Utilisation and maintenance of indigenous shrubs in protected open grassland (*Gentiano-Koelerietum*) by organic goats keeping

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Abstract

Endangered biotopes are often preserved by grazing animals (sheep, cattle and goats). In organic farming, this is co-financed under EU Regulation 1257/99 in AGENDA 2000. Biotope conservation is often seen, therefore, as both an objective and a requirement of organic animal husbandry. The grazing and browsing of goats on shrub-invaded grassland is one example of mutually beneficial effects: endangered biotopes are conserved while livestock welfare conditions are improved. In a six-year experiment (1994 - 1999) an investigation was conducted into the effects of goat-browsing on indigenous shrubs on protected grassland (*Gentiano-Koelerietum*), in the fodder values of the herbal zone (0 – 30 cm) and shrub zone (30 – 200 cm), and into the impact of organic farming on land use systems. This experiment showed the important role played by shrubs in the diet of goats in terms of improved fodder quality.

Keywords: Organic animal husbandry, biotope conservation, goats, shrubs

Nutzung und Pflege von einheimischen Gehölzen auf geschützten Biotopen (*Gentiano-Koelerietum*) durch ökologische Ziegenhaltung

Zusammenfassung

Gefährdete Biotope werden häufig durch Nutztiere (Schafe, Rinder und Ziegen) gepflegt. Wie der ökologische Landbau werden diese Maßnahmen durch die EU-Richtlinie 1257/99 der AGENDA 2000 co-finanziert. Biotoppflege mit Nutztieren wird häufig in Verbindung mit einer ökologischen Tierhaltung gesehen. Die Beweidung von geschützten Offenlandschaften und das Äsen von Büschen durch Ziegen kann die wechselseitigen Vorteile aufzeigen: die Flächen werden gepflegt und die Tiere artgerechter gehalten. In einem 6-Jahres-Experiment (1994-1999) wurde die Ziegenbeweidung bei heimischen Gehölzen auf geschützten Biotopen (*Gentiano-Koelerietum*) untersucht. Die Futterbeiträge der Gebüsche in der Krautschicht (0-30 cm Höhe) und in der Gebüschschicht (30-200 cm) wurden gemessen und ihre Bedeutung für die ökologische Ziegenhaltung bewertet. Die Untersuchung zeigte die hohe Bedeutung von Gehölzen für eine qualitativ verbesserte Fütterung von Ziegen.

Schlüsselwörter: Ökologische Tierhaltung, Biotoppflege, Ziegen, Entbuschung

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1 Introduction

In Germany, even in the context of organic farming, goats are usually kept on grassland that is free of shrubs. This practice ignores the behavioural preferences and "nutrient wisdom" or fodder requirements of goats as browsers (Papachristou, 1991; Papachristou and Nastis, 1993). Nevertheless, EU Regulation 1804/99 (Organic Animal Husbandry) does not require that organic farms permit goats to browse as a means of improving animal welfare. In this connection protected grassland represents an option that combines pastureland with shrubs. Abandoned farmland is rapidly invaded by shrubs. Clearance costs are high. Goats, however, can help to conserve and maintain shrub-endangered biotopes by simply browsing on such land (Rahmann, 1999). There would seem to be a good argument, then, for combining goat-keeping in an organic farming context and conservation of shrub-invaded grasslands. EU Regulation 1804/99 (Organic Animal Husbandry) – supplemented to Regulation 2092/91 (Organic Farming) – makes mention of this: *"(8) Pastoral stock farming carried out in accordance with the rules of organic farming is an activity particularly suited to the maintenance and exploitation of the potential of abandoned areas"*. In Germany there is no practical experience of goat-grazing on protected and shrub-invaded grassland, or of its effects on goat-keeping in the context of organic farming. In a six-year experiment (1994 - 1999) biotope maintenance was introduced to an organic goat-farming system.

2 Material and methods

The research was carried out at the experimental farm of the University of Kassel in Witzenhausen, central Germany, from 1994 to 1999 and involved 50 female goats (German Alpine goats, Bure goats, Cashmere goats). About 5.5 hectares of ordinary pastureland/meadowland and 14 hectares (5 experimental plots) of protected *Gentiano-Koelerietum* grassland (FFH-biotope classification code 34.02.01.03, see Riecken, Ries and Ssymank, 1994) were used for this new farming system combining "organic kid-meat production with biotopic conservation". The holistic concept of the New Farming Systems Research and Development (NFSR+D) approach was used to determine the scientific strategy to analyse the mutual interactivity of pastureland, animal stock, biotope and farming value(Rahmann, 2000).

The management of the goats and the ordinary pastureland was undertaken according to organic farming rules (EC/1804/99) (Rahmann, 2004). The biotopes were steeply inclined (>15°; no tractor access possible), dry (xero- and oligotrophic vegetation) with swallow soils (type: *calcareous Rendzina*), and 50 % to 100 % covered with invaded shrubs (max. of 20 % is acceptable by the biotope conservation concept). The plots were located around the experimental farm at a distance of up to eight kilometres and were managed under the nature conservation rules of HELP (Hessisches Landschaftspflegeprogramm), which are even more restrictive than the rules of organic farming: no supplemental feeding of the animals, short grazing period (summer), no melioration of the natural flora, fauna or habitat other than the impact of the grazing and the definition of specific husbandry techniques (mobile fences, no shelter).

The biotope with the name "Huebenthal" (acronym = HU) was used to analyse the interaction of shrubs and goats (see Fig. 1). This article only considers the experimental plots HU1, HU3 and HU4 (grazed by goats only; see Table 1).

The vegetation cover was classified in terms of 21 classification plots of 25 m^2 each. The classification methods used were those of Klapp and Stählin (1936). These methods (fodder yield and value) are commonly used for agricultural purposes. The classification procedure divides the vegetation on a 25 m^2 plot into the major groups of sweet grass (*Gramineae*), sour grass (*Juncaceeae and Cyperaceae*), legumes, herbs and shrubs. The proportion of each of the species in the groups is next estimated. The fodder value of each species is then ranked on a scale ranging from -1 (poisonous) and 0 (no fodder value) up to 8 (best fodder value). Shrubs were not classified by Klapp and

Table 1:
Grazing parameters on the experimental plot "Huebenthal" (1994 – 1997)

	1994	1995	1996	1997
Hectares grazed	0,8	0,8	0,8	0,8
Grazing started on...	20th May	26th June	22nd July	1st July
Grazing ended on...	6th June	7th August	20th August	20th July
Grazing days	48	43	30	19
Number of goats	15	30	19	38
Stocking rate in LW/ha	32,988	33,595	34,548	33,933
Stocking rate in LU/ha	66	67	69	68

LW = kg live weight; LU = Livestock Unit = 500 kg LW

Stählin (1936) because they were not regarded as fodder. For the purposes of this article they have been giving a ranking of "4", a middle value.

The biomass, the volume and the relation between the leaves and total stem were measured for five important species of shrub on the biotope Huebenthal. The bushes of 20 Cornus sanguinea, 20 *Prunus spinosa*, 20 *Frangula alnus*, 10 *Rosa canina* and 20 *Viburnum opulus* were measured in terms of height and widths (volume), cut, weighed as total shrub (balance accuracy of 0.01 g), defoliated, separately weighted as fresh leaves (5 % respiration and transpiration losses being allowed for) and retained stem fresh weight. Next the leaves were dried (24 hours at 60° C). Half of the shrubs were then browsed for four years by goats (HU1), whereas the other half were not (HU6). The fodder value and the minerals of the relevant shrubs have been analysed by the Weender Analyse (WA) and Hohenheimer Futtertest (HFT) in July 2002 (van Soest 1982).

The fodder values derived by Klapp-numbers (from quoting and ranking) are not suitable for measuring the actual fodder values grazed/browsed by a goat. These direct methods fail to take account of grazing behaviour (goats are extremely selective and their habits change with the weather (climate), body condition and "nutrient wisdom"). They ignore seasonal influences and the fact that the vegetation cover is very heterogeneous on marginal and protected grassland. Neither use of fistulas of the goats nor total vegetation cuts are possible or desirable. The fodder value can be derived by an indirect method according to Falke (1929), by making use of knowledge of the goat's fodder requirement for activity, body maintenance and production (growth and milk). Falke assumed a correlation between a cow's energy requirements, the available fodder and the digested dry matter. This simple "economic-pragmatic" approach (Klapp, 1971) gives fairly realistic results under conditions of extensive grazing on heterogenous pastures by selected animals and deserves further consideration (Voigtländer and Voss, 1979).

The carrying capacities and productivity of the plots were measured by weighing the goats (after 12 hours without fodder) at the outset and the end of the grazing period within the biotope. The accuracy of the balance (i.e. of weight measurement) was 100 g.

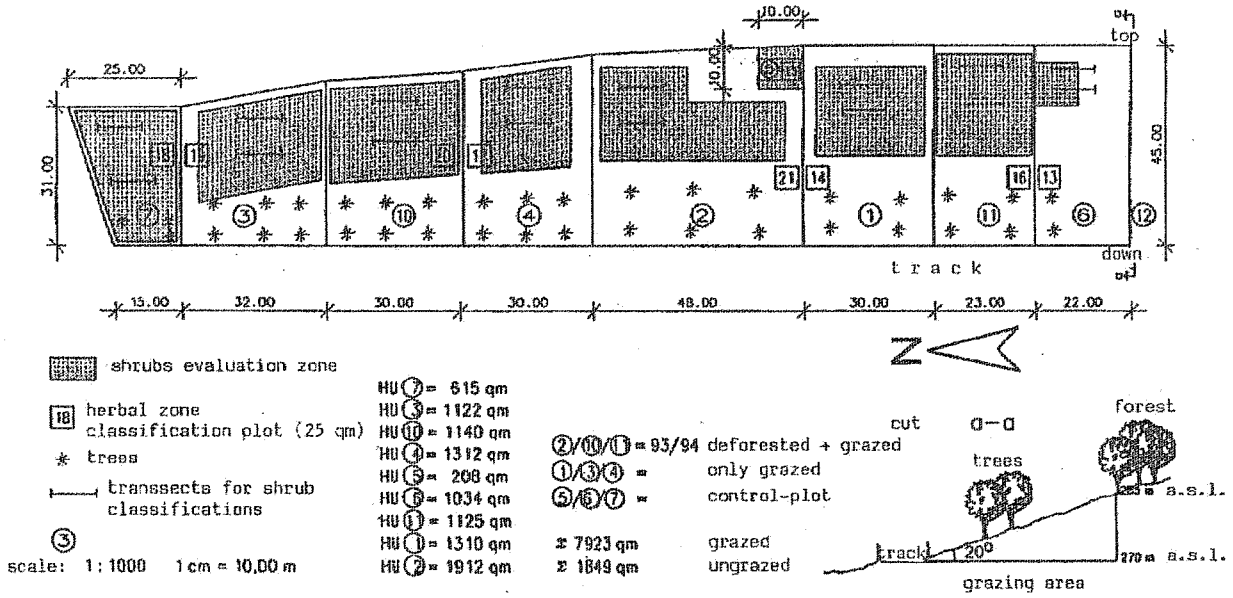

Fig. 1:
The experimental plot "Huebenthal"

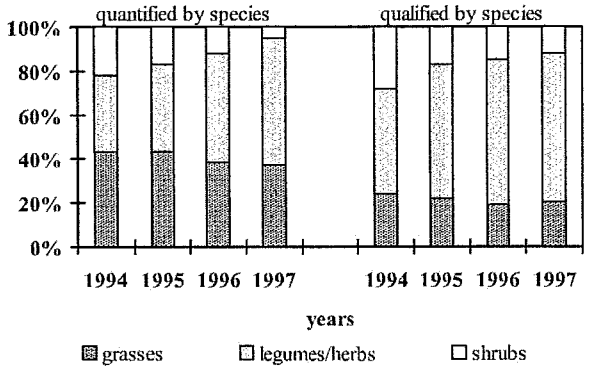

Fig. 2:
Development of vegetation in groups on shrub-invaded grassland (*Gentiano-Koelerietum*) with goat grazing (75 m²; classification plots 14, 17 and 19)

3 Results

The fodder value and the minerals of the several shrubs are very different (Table 2). Even under low browsing intensity, goats have an effect on the composition of the vegetation (Fig. 2). The selectivity of the goat, changing

Table 2:
Fodder values (WA and HFT) of different shrubs and important minerals (collected in July 2002)

	Prunus spinosa	*Cornus sanguinea*	*Frangula alnus*	*Rosa canina spp.*	*Viburnum opulus*
TS (% OM)	94.1	92.0	91.9	94.7	92.3
XA (% DM)*	9.0	12.9	6.6	6.7	9.4
XP (% DM)*	16.6	15.4	23.2	12.1	17.6
XF (% DM)*	12.2	8.7	14.8	11.9	19.4
XL (% DM)*	5.2	4.6	6.1	3.2	6.5
ADF (% DM)	15.5	13.1	20.0	17.0	35.0
NDF (% DM)	34.1	21.8	36.6	28.0	43.3
HFT (ml/200 ml OM)**	40.9	31.5	49.4	38.3	39.8
Ca (mg/kg DM)	10 096	30 435	9 576	19 007	20 585
Mg (mg/kg DM)	2 657	3 043	3 156	4 646	2 492
K (mg/kg DM)	25 505	9 565	19 587	16 895	23 835
Na (mg/kg DM)	776	185	283	243	90
Fe (mg/kg DM)	100	109	83	81	152
Mn (mg/kg DM)	70	29	131	27	26
Cu (mg/kg DM)	19	8	7	9	11
Zn (mg/kg DM)	19	18	27	24	47
Co (mg/kg DM)	<0.2	<0.2	<0.2	<0.2	<0.2
Se (mg/kg DM)	<0.02	0.027	0.098	0.041	0.028

OM = Organic matter, DM = Dry matter
* XA: asch, XP, XP: row proteine, XF: row fiber, XL: row fat as results of a Weender Feedstuff Analysis (WA)
** HFT: Hohenheimer Futtertest (see van Soest 1982)

Table 3:
Shrub volume, shrub biomass fresh (steam and leaf) and leaf biomass fresh over four years with and without goat-browsing

		With goat-browsing			Without goat-browsing		
	shrub species	n	Ø	s	n	Ø	s
Fresh shrub biomass in kg per m^3	*Cornus sanguinea*	10	1,01	0,78	10	0,85	0,32
	Prunus spinosa	10	1,97	0,96	10	0,92	0,52
	Rosa canina spp.	5	1,03	0,65	5	1,53	1,04
	Frangula alnus	10	1,82	0,80	10	0,50	0,10
	Viburnum opulus	10	0,64	0,17	10	0,30	0,20
Fresh leaf biomass in kg per m^3	*Cornus sanguinea*	10	0,31	0,26	10	0,47	0,25
	Prunus spinosa	10	0,36	0,11	10	0,37	0,19
	Rosa canina spp.	5	0,45	0,04	5	0,69	0,53
	Frangula alnus	10	0,29	0,12	10	0,13	0,06
	Viburnum opulus	10	0,29	0,08	10	0,11	0,06

ecological conditions (light, water, nutrients) and the related impact of the animals on the vegetation (trampling, defecating, resting, rubbing) are the reasons for these changes. The effect of the browsing was obvious (Table 3).

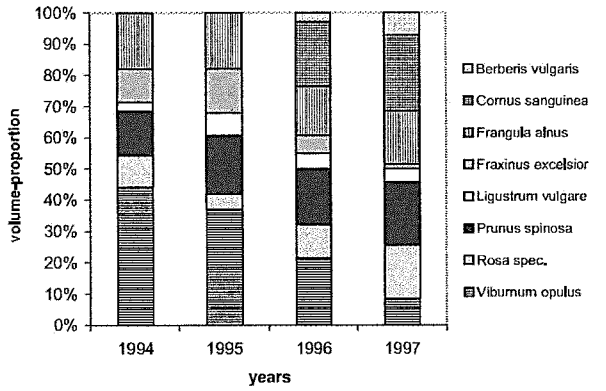

Fig. 3:
Development of the biomass volume-proportion of different shrubs species in the shrub zone (30 – 200 cm) when affected by goat grazing

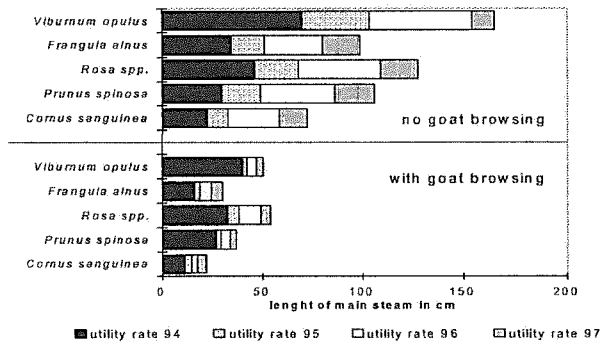

Fig. 4:
Utility rate of selected shrub species with and without four years of goat browsing

Even under low browsing intensity, goats have an effect on the composition of the vegetation (Fig. 2). The selectivity of the goat, changing ecological conditions (light, water, nutrients) and the related impact of the animals on the vegetation (trampling, defecating, resting, rubbing) are the reasons for these changes.

The selectivity of goats during browsing as well as the growth performance of the various species of shrubs (growth rate, competitiveness, etc.) change the proportion by volume of the given shrub species in the shrub cover on grassland areas (Fig. 3). For example, *Viburnum opulus* is greatly preferred by goats and accordingly decreases in volume, despite its high growth rate - particularly in spring - compared to the other shrub species present (Rahmann, 2000). Another example is *Cornus sanguinea*. Because the goats don't like it much they consume it less frequently than *Rubus spp.*, *Viburnum opulus* or *Prunus spp*, its proportion of the shrub cover remains stable. *Prunus spinosa* is preferred by the goats, but only when very fresh (leaves, sprouts). The sprouts very soon become woody, however, and are then no longer eaten. As a result, the proportion of this species of shrub does not change very much over the years. There is a close relationship between the shrub volume and shrub biomass (Table 3). When no browsing takes place, this relationship is less pronounced than with browsing. This leads to "cow bushes": compact shrubs. One exception: *Rosa canina spp.* The sprouts are not eaten down due to their thorns and their high growth rate. The relationship between shrub biomass and volume does not correspond to the fresh biomass of the leaves. Some shrubs have more, some the

Table 4:
Development of the fodder value of the herbal zone (0 – 30 cm) as influenced by goat grazing (measured with Klapp-ranking with and without shrubs: -1 = poisonous, 0 = no value, 8 = best value)

	1994	1995	1996	1997
• With shrubs	2,65	2,29	2,21	1,83
• Without shrubs	0,70	1,01	1,29	1,69

Table 5:
Indirect calculation of feed value via energy required by goats for maintenance, activity and production in relation to estimated dry-matter intake

Total flock:	1994	1995	1996	1997
Grazing days	48	43	30	19
Metabolic live weight at the beginning ($kg^{0,75}$)	279	344	465	720
Live weight changes while grazing (kg)	+23	+63	+22	+33
Maintenance energy (0,424 MJ ME $kg^{-0,75}$ day^{-1})	5.681	6.269	5.914	5.801
Activity energy (50 % of maintenance energy)	2.840	3.134	2.957	2.900
Production (34 MJ ME per kg weight gain)	772	2.124	751	1.116
Total energy requirement (MJ ME)	9.293	11.527	9.622	9.817
Dry matter intake	951	1.208	980	990
MJ ME per kg of dry matter	9,8	9,5	9,8	9,9

same, and some less, fresh-leaf biomass when browsing takes place, as compared to their performance when there is no browsing.

The fodder values derived from Klapp-values (plant species weighted according to biomass) show that grasses and herbs alone are adequate for maintenance of body performance, but not for production. Food sources are only valuable as animal fodder when their average values lie above "2.0" (Spatz, 1994). This ranking is only reached when shrubs are taken into consideration. After several years of goat grazing/browsing, the fodder values derived according to Klapp were found to decrease slightly (Table 4).

Given that the sucking goat kids gained weight and that the mothers kept their weight, the fodder value of the vegetation was clearly not as bad as suggested by the Klapp-figures (Table 4). Selective grazing/browsing allows the goats to obtain a higher fodder intake than the average for the vegetation. With the indirect calculation method the fodder value must have had a value of roughly 9 to 10 MJ ME per kg DM (Table 5). This is similar to the figures indicated by the cuts (Fig. 4).

4 Discussion

Goats have an impact on the composition of the vegetation. The short period of observation (four years) was insufficient for findings relating to long-term effects. However, given our knowledge of the impact of the long-term grazing/browsing of goats in other areas (e.g. in Greece, Italy and Spain over a thousand years) (Waterhouse et al., 1999; Papachristou, 1991) it can be reasonably assumed that the composition will achieve stability after a while. Shrubs, herbs and grasses will then retain an established relation. Shrubs form a highly valuable part of the diet of goats, especially in terms of protein. Without shrubs, the fodder value is very low. The selective grazing/browsing of the goat enables them to enjoy a better quality of fodder. Low stock density allows the goat to practice this habit. Estimates of the fodder value using Klapp-fodder values are unsuitable. The Klapp-values obtained for the vegetation were very low and were barely adequate for maintenance of the flocks. Yet the goats gained weight. Employing an indirect method, it proved possible to calculate that the diet should have an fodder value of 9 to 10 MJ ME per kg of dry matter.

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