

Sustainable meat and milk production from grasslands

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Grazing by free-ranging red deer: effective management for semi-natural grassland conservation?

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Abstract

How to maintain open habitats is a critical question for nature conservation, especially if the area of concern is large and difficult to access. Central to preventing natural succession and maintaining protected grasslands is the removal of biomass, which can be successfully achieved by livestock grazing. The effectiveness of grazing by wild-living autochthonous mega-herbivores has not yet been evaluated. On a military training area (Grafenwoehr, Bavaria, Germany) with high density of red deer (*Cervus elaphus*), we surveyed grassland productivity, forage quality and forage removal by red deer in burnt (B), mown (M) and untreated (U) grasslands (five replicates per treatment) on five dates per year in 2015 and 2016. Forage removal by red deer was 31.5% (B), 42.2% (M) and 44.3% (U) of the average annual net productivity (B: 385 g m⁻²; M: 486 g m⁻²; U: 410 g m⁻²). Forage removal rates peaked at 1.5 to 1.9 g m⁻² d⁻¹ between April and June. Forage quality was improved in mown grasslands after mowing. Red deer grazing could reach biomass removal rates comparable to those in extensive livestock grazing systems. Considering red deer as a grazing species could thus expand the established management options for large-scale grassland conservation.

Keywords: grazing, wildlife management, NATURA 2000, mowing, fire, forage quality

Introduction

The decline of traditional extensive land use systems in favour of agricultural intensification (or abandonment) and the accompanying loss of semi-natural open habitats during the last century is still a challenge to nature conservation in Europe. Most alarming is that only 5.2% of the grassland habitats protected under the EU Habitats Directive are in a favourable conservation status (European Environment Agency, 2015). Extensive livestock grazing has become a valuable management tool for the preservation of semi-natural grasslands (Gilhaus *et al.*, 2013), but is difficult to implement (e.g. with regard to fencing (Bunzel-Drüke *et al.*, 2008)), where the area is large or access is restricted. This is especially true for military training areas, which often have high nature conservation value (Warren *et al.*, 2007), but bring along even more difficulties for conservation management, e.g. unexploded ordnance or animal welfare concerns. In this context, wild herbivores could be an alternative management option for grassland conservation. We, therefore, assessed which proportion of the aboveground net primary productivity (ANPP) free-ranging red deer (*Cervus elaphus*) can remove/consume in semi-natural grasslands. We hypothesised that additional management (burning, mowing) improves forage quality and affects red deer forage removal.

Materials and methods

The study was conducted on the US Army Garrison Grafenwoehr military training area (GTA) in Bavaria, Germany (49° 40' 56" N, 11° 47' 20" E; c. 230 km²). Out of the c. 9,000 ha of open habitats within GTA, 340 ha are designated as the NATURA 2000 habitat type 6510, lowland hay meadows. Wildlife, mostly red deer, is abundant on GTA.

We used movable exclusion cages to assess grassland productivity and forage removal by red deer on five lowland hay meadow sites in 2015 and 2016. Each of the five sampling sites (c. 1 ha) comprised three treatments (225 m² plot size): burnt (B), mown (M) and untreated (U) grassland. The respective plots were burnt in March/April and mown in July. We translocated the exclusion cages and collected hand-pluck samples to analyse forage quality on five dates over each vegetation period. Crude protein (CP) and organic acid detergent fibre (exclusive of residual ash, oADF) in dried hand-plucked samples were determined by near-infrared spectroscopy. We analysed the main and interaction effects of year (2015, 2016), month (April, May, June, August, October) and management (B, M, U) on daily rates of productivity and forage removal as well as on CP and oADF by linear mixed effects models in R statistical software (v 3.3.1; R Core Team 2015). Treatment nested in sampling site was included as a random factor and variance structure functions were used if necessary to meet assumptions of heteroscedasticity and normality of residuals. We reported results for the models most parsimonious in terms of second-order Akaike information criterion (AICc).

Results and discussion

Aboveground net primary productivity was lowest in the B treatment and highest in the M treatment (Table 1).

Averaged over both study years, absolute forage removal by red deer amounted to 31.5% (B), 42.2% (M) and 44.3% (U) of the ANPP, respectively. Considering mowing reduced the actual available forage mass by 237.8 g m⁻² on average, red deer consumption accounted for 82.6% of the ANPP available to red deer in the M treatment, which supports our hypothesis. Forage removal rates peaked at 1.5 to 1.9 g m⁻² d⁻¹ between April and June (year × month: $F = 14.18$, $P < 0.001$) and, to some degree, mirrored the year-specific seasonal productivity patterns (Figure 1a; year × month: $F = 7.61$, $P < 0.001$). Opposing seasonal variations in CP and oADF indicated constantly decreasing forage quality starting from high quality spring forage (Figure 1b and 1c). As hypothesised, the M treatment provided considerably higher forage quality in the late season after mowing (treatment × month: $F = 27.76$, $P < 0.001$ (CP); $F = 39.35$, $P < 0.001$ (oADF)). Year × month interactions were significant but minor ($F = 7.50$, $P < 0.001$ (CP); $F = 18.39$, $P < 0.001$ (oADF)).

Annual forage removal averaged over all treatments equalled 1,692 kg ha⁻¹y⁻¹. Based on a standard animal unit (AU) requiring 8.8 kg dry matter d⁻¹ at maintenance level (Allen *et al.*, 2011), this can be translated to a theoretical stocking rate of 0.53 AU ha⁻¹ y⁻¹. Given that a stocking rate of 0.5 AU ha⁻¹ y⁻¹ is recommended for neutral grasslands in extensive systems (Crofts and Jefferson, 1999), this rough estimation indicates that red deer forage removal in semi-natural grasslands could be relevant to nature conservation. Moreover, red deer grazing appeared to be influenced by forage quality patterns resulting in a high forage removal in spring and early summer, which is an important aim of grassland conservation in order to prevent the accumulation of unpalatable dead plant material (Crofts and Jefferson, 1999).

Table 1. Mean and 95% confidence interval (CI) of aboveground net primary productivity (ANPP) and red deer forage removal (g m⁻²) in burnt (B), mown (M) and untreated (U) grasslands (n = 5).

Treatment	ANPP				Forage removal			
	2015		2016		2015		2016	
	Mean	CI	Mean	CI	Mean	CI	Mean	CI
B	412.3	92.8	357.5	17.4	160.7	77.8	82.0	35.6
M	495.4	81.5	476.3	45.4	185.2	54.0	224.5	91.0
U	396.3	114.0	422.9	45.0	184.2	91.1	178.8	41.1

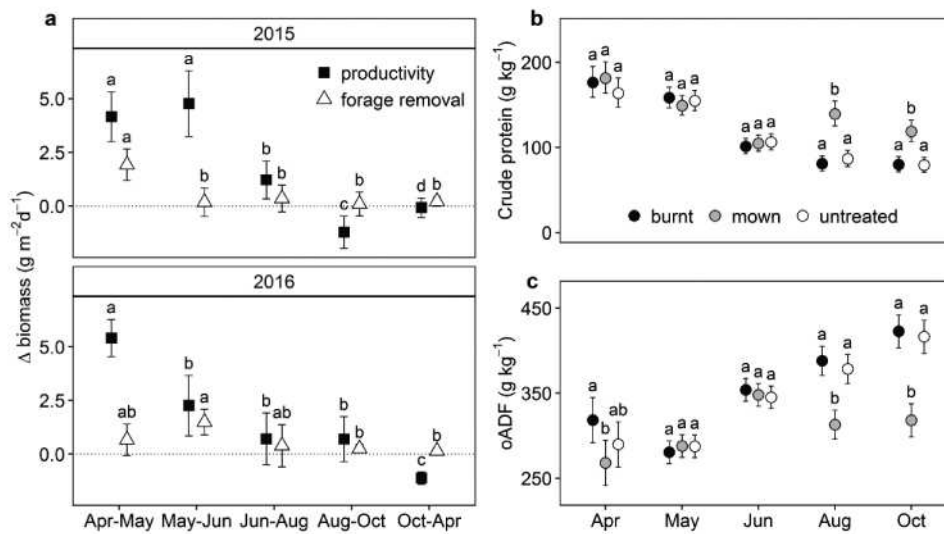


Figure 1. Daily rates of aboveground net primary productivity (DM) and red deer forage removal averaged over all treatments measured for five growth periods in 2015 and 2016 (a). Crude protein (b) and oADF (c) for the different treatments were averaged over both study years. Symbols represent least square means and lines indicate the 95% confidence interval.

Conclusion

We provided evidence that free-ranging red deer, given a sufficient population density, can be effective grazers in semi-natural grasslands and, hence, could present an appropriate management option for target areas where conventional conservation measures are difficult to implement (e.g. regarding area size or accessibility). Enhancing late season forage quality by mowing appeared to increase grassland attractiveness to red deer and could, therefore, possibly be used to direct red deer foraging activity in specific areas.

References

- Allen, V. G., Batello, C., Berretta, E. J., Hodgson, J., Kothmann, M., Li, X., McIvor, J., Milne, J., Morris, C., Peeters, A. and Sanderson, M. (2011) An international terminology for grazing lands and grazing animals. *Grass and Forage Science* 66, 2-28.
- Bunzel-Drüke, M., Böhm, C., Finck, P., Kämmer, G., Luick, R., Reisinger, E., Riecken, U., Riedl, J., Scharf, M. and Zimball, O. (2008) *‘Wilde Weiden’: Praxisleitfaden für Ganzjahresbeweidung in Naturschutz und Landschaftsentwicklung*, Arbeitsgem. Biologischer Umweltschutz im Kreis Soest eV (ABU), Bad Sassendorf-Lohne, DE, 215 pp.
- Crofts, A. and Jefferson, R.G. (eds) (1999) *The lowland grassland management handbook*, English Nature/The Wildlife Trusts, Peterborough, UK, 238 pp.
- European Environment Agency (2015) *EU 2010 biodiversity baseline – adapted to the MAES typology (2015)*, Publications Office of the European Union, LU, 183 pp.
- Gilhaus, K., Stelzner, F. and Hölzel, N. (2013) Cattle foraging habits shape vegetation patterns of alluvial year-round grazing systems. *Plant Ecology* 215, 169-179.
- Warren, S.D., Holbrook, S.W., Dale, D.A., Whelan, N.L., Elyn, M., Grimm, W. and Jentsch, A. (2007) Biodiversity and the heterogeneous disturbance regime on military training lands. *Restoration Ecology* 15, 606-612.