Article

The Importance of Groves for Cattle in Semi-Open Pastures

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Abstract: Groves are of ecological importance, but can reduce the productivity of pastures. They may be used by cattle for nutrition as well as for comfort and shelter. To describe the importance and to estimate the influence of cattle on groves, the behavior of cattle around trees and shrubs was observed on six semi-open pastures in the mountain range of Thuringia and the Southern Black Forest (Germany). The groves were divided into formations, species and structures. The cattle used the groves more for browsing than rubbing. Significantly preferred species calculated by Chesson-Index were dogwood (*Cornus sanguinea*), black elder (*Sambucus nigra*), fly honeysuckle (*Lonicera xylosteum*), plum (*Prunus domestica*), osier (*Salix viminalis*), white beam (*Sorbus chamaemespilus*), and guelder rose (*Viburnum opulus*). The browsing preference is discussed in relation to nutritional importance and as self-medication. Cattle suppressed some species according to the utilization frequency, but for other species, there was no correlation. The animals preferred the tree hedges in comparison to the other formations. Hedges were utilized as shelter in extreme weather. In addition, under high browsing pressure, hedges were sustained and regenerated. Hedges on pastures turned out to be important for cattle under several aspects and accordingly should be preserved.

Keywords: browsing; bushes; comfort behavior; self-medication; preference; sheltering

1. Introduction

Pasture landscapes not only consist of homogenous open grassland, but also are structured by shrubs and trees, partially as solitary units or as more or less closed groves and borderlines. These may play essential roles in soil conservation and water retention, prevent erosion, break wind, retain wind-distributed seeds, and contain a high number of ecological niches for plants and animal species like birds, small mammals, and deer [1–4]. Groves and hedges are often appreciated by humans as elements of natural pasture landscapes with an aesthetic value per se. Furthermore, they can be important structures for grazing animals like cattle as they may offer them not only additional food but also shelter against sun, wind, rain, or snow, and can be used for comfort behavior such as rubbing or scratching. The nutritional importance of shrubs for cattle has often been described, as well as their ecological importance for landscape stability, but there is also a function of cattle for bush management on pastures [5–8]. Bushes and trees on pastures can be regarded as important ecological structures, which can be affected by browsing pressure. However, they are desirable for animals in different functions, but on the contrary, are not desired from an economic point of view. Consequently, we had the following questions for central European conditions, first for pasture purposes: Which importance do the groves really have for grazing animals and in which manner do the cattle influence the structure of the groves? We asked whether cattle browse groves depending on the species, which may indicate the different influence cattle have on the biodiversity of the groves. To answer this question the food intake by browsing on the individual grove species was observed. The second question follows for animal purposes: Which types of groves are cattle in pasture utilizing to supplement their diet and for comfort behavior? We investigated the cattle contacts by browsing and rubbing considering the different grove formations. Finally, we categorized the groves regarding their state of repression and searched for a possible correlation between this and the browsing frequency by cattle.

2. Material and Methods

2.1. Study Areas and Animals

The two areas of study were pastures integrated in two agricultural companies in Germany. One was arranged in the low mountain range of Thuringia and the other one in the Black Forest. In Thuringia, four permanent pastures and two rotation pastures lying between 450 m and 800 m ASL were available. The rotation pastures and two of the permanent pastures were grazed by German Simmental-Charolais crossbreds (cows with calves), and the rotation pastures were stocked with Holstein heifers. The sizes of the continuous grazing pastures were between 20 and 50 hectares, and those of the rotation pastures, between 5 and 7 hectares. In the range of the Black Forest, two rotation pastures of 8 and 10 hectares were available, stocked with "Hinterwälder", a typical cattle breed of this region. They were located between two mountains 1310 m and 1263 m high. The coverage with groves in the pasture areas was between 5.9% and 36.5%. All studies were performed within the normal farming routine without any influence on the animals or on the pasture.

2.2. Observation and Analysis

The observations of the cattle were conducted during the growing seasons (April to September). Five focus animals were chosen from each herd in order to determine the terrain covered by the animals. In order to determine browsing and rubbing patterns, the behavior observation method called "point sampling procedure" was applied. All observations were made from a distance not to disturb the animals and by the same experienced person. At intervals of 10 min, browsing and rubbing in the focus animals were recorded. This took one minute each. The groves were divided into formations and species. The categories of grove formations were single grove, shrub hedge, tree hedge, edge of the forest and forest. All the data was listed and computed in Excel 2000 and for statistical tests SsS 1.0 (G-Test) applied. Using the Bonferroni-correction, the level of significance was defined as $\alpha \leq 0.013$ and the marginal level as $\alpha \leq 0.025$. To define the preferences for grove species, the Chesson-Index was applied [9]. For each herd observations were made in three blocks of 12 days, during different seasons in Thuringia and in two blocks of six days in the Black Forest. All of them were conducted rotationally during daylight hours. Altogether, in Thuringia the cattle were observed 360 h resulting in 2160 records and in the Black Forest 512 records during 88 h were made. During every observation period, the grove species were visually categorized whether the suppression was high or low.

3. Results

3.1. Grove Utilization for Browsing, Rubbing, and Shelter

All the grove formations were used by the cattle for browsing and for comfort behavior like rubbing, but browsing was much more frequently observed than rubbing ($p < 0.001$). In Thuringia, during 36 days 648 events of browsing were observed and only 89 events of rubbing. In the Southern Black Forest, during 16 days 143 events of browsing were observed and 34 events of comfort behavior (rubbing). Regarding the grove formations, in Thuringia tree hedges were preferred (Table 1). Both of the behavior patterns, browsing and rubbing, were observed to be significantly more frequent for tree hedges ($p < 0.001$) compared to the other groves types like single groves, shrub hedges, edges of the forests and forests. The single groves were less utilized compared to the tree hedges but significantly more frequented than at the edges of the forests ($p < 0.001$) and the forest areas ($p < 0.001$). Browsing was significantly less observed in the forest than on shrub hedges and single groves. In the Black Forest, the cattle preferred the single groves ($p < 0.001$) by browsing and rubbing compared to the other groves.

Table 1. Browsing and rubbing (separately in %) on groves in pastures of Thuringia ($n = 648$) and Black Forest ($n = 143$). * significance.

Grove formation	Browsing Thuringia	Rubbing Thuringia	Browsing Black Forest	Rubbing Black Forest
Single groves	11.7 *	20.2	52.4 *	70.6 *
Shrub hedges	18.2 *	10.1	23.8 *	14.7
Tree hedges	48.1 *	61.8 *	5.6	5.9
Edges of the wood	17.1	4.5	12.6	5.9
Woods	4.9	3.4	5.6	2.9

3.2. Preference for Grove Species

In Thuringia, most browsing events were observed on hazel (*Corylus avellana*) and hawthorn (*Crataegus monogyna/laevigata*) followed by sycamore maple (*Acer pseudoplatanus*), field maple (*Acer campestre*), blackthorn (*Prunus spinosa*), goat willow (*Salix caprea*), ash (*Fraxinus excelsior*) and black alder (*Alnus glutinosa*). The Chesson-Index indicated a preference for the grove species dogwood (*Cornus sanguinea*), fly honeysuckle (*Lonicera xylosteum*), plum (*Prunus domestica*), osier (*Salix viminalis*), whitebeam (*Sorbus chamaemespilus*), and guelder rose (*Viburnum opulus*) (Table 2). The most browsing events in Black Forest were observed for copper beech (*Fagus sylvatica*), and whitebeam (*Sorbus aria*), followed by hazel, hawthorn, rowan (*Sorbus aucuparia*) and blackthorn. The Chesson-Index shows preferences for fly honeysuckle (*Lonicera xylosteum*), and black elder (*Sambucus nigra*) (Table 3).

Table 2. Frequency of grove species, frequency of browsing and Chesson-Index (bold = preference) of browsing on groves in pastures of Thuringia (*n* = 648).

Grove species	% Groves (n_i)	% Browsing (r_i)	Chesson-Index (α_1)
Caucasian fir (*Abies nordmanniana*)	0.14	0.00	0.00
Field maple (*Acer campestre*)	9.38	7.76	0.01
Norway maple (*Acer platanoides*)	0.05	0.00	0.00
Sycamore maple (*Acer pseudoplatanus*)	7.98	9.47	0.01
Black alder (*Alnus glutinosa*)	12.79	4.66	0.00
Grey alder (*Alnus incana*)	0.04	0.00	0.00
Silver birch (*Betula pendula*)	0.15	0.00	0.00
Hornbeam (*Carpinus betulus*)	5.17	4.35	0.01
Sweet cherry (*Cerasus avium*)	3.03	3.11	0.01
Sour cherry (*Cerasus vulgaris*)	0.04	0.00	0.00
Common dogwood (*Cornus sanguinea*)	0.21	2.02	**0.10**
Common hazel (*Corylus avellana*)	6.35	15.68	0.03
Hawthorn (*Crataegus monogyna/laevigata*)	14.22	14.60	0.01
Copper beech (*Fagus sylvatica*)	7.26	1.55	0.00
Common ash (*Fraxinus excelsior*)	4.50	6.06	0.01
Fly honeysuckle (*Lonicera xylosteum*)	0.18	3.57	**0.20**
Apple (*Malus domestica*)	0.11	0.00	0.00
Common spruce (*Picea abies*)	2.93	0.00	0.00
Scots pine (*Pinus sylvestris*)	0.06	0.00	0.00
Common aspen (*Populus tremula*)	0.20	0.16	0.01
Common plum (*Prunus domestica*)	0.04	0.31	**0.08**
Bird cherry (*Prunus padus*)	0.86	0.16	0.00
Blackthorn (*Prunus spinosa*)	6.98	7.76	0.01
Common oak (*Quercus robur*)	2.49	1.09	0.00
Dog rose (*Rosa canina*)	2.27	3.26	0.01
Goat willow (*Salix caprea*)	8.56	6.83	0.01
Common osier (*Salix viminalis*)	0.10	0.62	**0.06**
Black elder (*Sambucus nigra*)	1.29	3.73	0.03
European red elder (*Sambucus racemosa*)	0.01	0.00	0.00
Common whitebeam (*Sorbus aria*)	0.01	0.31	**0.32**
European rowan (*Sorbus aucuparia*)	1.66	2.64	0.02
Wych elm (*Ulmus glabra*)	0.81	0.00	0.00
Guelder rose (*Viburnum opulus*)	0.08	0.31	**0.04**

Table 3. Frequency of grove species, frequency of browsing and Chesson-Index (bold = preference) of browsing on groves in pastures of the Black Forest (*n* = 143).

Grove species	% Groves (n_i)	% Browsing (r_i)	Chesson-Index (α_1)
Sycamore maple (*Acer pseudoplatanus*)	2.04	4,20	0.02
Silver birch (*Betula pendula*)	3.08	4,20	0.01
Sweet cherry (*Cerasus avium*)	0.03	0.00	0.00
Common dogwood (*Cornus sanguinea*)	0.02	0.00	0.00
Common hazel (*Corylus avellana*)	4.06	10,49	0.02
Hawthorn (*Crataegus monogyna/laevigata*)	2.31	7,69	0.03
Copper beech (*Fagus sylvatica*)	18.18	28,67	0.01
Common ash (*Fraxinus excelsior*)	0.69	2,10	0.02
Common juniper (*Juniperus communis*)	0.05	0.00	0.00
Fly honeysuckle (*Lonicera xylosteum*)	0.03	2,80	0.72
Apple (*Malus domestica*)	0.02	0.00	0.00
Common spruce (*Picea abies*)	6.79	0.00	0.00
Common aspen (*Populus tremula*)	0.28	0.00	0.00
Blackthorn (*Prunus spinosa*)	20.70	4,90	0.00
Dog rose (*Rosa canina*)	2.67	2,80	0.01
Blackberry (*Rubus fruticosus*)	19.72	2,10	0.00
Goat willow (*Salix caprea*)	1.82	0,70	0.00
Black elder (*Sambucus nigra*)	0.17	2,10	0.10
Common whitebeam (*Sorbus aria*)	7.64	20,98	0.02
European rowan (*Sorbus aucuparia*)	9.42	5,59	0.00
Dwarf whitebeam (*Sorbus chamaemespilus*)	0.16	0,70	0.03
Wych elm (*Ulmus glabra*)	0.02	0.00	0.00
Guelder rose (*Viburnum opulus*)	0.08	0.00	0.00

3.3. Suppression and Conformity

The groves, categorized following their suppression state, were significantly different between each other (*p* < 0.001). It was tested whether the suppression state correlated with the utilization frequency by cattle. As conform were species defined which were highly frequented by cattle and also highly suppressed, respectively low suppressed and low frequented. As not conform was defined: The highly suppressed groves which were low frequented by cattle, and low repressed groves which were highly frequented by cattle. It turned out that for a number of species suppression state and utilization intensity differed (Table 4).

Table 4. Conformity between the structure of the groves and the preferred groves of the cattle (* preferred by cattle attested by Chesson-Index).

Conform: High suppressed, high frequented by cattle	Conform: Low suppressed, low frequented by cattle	Not conform: High suppressed, low frequented by cattle	Not conform: Low suppressed, high frequented by cattle
Sycamore maple (*Acer pseudoplatanus*)	Black alder (*Alnus glutinosa*)	Field maple (*Acer campestre*)	Copper beech (Black forest) (*Fagus sylvatica*)
Common dogwood * (*Cornus sanguinea*)	Silver birch (*Betula pendula*)	Hornbeam (*Carpinus betulus*)	

Table 4. *Cont.*

Conform: High suppressed, high frequented by cattle	Conform: Low suppressed, low frequented by cattle	Not conform: High suppressed, low frequented by cattle	Not conform: Low suppressed, high frequented by cattle
Common hazel (*Corylus avellana*)	Hawthorn (*Crataegus monogyna/laevigata*)	Sweet cherry (*Cerasus avium*)	
Hawthorn (*Crataegus monogyna/laevigata*)	Common aspen (*Populus tremula*)	Copper beech (Thuringia) (*Fagus sylvatica*)	
Common ash (*Fraxinus excelsior*)	Blackthorn (*Prunus spinosa*)	Bird cherry (*Prunus padus*)	
Fly honeysuckle * (*Lonicera xylosteum*)	Common oak (*Quercus robur*)	Blackthorn (*Prunus spinosa*)	
Common plum * (*Prunus domestica*)	Dog rose (*Rosa canina*)	Dog rose (*Rosa canina*)	
Goat willow (Thuringia) (*Salix caprea*)	*Blackberry* (*Rubus fruticosus*)	Goat willow (Black Forest) (*Salix caprea*)	
Common osier * (*Salix viminalis*)		European rowan (*Sorbus aucuparia*)	
Black elder (*Sambucus nigra*)			
Common whitebeam * (*Sorbus aria*)			
European rowan (*Sorbus aucuparia*)			
Guelder rose * (*Viburnum opulus*)			

4. Discussion

Grazed and browsed by cattle since many decenniums, the pastures in the mountains of Thuringia and in the Southern Black Forest show the typical grove structures caused by pasturing. These groves are important resources for cattle and utilized especially for browsing but also for comfort and sheltering in Thuringia and in the Black Forest. In Thuringia, the tree hedges were forming a very useful grove structure for shelter during bad weather conditions and for comfort behavior such as rubbing. They also provided nutrition via being browsed and were used as resting places. All wooden structures were especially used during resting periods. The hedges were open to both sides and the crowns were closed like a roof. In the Southern Black Forest, most of the hedges were impenetrable but the single groves served as shelter, too. No data was taken to investigate the influence of weather conditions, but it was very obvious that in both areas, the cattle were always observed in the groves during strong rain showers as well as during intensive sunshine and heat. It was observed that cattle like to stay in or near groves because they provide good shelter against rain and sun [10,11]. The importance of shade for thermoregulation has been described [12]. Arnold and Dudzinski [13], and Sambraus [11], reported seeking shelter in strong weather conditions. Especially in hot weather, the importance of shading structures like trees and bushes has been demonstrated based on physiological and behavioral records for cattle [14,15] and for horses [16]. Generally, the existence of groves in pastures is very important for the well-being of cattle, because they are useful for sheltering and for comfort behavior even if not very frequently used [17,18].

The grove species develop a certain resistance against browsing and rubbing and are able to regenerate after the damage [19]. Accordingly, the selection by browsing has a positive influence on all of the species protected by thorn and spines, such as blackthorn, hawthorn and dog rose, and form a passive mechanism of defense against overgrazing [20]. Fraser and Broom [18] claim that cattle avoid thorny and spiny groves. Buttenschøn and Buttenschøn [17] state that cattle are unable to browse such grove species due to their physiological feed intake pattern using the tongue for grazing. Thorns and spines as well as secondary substances of the leaf, are morphological and physiological features, which lead cattle to avoid such plants [21]. Nevertheless, we saw cattle also repeatedly browsing by biting very short pieces of plant material from thorny and spiny species. In the project areas, beside the preferred groves by cattle according to the Chesson-Index, the thorny and spiny groves were highly frequented too. However, there were also conformances with Buttenschøn and Buttenschøn [17], referring to a high browsing by cattle of willow, birch, rowan and aspen and a moderate browsing of oak, apple and blackthorn, whereas juniper and dog rose were not repressed by cattle.

Preferences for rowan, oak, buckthorn and black cherry, and avoidances of pine, birch and blackberry have been found [22]. Silva-Pando *et al.* [23] observed a frequent browsing on species of pine and avoidances of blackberry, oak and chestnut. Gerken and Sonnenburg [24] refer to browsing by cattle on beech, raspberry and blackberry. Härdtle *et al.* [25] recorded preferences for raspberry, willow and black alder, and a moderate browsing on hawthorn and oak.

Relating to the most frequented groves, the majority of observed browsing events correlated to their state of suppression. The other groves, which show no correlation between browsing and suppression, were probably suppressed by wild animals. This can be seen as an indication that groves also play an important role for the different game species living in these areas, especially roe deer. But it must be remarked, that the observations did not cover all seasons of the year and the cattles preferences may change seasonally depending on the growth stage of the trees. In the case of beech, which were highly frequented but had low suppression in the Black Forest, there were large quantities of trees in any state of age growing. Blackthorns as well as blackberry formed compact structures, as cattle do not try to penetrate dense coppice [21].

Browsing it is not part of an essential diet [26], but groves are of importance because of the crude fiber and mineral nutrients. Additionally, the intake of small amounts of substances like tannic acid may be important for animal health. This feeding behavior has been described as specific appetite, or "self-medication" [27]. It could explain browsing grove species like oak and willow because of their contents of tannic acid. How important browsing may be is illustrated by the result that dairy heifers in a silvopastoral system reached higher annual body weight gains compared to a monoculture pasture [28].

In spite of being suppressed by browsing, the grove species survive and regenerate themselves, and grove formations are developing under pasturing. Like Table 4 shows, nearly all the groves that were located, were suppressed too, with the exception of beech. Therefore, cattle have an explicit influence on groves but the groves sustain in spite of this. The effects, browsing cattle have on groves, are able to accelerate certain cycles of mosaics [22]. They could suppress the scrub of the woods, create a pasture sward and conserve this, until resistant shrubs or trees are established. Cattle have the ability to clear grove areas in common with wild large herbivores of central-European landscapes, like the bison [29] and the elk [30]. Theoretical concepts like the one of Vera [31] originate from a pristine landscape like parks with grassland, these are also described as mosaic structures. In this landscape, herbivores like

cattle played a decisive role for the regeneration of the groves and succession of the herbage. Vera [31,32] favors a pasturing by cattle for the establishment of oak, hazel, wild pear, apple, rowan, plum, hawthorn and blackthorn. These grove species are not able to regenerate themselves in closed woods. Grazing animals like cattle control the ecological succession of landscapes, and therefore have a positive effect on the development of natural conditions in pastures.

5. Conclusions

Groves and hedges turned out to be essential structures on rangelands. They are used by cattle as natural supplementary food sources, for comfort behavior, and sheltering. Furthermore, they are essential elements of biodiversity. Accordingly, such structures should be preserved and not removed for short time economic advantage. On the other hand, they must not be protected from animals since they grow and regenerate over a long time on paddocks under animal browsing pressure.

References

1. Barth, W.-E. *Naturschutz.: Das Machbare*, 2nd ed.; Paul Parey Verlag: Hamburg, Germany, 1995; pp. 242–248.
2. Costa, W. Landschaftspflegerische Maßnahmen im Rahmen der Flurbereinigung. Schutzpflanzungen in der freien Landschaft. *Natur. Landsch.* **1978**, *53*, 53–59.
3. Zwölfer, H.; Bauer, G.; Hensinger, G.; Stechmann, D. Die tierökologische Bedeutung und Bewertung von Hecken. *Ber. ANL Laufen* **1984**, 1–155.
4. Schroeder, H. Zur Bedeutung der Wallhecken in einem Agraroekosystem Schleswig-Holsteins. 1. Besiedlung der Wallhecken durch Voegel. *Z. Kulturtechnik Flurberein.* **1988**, *29*, 294–299.
5. Brock, J.H. Livestock: Biological control in brush/weed management programs. *Rangelands* **1988**, *10*, 32–34.
6. Lefroy, E.C.; Dann, P.R.; Wildin, J.H.; Wesley-Smith, R.N.; McGowan, A.A. Trees and shrubs as sources of fodder in australia. *Agrofor. Syst.* **1992**, *20*, 117–139.
7. Mayer, A.C.; Stöckli, V.; Huovinen, C.; Konold, W.; Estermann, B.L.; Kreuzer, M. Herbage selection by cattle on sub-alpine wood pastures. *For. Ecol. Manag.* **2003**, *181*, 39–50.

8. Mitchell, J.E.; Rodgers, R.T. Food habits and distribution of cattle on a forest pasture range in Northern Idaho. *J. Range Manag.* **1985**, *38*, 214–220.

9. Chesson, J. Measuring preference in selective predation. *Ecology* **1978**, *59*, 211–215.

10. Buchholtz, C. Rinder. In *Grzimeks Enzyklopädie Säugetiere*; Grzimek, B., Ed.; Kindler-Verlag: München, Germany, 1988; Band 5, pp. 360–397.

11. Sambraus, H.H. Spezielle Ethologie: Rind. In *Nutztierethologie: Das Verhalten Landwirtschaftlicher Nutztiere*, 1st ed.; Sambraus, H.H., Ed.; Verlag Paul Parey: Berlin, Germany, 1978; pp. 49–127.

12. Hafez, E.S.E. Behavioral Adaptation. In *Adaptation of Domestic Animals*; Hafez, E.S.E., Ed.; Lea and Febiger: Philadelphia, PA, USA, 1968; pp. 202–214.

13. Arnold, G.W.; Dudzinski, M.L. *Ethology of Free-Ranging Domestic Animals*; Elsevier: New York, NY, USA. 1978; pp. 1–198.

14. Langbein, J.; Nichelmann, M. Differences in behaviour of free-ranging cattle in the tropic climate. *Appl. Anim. Behav. Sci.* **1993**, *37*, 197–209.

15. Mitlöhner, F.M.; Laube, R.B. Chronobiological indicators of heat stress in Bos Indicus cattle in the tropics. *J. Anim. Vet. Adv.* **2003**, *2*, 654–659.

16. Duncan, P. *Horses and Grasses: The Nutritional Ecology of Equids and Their Impact on the Camargue*; Springer Verlag: New York, NY, USA, 1992; pp. 1–287.

17. Buttenschøn, R.M.; Buttenschøn, J. The effect of browsing by cattle and sheep on trees and bushes. *Nat. Jutlandica* **1978**, *20*, 79–94.

18. Fraser, A.F.; Broom, D.M. *Farm Animal Behaviour and Welfare*, 3rd ed.; CABI Publishing: Wallingford, UK, 1996; pp. 1–448.

19. Hüppe, J. Vegetationsdynamik in halboffenen Hudelandschaften—Abhängigkeit von Nutzungsintensität und natürlichen Ausgangsbedingungen sowie Anforderungen an künftige Naturschutzziele. *Schriftenr. Landschaftspflege Naturschutz Bonn-Bad Godesb.* **1997**, *54*, 145–159.

20. Rahmann, G. Praktische Anleitungen für eine Biotoppflege mit Nutztieren. *Schriftenr. Angew. Naturschutz* **1998**, *14*, 113.

21. Stuth, J.W. Foraging Behavior. In *Grazing Management: An Ecological Perspective*; Heitschmidt, R.K., Stuth, J.W., Eds.; Timer Press: Portland, OR, USA, 1991; pp. 65–83.

22. Bokdam, J.; Gleichman, J.M.; van Wieren, S.E.; de Vries, M.F.W. Free-Ranging Cattle as Opportunistic Exploiters of a Successional Woodland-Grassland-Heathland Mosaic. In *Nature Conservation and Grazing Management*; Bokdam, J., Ed.; Ponsen and Looyen b.v.: Wageningen, The Netherlands, 2003; pp. 87–116.

23. Silva-Pando, F.J.; Lorenzo, M.J.R.; Pilar, M.; Hernandez, G. Grasslands and Scrublands in the Northwest of the Iberian Peninsula: Silvopastoral Systems and Nature Conservation. In *Pasture Landscapes and Nature Conservation*; Redecker, B., Härdtle, W., Finck, P., Riecken, U., Schröder, E., Eds.; Springer-Verlag: Berlin, Germany, 2002; pp. 271–283.

24. Gerken, B.; Sonnenburg, H. Landscape Development and Species Protection in Woodlands, Forests and Pastures Using Large Herbivores. In *Pasture Landscapes and Nature Conservation*; Redecker, B., Härdtle, W., Finck, P., Riecken, U., Schröder, E., Eds.; Springer Verlag: Berlin, Germany, 2002; pp. 285–301.

25. Härdtle, W.; Mierwald, U.; Behrends, T.; Eischeid, I.; Garniel, A.; Grell, H.; Haese, D.; Schneider-Fenske, A.; Voigt, N. Pasture Landscapes in Germany—Progress towards Sustainable Use of Agricultural Land. In *Pasture Landscapes and Nature Conservation*; Redecker, B., Härdtle, W., Finck, P., Riecken, U., Schröder, E., Eds.; Springer Verlag: Berlin, Germany, 2002; pp. 147–160.

26. Schwabe, A.; Kratochwil, A. Weidbuchen im Schwarzwald und ihre Entstehung durch Verbiß des Wälderviehs: Verbreitung, Geschichte und Möglichkeiten der Verjüngung. *Beih. Veröff. Naturschutz Landschaftspflege* **1987**, *49*, 1–120.

27. Lozano, G.A. Parasitic stress and self-medication in wild animals. *Adv. Study Behav.* **1998**, *27*, 291–317.

28. Paciullo, D.S.C.; de Castro, C.R.T.; de Miranda Gomide, C.A.; Maurício, R.M.; de Fátima Ávila Pires, M.; Müller, M.D.; Ferreira Xavier, D. Performance of dairy heifers in a silvopastoral system. *Livestock Sci.* **2011**, *141*, 166–172.

29. Krasinska, M.; Cabon-Raczynska, K.; Krasinski, Z.A. Strategy of habitat utilization by European Bison in the Bialowieza Forest. *Acta. Theriol.* **1987**, *32*, 147–202.

30. Persson, I.L.; Danell, K.; Bergström, R. Disturbance by large herbivores in boreal forests with special reference to moose. *Ann. Zool. Fennici.* **2000**, *37*, 251–263.

31. Vera, F.W.M. *Grazing Ecology and Forest History*; CABI Publishing: Wallingford, UK, 2000; pp. 1–506.

32. Vera, F.W.M. Ohne Pferd und Rind wird die Eiche nicht überleben. *Natur.-und Kulturlandschaft.* **1998**, *3*, 404–424.