]
32. Adams, S.N. Sheep and cattle grazing in forests: A Review. *J. Appl. Ecol.* **1975**, *12*, 143–152. [CrossRef]
33. Rackham, O. *Ancient Woodland: Its History, Vegetation and Uses in England*; E. Arnold Press: London, UK, 1980; 584p.
34. Vanbergen, A.J.; Hails, R.S.; Watt, A.D.; Jones, T.H. Consequences for host-parasitoid interactions of grazing-dependent habitat heterogeneity. *J. Anim. Ecol.* **2006**, *75*, 789–801. [CrossRef] [PubMed]
35. Poschlod, P. *Geschichte der Kulturlandschaft*; Ulmer Verlag: Stuttgart, Germany, 2015; 320p.

36. Putman, R.J. Ungulates in temperate forest ecosystems: Perspectives and recommendations for future research. *For. Ecol. Manag.* **1996**, *88*, 205–214. [CrossRef]
37. Tubbs, C.R. The ecology of pastoralism in the New Forest. *Br. Wildl.* **1997**, *9*, 7–16.
38. Fuls, E.R. Ecosystem modification created by patch-overgrazing in semi-arid grassland. *J. Arid Environ.* **1992**, *23*, 59–69. [CrossRef]
39. Paulsamy, S.; Lakshmanachary, A.S.; Manian, S. Effects of overgrazing on the phytosociology of a tropical grassland ecosystem. *Indian J. Range Manag.* **1987**, *8*, 103–107.
40. Jávor, A.; Molnár, G.; Kukovics, S. Juhtartás összehangolása a legelővel [Coordination of sheep husbandry with pasture]. In *Agroökológia—Gyep—Vidékfejlesztés*; Nagy, G., Vinczeffy, I., Eds.; Debrecen University of Agricultural Sciences: Debrecen, Hungary, 1999; pp. 169–172.
41. Eichhorn, M.P.; Paris, P.; Herzog, F.; Incoll, L.D.; Liagre, F.; Mantzanas, K.; Mayus, M.; Moreno, G.; Papanastasis, V.P.; Pilbeam, D.J.; et al. Silvoarable systems in Europe—Past, present and future prospects. *Agrofor. Syst.* **2006**, *67*, 29–50. [CrossRef]
42. Luoto, M.; Pykälä, J.; Kuussaari, M. Decline of landscape-scale habitat and species diversity after the end of cattle grazing. *J. Nat. Conserv.* **2003**, *11*, 171–178. [CrossRef]
43. Pykälä, J.; Luoto, M.; Heikkinen, R.K.; Kontula, T. Plant species richness and persistence of rare plants in abandoned semi-natural grasslands in Northern Europe. *Basic Appl. Ecol.* **2005**, *6*, 25–33. [CrossRef]
44. Noy-Meir, I.; Gutman, M.; Kaplan, Y. Responses of mediterranean grassland plants to grazing and protection. *J. Ecol.* **1989**, *77*, 290–310. [CrossRef]
45. Adler, P.B.; Lauenroth, W.K. Livestock exclusion increases the spatial Heterogeneity of vegetation in Colorado shortgrass steppe. *Appl. Veg. Sci.* **2000**, *3*, 213–222. [CrossRef]
46. Peco, B.; Sánchez, A.M.; Azcárate, F.M. Abandonment in grazing systems: Consequences for vegetation and soil. *Agric. Ecosyst. Environ.* **2006**, *113*, 284–294. [CrossRef]
47. Sala, O.E.; Lauenroth, W.K.; McNaughton, S.J.; Rusch, G.; Zhang, X. Biodiversity and ecosystem functioning in grasslands. In *Functional Roles of Biodiversity: A Global Perspective*; Mooney, H.A., Cushman, J.H., Medina, E., Sala, O.E., Schulze, E.D., Eds.; Wiley: Chichester, UK, 1996; pp. 129–149.
48. Kahmen, S.; Poschlod, P.; Schreiber, K.F. Conservation management of calcareous grasslands. Changes in plant species composition and response of functional traits during 25 years. *Biol. Conserv.* **2002**, *104*, 319–328. [CrossRef]
49. Fuhlendorf, S.D.; Smeins, F.E. Scaling effects of grazing in a semi-arid grassland. *J. Veg. Sci.* **1999**, *10*, 731–738. [CrossRef]
50. Cipriotti, P.A.; Aguiar, M.R. Effects of grazing on patch structure in a semi-arid two-phase vegetation mosaic. *J. Veg. Sci.* **2005**, *16*, 57–66. [CrossRef]
51. Catorci, A.; Ottaviani, G.; Cesaretti, S. Functional and coenological changes under different long-term management conditions in Apennine meadows (central Italy). *Phytocoenologia* **2011**, *41*, 45–58. [CrossRef]
52. Naveh, Z.; Whittaker, R.H. Structural and floristic diversity of shrublands and woodlands in Northern Israel and other mediterranean areas. *Vegetatio* **1980**, *41*, 171–190. [CrossRef]
53. Milchunas, D.G.; Sala, O.E.; Lauenroth, W.K. A generalized model of the effects of grazing by large herbivores on grassland community structure. *Am. Nat.* **1988**, *132*, 87–106. [CrossRef]
54. Penksza, K. Gyepterületek Természetvédelmi Gyepgazdálkodási Vizsgálatai: Legelők, Kaszálók, fás Legelők, Felhagyott, Illetve Vetett Gyepek, Gyeptöredékek Florisztikai, Cönológiai, Gyepgazdálkodási Értékelése, Élőhelytérképezésük, Pázsitfű Fajaik Taxonómiai Adatai És Vizsgálatai [Grassland Management Studies of Grasslands for Nagure Conservation: Pastures, Meadows, Wood-Pastures, Abandoned or Sown Grasslands, Grassland Fragments Floristic, Coenological, Grassland Management Assessment, Habitat Mapping, Taxonomic Assessment of Grass Species Data and Investigations]. Ph.D. Thesis, Szent István University, Gödöllő, Hungary, 2013.
55. Saláta, D.; Wichmann, B.; Házi, J.; Falusi, E.; Penksza, K. Botanikai összehasonlító vizsgálat a cserépfalui és az erdőbényei fás legelőn [Botanical comparison study on the wood pastures of Cserépfalu and Erdőbénye]. *AWETH* **2011**, *7*, 234–262.
56. Saláta, D.; Horváth, S.; Varga, A. Az erdei legeltetésre, a fás legelők és legelőerdők használatára vonatkozó 1791 és 1961 közötti törvények [Laws for the use of forest grazing, wood-pastures and grazing forest between 1791 and 1961]. *J. Landsc. Ecol.* **2009**, *7*, 387–401.
57. Dövényi, Z. *Magyarország Kistájainak Katasztere [Cadastre of Microregion of Hungary]*; Magyar Tudományos Akadémia, Földrajztudományi Kutatóintézet: Budapest, Hungary, 2010; pp. 34–56.
58. Arcanum. *Első Katonai Felmérés [First Military Survey]*; Arcanum Adatbázis Kft.: Budapest, Hungary, 2006.
59. Geiger, B.; Saláta, D.; Malatinszky, Á. Tájtörténeti vizsgálatok a kisgombosi fás legelőn [Studies on landscape history on the wood-pasture of Kisgombos]. *J. Landsc. Ecol.* **2011**, *9*, 219–233.
60. Tímár, G.; Molnár, G.; Székely, B.; Biszak, S.; Varga, J.; Jankó, A. *A Második Katonai Felmérés Térképszelvényei és Azok Georeferált Változata [Map and Georeferenced Version of the Second Military Survey]*; Arcanum Adatbázis Kft.: Budapest, Hungary, 2006.
61. Biszak, S.; Tímár, G.; Molnár, G.; Jankó, A. *A Harmadik Katonai Felmérés—A Habsburg Birodalom digitalizált térképei [The Third Military Survey—Digitised Maps of the Habsburg Empire]*; Arcanum Adatbázis Kft.: Budapest, Hungary, 2007.
62. Tímár, G.; Molnár, G.; Székely, B.; Biszak, S.; Jankó, A. *Magyarország Topográfiai Térképei a Második Világháború Időszakából [Topographic Maps of Hungary from the Second World War Period]*; Arcanum Adatbázis Kft.: Budapest, Hungary, 2008.
63. Szirmai, O.; Saláta, D.; Benedek, L.K.; Czóbel, S. Investigation of the Secondary Succession of Abandoned Areas from Different Cultivation in the Pannonian Biogeographic Region. *Agronomy* **2022**, *12*, 773. [CrossRef]

64. Varga, A. Fáslegelők és legelőerdők egykori és mai vegetációdinamikája [Recent and one-time vegetation dynamics of wood-pastures and grazing forests]. *Kitaibelia* **2008**, *13*, 195.
65. Bölöni, J.; Molnár, Z.; Bíró, M.; Horváth, F. Distribution of the (semi-) natural habitats in Hungary II. Woodlands and shrublands. *Acta Bot. Hung.* **2008**, *50*, 107–148. [CrossRef]
66. Varga, A.; Bölöni, J. Erdei legeltetés, fáslegelők, legelőerdők tájtörténeti kutatása [Landscape historical research of forest grazing, wood-pastures, grazing forest]. *Természetvédelmi Közlemények* **2009**, *15*, 68–79.
67. Braun-Blanquet, J. *Pflanzensoziologie*; Wien: New York, NY, USA, 1964; pp. 2–865.
68. Király, G. (Ed.) *Új Magyar Füvészkönyv. Magyarország Hajtásos Növényei. Határozókulcsok [New Hungarian Herbal. The Vascular Plants of Hungary. Identification Key]*; ANP Igazgatóság: Jósvafő, Hungary, 2009; pp. 3–456.
69. Tasi, J. Diverse impacts of nature conservation grassland management. *Cereal Res. Commun.* **2007**, *35*, 1205–1208. [CrossRef]
70. Briemle, G.; Nitsche, S.; Nitsche, L. *Nutzungswertzahlen für Gefäßpflanzen des Grünlandes. Schriftenreihe für Vegetationskunde*; Bundesamt für Naturschutz: Bonn, Germany, 2005; pp. 203–225.
71. Házi, J.; Penksza, K.; Barczi, A.; Szentes, S.; Pápay, G. Effects of Long-Term Mowing on Biomass Composition in Pannonian Dry Grasslands. *Agronomy* **2022**, *12*, 1107. [CrossRef]
72. Balázs, F. *A Gyepek Termésbecslése Növényszociológiai Felvételek Alapján [Yield Estimation of Grasslands Based on Plant Sociological Surveys]*; Agrártudomány: Budapest, Hungary, 1949; pp. 109–118.
73. Balázs, F. *A Gyepek Botanikai és Gazdasági Értékelése [Botanical and Economic Assessment of Grasslands]*; Mezőgazdasági kiadó: Budapest, Hungary, 1960; pp. 3–28.
74. Pignatti, S. Valori di bioindicazione delle piante vascolari della flora d'Italia. *Braun-Blanquetia* **2005**, *39*, 1–97.
75. Chiarucci, A.; Bonini, I. Quantitative floristics as a tool for the assessment of plant diversity in Tuscan forests. *For. Ecol. Manag.* **2005**, *212*, 160–170. [CrossRef]
76. Ricotta, C.; Avena, G.; Chiarucci, A. An index of divergence from species to life-form diversity based on the notion of intrinsic diversity ordering. *Plant Ecol.* **2002**, *165*, 217–222. [CrossRef]
77. Addinsoft XLSTAT 2016: Data Analysis and Statistical Solution for Microsoft Excel. Long Island, NY, USA. Available online: https://www.xlstat.com/fr/ (accessed on 19 February 2024).
78. Borhidi, A.; Kevey, B.; Lendvai, G.; Seregélyes, T. *Plant Communities of Hungary*; Akadémiai Kiadó: Budapest, Hungary, 2012.
79. Borhidi, A. Social behaviour types, the naturalness and relative ecological indicator values of the higher plants in the Hungarian Flora. *Acta Bot. Hung* **1995**, *39*, 97–181.
80. Simon, T. *A Magyarországi Edényes Flóra Határozója [Identification of the Hungarian Vascular Flora]*; Tankönyvkiadó: Budapest, Hungary, 2000; pp. 34–56.
81. Klapp, E.; Boeker, P.; König, F.; Stählin, A. Wertzahlen der Grünlandpflanzen. *Grünland* **1953**, *2*, 38–40.
82. Penksza, K.; Böcker, R. Zur Verbreitung von Poa humilis Ehrh. ex Hoffm. in Ungarn. *Bot. Közlem.* **1999**, *86–87*, 89–93.
83. Stilling, F.; Penksza, K.; Hajnáczki, S.; Szentes, S.; Fűrész, A.; Sipos, L.; Penksza, P.; Saláta, D.; Melenya, C.; Wagenhoffer, Z.; et al. Botanical and turf management evaluation in goat pastures established from Pannonian natural and abandoned arable land. *Small Rumin. Res.* **2023**, *229*, 107119. [CrossRef]
84. Varga, A.; Molnár, Z.; Biró, M.; Demeter, L.; Gellény, K.; Miókovics, E.; Molnár, Á.; Molnár, K.; Ujházy, N.; Ulicsni, V.; et al. Changing year-round habitat use of extensively grazing cattle, sheep and pigs in East-Central Europe between 1940 and 2014: Consequences for conservation and policy. *Agric. Ecosyst. Environ.* **2016**, *234*, 142–153. [CrossRef]
85. Tasi, J. Heavy metal, macro- and microelement content of grass species and dicotyledons. *Acta Agron. Hung.* **2005**, *53*, 349–352. [CrossRef]
86. Raunkiær, C. *The Life Forms of Plants and Statistical Plant Geography, Being the Collected Papers of C. Raunkiær*; Oxford University Press: Oxford, UK, 1934; 632p.
87. de Bello, F.; Lepš, J.; Sebastià, M.T. Variations in species and functional plant diversity along climatic and grazing gradients. *Ecography* **2006**, *29*, 801–810. [CrossRef]
88. Walker, J.K.; David, R.; Arney, D.R.; Waran, N.K.; Handel, I.H.; Phillips, C.J.C. The effect of conspecific removal on behavioural and physiological responses of dairy cattle. *J. Dairy Sci.* **2015**, *98*, 8610–8622. [CrossRef] [PubMed]
89. Garin, I.; Aldezabal, A.; Herrero, J.; Garcia-Serrano, A. Understorey foraging and habitat selection by sheep in mixed Atlantic woodland. *J. Veg. Sci.* **2000**, *11*, 863–870. [CrossRef]
90. Cromsigt, J.P.G.M.; Kemp, Y.J.M.; Rodriguez, E.; Kivit, H. Rewilding Europe's large grazer community: How functionally diverse are the diets of European bison, cattle, and horses? *Restor. Ecol.* **2018**, *26*, 891–899. [CrossRef]
91. Kiss, T.; Lévai, P.; Ferencz, Á.; Szentes, S.; Hufnagel, L.; Nagy, A.; Balogh, Á.; Pintér, O.; Saláta, D.; Házi, J.; et al. Change of composition and diversity of species and grassland management between different grazing intensity—In Pannonian dry and wet grasslands. *Appl. Ecol. Environ. Res.* **2011**, *9*, 197–230. [CrossRef]
92. Catorci, A.; Piermarteri, K.; Penksza, K.; Házi, J.; Tardella, F.M. Filtering effect of temporal niche fluctuation and amplitude of environmental variations on the trait-related flowering patterns: Lesson from sub-Mediterranean grasslands. *Sci. Rep.* **2017**, *7*, 12034. [CrossRef] [PubMed]
93. Tasker, E.M.; Bradstock, R.A. Influence of cattle grazing practices on forest understorey structure in north-eastern New South Wales. *Austral Ecol.* **2006**, *31*, 490–502. [CrossRef]

94. Kampmann, D.; Herzog, F.; Jeanneret, P.; Konold, W.; Peter, M.; Walter, T.; Wildi, O.; Lüscher, A. Mountain grassland biodiversity: Impact of site conditions versus management type. *J. Nat. Conserv.* **2008**, *16*, 12–25. [CrossRef]
95. Fischer, M.; Wipf, S. Effect of low-intensity grazing on the species-rich vegetation of traditionally mown subalpine meadows. *Biol. Conserv.* **2002**, *104*, 1–11. [CrossRef]
96. Losvik, M. Plant species diversity in an old, traditionally managed hay meadow compared to abandoned hay meadows in southwest Norway. *Nord. J. Bot.* **1999**, *19*, 473–487. [CrossRef] [PubMed]
97. Proulx, M.; Mazumder, A. Reversal of grazing impact on plant species richness in nutrient-poor vs. nutrient-rich ecosystems. *Ecology* **1998**, *79*, 2581–2592. [CrossRef]
98. Enyedi, Z.M.; Ruprecht, E.; Deák, M. Long-term effects of the abandonment of grazing on steppe-like grasslands. *Appl. Veg. Sci.* **2008**, *11*, 53–60. [CrossRef]
99. Filazzola, A.; Brown, C.; Dettlaff, M.A.; Batbaatar, A.; Grenke, J.; Bao, T.; Peetoom Heida, I.; Cahill, J.F., Jr. The effects of livestock grazing on biodiversity are multi-trophic: A meta-analysis. *Ecol. Lett.* **2020**, *23*, 1298–1309. [CrossRef] [PubMed]
100. Ringmark, S.; Skarin, A.; Jansson, A. Impact of Year-Round Grazing by Horses on Pasture Nutrient Dynamics and the Correlation with Pasture Nutrient Content and Fecal Nutrient Composition. *Animals* **2019**, *9*, 500. [CrossRef] [PubMed]
101. Yayota, M.; Doi, K. Goat Grazing for Restoring, Managing, and Conserving "Satoyama", a Unique Socio-Ecological Production Landscape. *Front. Sustain. Food Syst.* **2020**, *4*, 541721. [CrossRef]
102. Wei, P.; Zhao, S.; Lu, W.; Ni, L.; Yan, Z.; Jiang, T. Grazing altered the plant diversity-productivity relationship in the Jianghan plain of the Yangtze River basin. *For. Ecol. Manag.* **2023**, *531*, 120767. [CrossRef]
103. Wilkinson, J.M.; Lee, M.R.F.; Rivero, M.J.; Chamberlain, A.T. Some challenges and opportunities for grazing dairy cows on temperate pastures. *Grass Forage Sci.* **2019**, *75*, 1–17. [CrossRef] [PubMed]
104. Bakker, J.P. *Nature Management by Grazing and Cutting*; Springer: Dordrecht, The Netherlands, 1989; 400p. [CrossRef]
105. McEvoy, P.M.; McAdam, J.H. Sheep grazing in young oak *Quercus* spp. and ash Fraxinus excelsior plantations: Vegetation control, seasonality and tree damage. *Agrofor. Syst.* **2008**, *74*, 199–211. [CrossRef]
106. Cutter, B.E.; Hunt, K.; Haywood, J.D. Tree/wood quality in slash pine following long-term cattle grazing. *Agrofor. Syst.* **1998**, *44*, 305–312. [CrossRef]
107. Sala, O.E. The effect of herbivory on vegetation structure. In *Plant Form and Vegetation Structure*; Werger, M.J.A., van der Aart, P.J.M., During, H.J., Verhoeven, J.T.A., Eds.; SPB: The Hague, The Netherlands, 1988; pp. 317–330.
108. Török, P.; Penksza, K.; Tóth, E.; Kelemen, A.; Sonkoly, J.; Tóthmérész, B. Vegetation type and grazing intensity jointly shape grazing effects on grassland biodiversity. *Ecol. Evol.* **2018**, *8*, 10326–10335. [CrossRef]