

Using goats for reducing shrub clearance costs on protected biotopes (*Gentiano-Koelerietum*) in Germany

G. RAHMANN

Department of International Animal Husbandry, University of Kassel, Witzenhausen, Germany

Summary

In hilly areas of Germany, shrub clearance is one of the most costly measures to maintain anthropo-zoogenic biotopes. Usually, shrub clearance is done by motor trimmer and manual labour; costs of 4000 EURO ha⁻¹ y⁻¹ are usual. Authorities and other persons concerned are under increasing pressure to find more efficient, lower cost methods of biotope conservation. In an experiment, goat grazing was assessed as a low-cost alternative for shrub clearance. The experiments were carried out on two protected biotopes (*Gentiano-Koelerietum*) on hilly plots in the middle of Germany. Four different measures of shrub clearance were made over a period of four years (1994-1998): manual cleaning, manual cleaning and goat grazing, goat grazing and a control plot. On the less productive biotope, the cheapest shrub clearance was done by manual cleaning at the beginning and then continuous grazing with goats. The shrub growth was controlled well by the goats. On the more productive biotope, the goats were not able to control the shrub growth fully but reduced the regrowth considerably. During the 3-year period a manual shrub clearance had to be done even when goats were used. Nevertheless, goat grazing reduced the shrub cleaning cost to 34% (1384 EURO ha⁻¹ y⁻¹) on the more productive and to 22% (874 EURO ha⁻¹ y⁻¹) on the less productive biotope, compared with usual manual clearance.

Keywords: conservation costs, goats, grazing effects, protected biotopes, shrub clearance.

Introduction

Marginal grassland was used for sheep grazing to produce wool. Continuous cutting and grazing prevented regrowth of shrubs on marginal and hilly grassland in Germany, creating open spaces with adapted marginal-grassland vegetation. In this century wool decreased in value, the numbers of sheep also decreased heavily and in recent decades, marginal land - used traditionally by sheep grazing - has been left unused by farmers. After centuries shrubs appeared again in such abandoned pastures. This shrub invasion adversely influences the vegetation, which depends on sheep grazing. Shrubs became a threat to the protection of the cultural landscape (Rahmann, 1998).

Nowadays, shrub clearance is necessary to conserve such rare anthropo-zoogenic biotopes (e.g. *Gentiano-Koelerietum*). On slopes this clearance is done by hard manual work and is very cost-intensive. Usually, it costs about 4000 EURO ha⁻¹ y⁻¹ to clean such

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shrub-invaded pasture. In the EU share cost project EQUFLA, the ability of goats to keep protected biotopes free of shrubs has been evaluated. In a four-year experiment (1995 - 1998), the ecological and economic impact of goat grazing on shrubs has been assessed.

Materials and methods

Two sites (EB and HU) of protected *Gentiano-Koelerietum* pastures were chosen for the grazing experiment. One experimental site (EB) was more productive than the other (HU), measured in carrying capacity (Table 1). This was important to assess the range of shrub clearance costs for different production potentials of *Gentiano-Koelerietum*. Both sites had not been grazed for decades.

At the beginning of the experiment both sites were about 50% infested by shrubs of 0.75 to 1.5 m in height. The site EB was mainly infested by *Rubus fruticosus*, *Rosa* spp. and *Crateagus* spp., the site HU mainly by *Cornus sanguinea*, *Viburnum opulus*, *Prunus spinosa* and *Rosa* spp..

Table 1. Description of the two experimental sites.

	Experimental site 1 (EB)	Experimental site 2 (HU)
Productivity	high	low
Experimental plot size	4.614 m ²	7.923 m ²
Altitude	215 - 240 m a.s.l.	270 - 285 m a.s.l.
Inclination	25°	20°
Exposure	S - SW	W

Four different methods of shrub clearance were carried out on different plots of the experimental site:

1. manual cleaning (EB1 and HU1),
2. manual cleaning and goat grazing (EB2 and HU2),
3. goat grazing (EB3 and HU3) and
4. control (EB4 and HU4).

The experimental plots of the site EB were all about 500 m² and on HU site between 600 and 1930 m². In February 1994, plots EB1, EB2, HU1 and HU2 were cleared manually; the other plots were not. During the following years, plot EB2, EB3, HU2 and HU3 were grazed by goats (Table 2). All plots of the experimental site EB were manually cleared of shrubs in February 1997 and all plots of the experimental site HU one year later in February 1998. The time needed for shrub clearance, and the fresh biomass of the removed shrubs, were assessed. The grazing period was between 3 and 4 weeks y⁻¹ in the summer season. The labour needs, the animal growth and animal welfare were evaluated.

The annual shrub growth and the utilisation rates by goat browsing were measured on the HU site. The shrub level was fixed between 30 and 200 cm in height. The shrub composition was identified and assessed on 25 m² sub-plots, of which three were used for each experimental plot.

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Table 2. Grazing pattern on the experimental sites.

	1994	1995	1996	1997
EB: grazing period	23.6. - 26.7.	14.7. - 28.7.	20.6. - 28.6.	1.8. - 20.8.
stocking rate	97	84	80	87
HU: grazing period	20.5. - 6.7.	26.6. - 7.8.	22.7. - 20.8.	1.7. - 20.7.
stocking rate	66	67	69	68

In two plots of HU, 200 stumps of 5 cm height were permanently marked. For each plot, these were 20 stumps of the five chosen shrub species *Viburnum opulus*, *Prunus spinosa*, *Cornus sanguinea*, *Rosa* spp. and *Frangula alnus*. One plot (HU2) was grazed in 1994, '95, '96 and '97 by goats, the other was not grazed (HU1). Before and after the grazing period, the length, the width and the depth of the marked shrubs were measured. Utilisation rates and annual growth could be assessed using these data.

$$\text{Utilisation rate (\%)} = \left(1 - \frac{\text{branch length after grazing}}{\text{branch length before grazing}}\right) \times 100$$

Results

Annual shrub growth after shrub clearance and utilisation rate by browsing

After manual cleaning, shrub growth can be limited by goat grazing. In the first year after clearance the shrubs have a high ability to regrow. Even with goat grazing, the shrubs grow to an average height of 22 cm. In the following years the shrub growth is reduced to approximately 5 to 10 cm y^{-1} . There are differences in regrowth of the shrub species, depending on the selection for goats, the access and the growing season (Figure 1). *Viburnum opulus* grows early in spring, before the goats enter the plots. *Rosa* spp. and *Prunus spinosa* are thorny shrubs, and after some years access by goats for browsing is difficult. All the shrubs were grazed but some were more preferred than others. *Cornus sanguinea* is the least preferred of these five chosen shrubs. Nevertheless, its growth rate was low compared to the other species.

Over the grazing period, the utilisation rate of all shrubs was positive. That means that the shrub did not grow during but before and after the time of grazing (Figure 2). Permanent goat grazing would reduce the shrub growth more than the usual 3 to 4 weeks y^{-1} . However, to extend the grazing period is not possible so as to avoid negative influences on protected vegetation.

The regrowth of the shrubs - even with goat browsing - needs occasional manual cleaning, as in former times. If goats are not used then on more productive pastures, after every third, and on less productive pastures, after every fourth year, manual clearance is necessary. About 9 t ha^{-1} of fresh biomass have to be removed (Table 3). On more productive biotopes this is about 3 t and on less productive biotopes about 2 t $ha^{-1} y^{-1}$. If goats are used, the annual amount of shrub biomass can be reduced to 200 kg $ha^{-1} y^{-1}$. If manual cleaning is carried out at the beginning and then the plots are continually grazed by goats, the shrubs are well-controlled. This is valid particularly on less productive plots.

Figure 1. Shrub growth after a manual clearance with and without goat grazing.

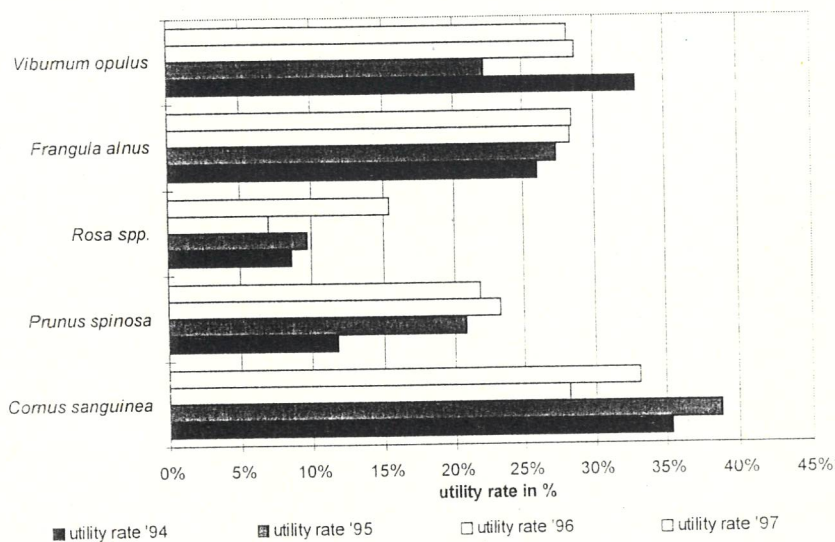


Figure 2. Utilisation rates of shrub branches by goat browsing.

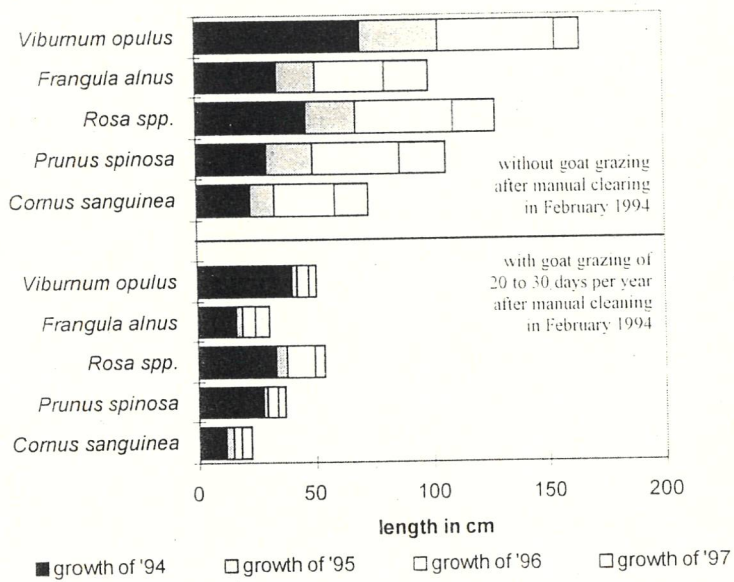


Table 3. Regrowth of shrub biomass (kg ha^{-1}) after different clearance measures.

	Manual cleaning	Manual cleaning and goat grazing	Goat grazing	Control plot
<u>Experimental site EB</u>	EB1	EB2	EB3	EB4
Regrowth per year (linear, in kg)	3,302	383	201	1,366
<u>Experimental site HU</u>	HU1	HU2	HU3	HU4
Regrowth per year (linear, in kg)	2,250	170	225	1,466

Labour needs and costs of shrub clearance for different measures

With annual goat grazing, the labour needed for clearance could be reduced to 41% on the more productive site EB and 49% on the less productive site HU (Figure 3). Nevertheless, manual work cannot be avoided. Every three or four years the shrubs which have grown again have to be removed in order to have clean pastures. On the more productive EB site, the lowest labour requirement was goat grazing over a period of three years and then manual cleaning at the end (measurement EB3). On the less productive HU site, manual clearance at the beginning and then goat grazing over a period of four years was the measure with the lowest labour requirement (HU2).

The lowest labour requirement was even the cheapest way of shrub clearance. Usual manual shrub clearance every three or four years cost about 4103 EURO on the more productive EB site and 3887 EURO $\text{ha}^{-1} \text{y}^{-1}$ on the less productive HU site. The cheapest clearance measures were on EB3, namely 1384 EURO $\text{ha}^{-1} \text{y}^{-1}$ (33.7%) and on HU2, namely 874 EURO $\text{ha}^{-1} \text{y}^{-1}$ (22.5%) (Table 4). Even here, most of the costs were for manual clearance. The premiums for goat grazing were 23% on HU2 and 13% on EB3.

Table 4. Shrub clearance cost (EURO ha^{-1})² for different measures.

	Manual cleaning	Manual cleaning and goat grazing	Goat grazing	Control plot
<u>Experimental site EB</u>	EB1	EB2	EB3	EB4
Manual cleaning ^{1,3}	12,848	4,885	3,839	8,328
Disposal/composting ⁴	767	325	295	467
Grazing premium	0	609	609	0
Discounted costs ² (y^{-1})	4,103	1,876	1,384	2,533
<u>Experimental site HU</u>	HU1	HU2	HU3	HU4
Manual cleaning ^{1,3}	16,047	2,750	4,591	8,732
Disposal/composting ⁴	906	137	236	552
Grazing premium	0	813	813	0
Discounted costs ² (y^{-1})	3,887	874	1,164	1,891

¹At the beginning and at the end of the experiment.

²Discounting and interest rate: 5% y^{-1} .

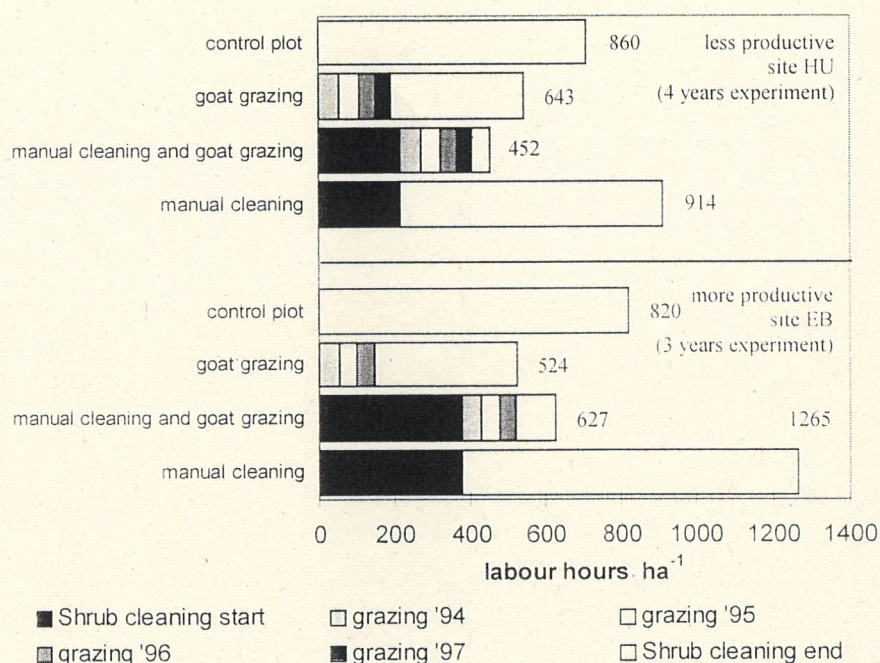
³Labour costs: 10.16 EURO h^{-1} .

⁴Disposal/composting cost: 50.78 EURO per ton fresh biomass including transport.

Daily liveweight gain of kids and labour income for biotope grazing

Grazing on protected biotopes is not only nature conservation but kid meat production too. A part of the income of the goat keeping is derived by rearing kids. Due to the low fodder quality of grass, herbs and shrubs on *Gentiano-Koelerietum* and prohibition of concentrate feeding, the growth of the kids is low compared to intensive fattening methods. High performance breeds like Boer goats (meat breed) and German Alpine goats (milk breed) gain only 130 to 200 g d⁻¹ while biotope grazing. This is between 40% and 60% of the daily weight gain in intensive fattening (Figure 4). Non-meat and non-milk breeds (Cashmere fibre breeds) have a daily weight gain below 100 g.

Figure 3. Labour hours needed for different shrub cleaning measures.



Although the liveweight gain of the kids and the income from meat sales is less compared to intensive fattening, the turnover per labour hour for goat grazing is adequate, because agri-environmental grazing premiums of about 200 EURO ha⁻¹ y⁻¹ are paid. The management of goat grazing determines the total income per hour spent for goat grazing. If only a small stocking density is used, the period of grazing is very long, the time spent is high. Two weeks of grazing is optimal for labour income. This needs about 40 hours labour ha⁻¹ without time spent on manual cleaning (Table 5).

Discussion

The shrub clearance experiments on two biotopes of *Gentiano-Koelerietum* have shown that shrub clearance can be made more effective with the use of goat browsing. The

Figure 4. Daily liveweight gain (g day^{-1}) of goat kids while biotope grazing.

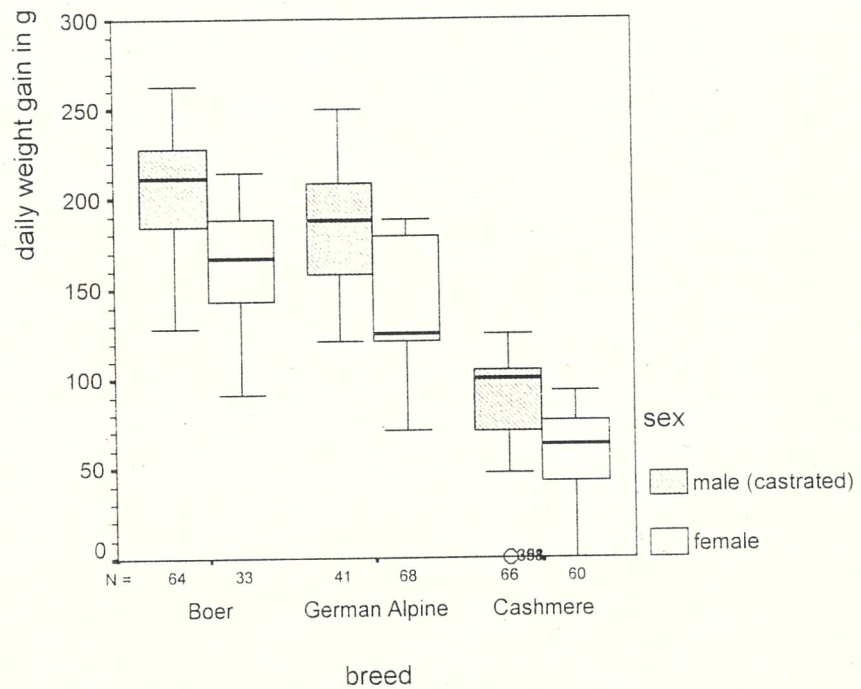


Table 5. Labour income (EURO ha^{-1}) for goat grazing without manual cleaning.

	1994	1995	1996	1997
<u>Experimental site HU</u>				
Labour hours (h^3)	54	52	45	40
Total turnover for grazing (EURO)	239	388	254	249
Turnover per labour hour (EURO)	4.42	7.47	5.64	6.22
<u>Experimental site EB</u>				
Labour hours (h^3)	55	47	44	40
Total turnover for grazing (EURO)	274	495	414	399
turnover per labour hour (EURO)	4.98	10.53	9.41	9.98

¹Only weight gain of kids is considered. Usual weight losses of mothers are not relevant for selling.

²About 2.54 EURO kg^{-1} liveweight are assumed.

³Labour needs: 30 hours for fencing and de-fencing, 30 minutes per day for control.

best measures of shrub clearance need only 40 to 50% of the labour of usual manual cleaning every three to four years. The costs are even less. Only 22.5 to 35% have to be spent on the cheapest measure, but with the same result: a shrub-cleared pasture. On more productive sites, several years with goat grazing and no manual cleaning at the beginning but at the end is the most effective measure (EB3). On less productive sites, manual cleaning at the beginning and then continual goat grazing is the best measure (HU2). Goats can reduce the growth of shrubs but they are not able to complete clearance. That has to be done manually. Kids have a medium liveweight gain but in combination with the agri-environmental schemes the turnover per labour hour is adequate. Consequently, it can be stated that the implementation of goat grazing into shrub clearance measures is advantageous for both the budgets of the nature protection authorities and the goat keepers.

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Edited by

V.P. PAPANASTASIS

Aristotle University of Thessaloniki, Greece

J. FRAME

Formely of Scottish Agricultural College, UK

A.S. NASTIS

Aristotle University of Thessaloniki, Greece



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