Temporary night camp areas: an effective way to restore shrub-encroached grasslands using livestock

Probo M., Pittarello M., Ravetto Enri s., Perotti E., Lonati M., Lombardi G.

in

Casasús I. (ed.), Lombardi G. (ed.).
Mountain pastures and livestock farming facing uncertainty: environmental, technical and socio-economic challenges

Zaragoza : CIHEAM
Options Méditerranéennes : Série A. Séminaires Méditerranéens; n. 116

2016
pages 237-240

Temporary night camp areas: an effective way to restore shrub-encroached grasslands using livestock

M. Probo[1,*], M. Pittarello[1], S. Ravetto Enri[1], E. Perotti[1], M. Lonati[1] and G. Lombardi[1]

[1]Department of Agricultural, Forest and Food Sciences, University of Torino
Largo Braccini 2, 10095, Grugliasco, Torino (Italy)
*e-mail: massimiliano.probo@unito.it

Abstract. Over the last decades, the decline of agro-pastoral activities in many European mountain regions has led to an extensive tree and shrub-encroachment of semi-natural grasslands, with a reduction of the ecosystem services provided by these open habitats. In 2011, temporary night camp areas (TNCA) for cattle were arranged in shrub-encroached areas to reverse this process and to restore semi-natural sub-alpine grasslands within the Val Troncea Natural Park in the western Italian Alps. Vegetation surveys were conducted along permanent transects from 2011 to 2015 and the effects on vegetation structure (cover and height), vegetation composition (cover of species belonging to different phytosociological units and species richness), and pastoral value of forage were assessed. Four years after their implementation, TNCA were effective in reducing the cover of shrubs and increasing herbaceous cover and height ($p < 0.01$). Moreover, the cover of species typical of mesophilic and nutrient-rich grasslands and the cover of fringe and tall herb grassland species significantly increased ($p < 0.05$). Conversely, plant biodiversity did not change over time, but pastoral value was significantly enhanced ($p < 0.001$). These findings highlight that the establishment of TNCA can be an effective and sustainable practice to restore shrub-encroached grasslands in steep and rugged mountain locations.

Keywords. Alps – Grazing – Pastoral value – Plant biodiversity – Semi-natural grasslands.

Aires de repos nocturne temporaires : un moyen efficace pour restaurer les prairies envahies par les arbustes en utilisant le bétail

Résumé. *Dans les dernières décennies, le déclin des pratiques agro-pastorales au sein de nombreuses régions européennes de montagne a amené à un empiétement extensif des prairies semi-naturelles par les arbres et les arbustes, avec une réduction des services écosystémiques fournis par ces habitats ouverts. En 2011, des aires de repos nocturne temporaires (ARNT) pour les bovins ont été arrangées dans des zones envahies par arbustes afin de renverser ce processus et de restaurer les prairies semi-naturelles subalpines au sein du Parc Naturel Val Troncea (Alpes italiennes occidentales). Entre 2011 et 2015, nous avons effectué des relevés de végétation le long des transepts permanents et nous avons déterminé les effets provoqués sur la structure de la végétation (couverture et hauteur), sur la composition botanique (couverture des espèces reconductibles à différentes unités phytosociologiques et indices de biodiversité) et sur certaines variables de la communauté des plantes (valeur pastorale et valeur de disponibilité des nutriments du sol d'après Landolt). Après quatre années d'arrangement, les ARNT se sont révélées efficaces dans la réduction de la couverture des arbustes et dans l'augmentation de couverture et hauteur de l'herbe ($p < 0,01$). De plus, la couverture des espèces typiques des prairies mésophiles et grasses et la couverture des espèces hautes et d'écotone ont augmenté significativement ($p < 0,05$). Au contraire, la biodiversité générale n'a pas changé au cours de l'expérimentation, mais la valeur pastorale a été améliorée significativement ($p < 0,001$). Ces résultats soulignent que l'arrangement des ARNT peut être une pratique efficace et soutenable pour restaurer les prairies envahies par les arbustes en zones de montagne raides et accidentées.*

Mots-clés. *Alpes – Biodiversité des plantes – Pâturage ciblé – Prairies semi-naturelles – Valeur Pastorale.*

I – Introduction

Since the end of the Second World War, agro-pastoral abandonment has resulted in an extensive tree and shrub-encroachment of former semi-natural grasslands in different European mountain chains (MacDonald *et al*., 2000). Sub-alpine meso-eutrophic grasslands have been one of the most abandoned habitats, above all in the south-western Italian Alps, where nowadays they amount to about 15% of total grassland area (Cavallero *et al*., 2007).

The implementation of temporary night camp areas (TNCA) for cattle in shrub-encroached areas can be used to reduce shrub cover and restore meso-eutrophic grassland vegetation, as described by Pittarello *et al*. (2015). In this study the effects on vegetation were examined three years after treatments. However, to better understand the effects of this restoration practices on vegetation, a longer period of monitoring is often needed. Therefore, the aim of this research was to assess the effects produced by TNCA on (i) vegetation structure and (ii) botanical composition to identify their potential to restore sub-alpine meso-eutrophic grassland vegetation over a longer period (i.e. four years after treatment).

II – Materials and methods

1. Study area and experimental design

The study area was located in Val Troncea Natural Park, south-western Italian Alps, with altitudes ranging from 1,960 to 2,360 m a.s.l.. Grasslands were mainly dominated by *Festuca curvula* Gaudin, *Nardus stricta* L. and *Festuca* gr. *rubra* and they were encroached by *Juniperus nana* Willd. and *Rhodendron ferrugineum* L.. The area (about 75 ha) was grazed for three weeks in July 2011 by 160 beef cows. The paddock was stocked at the same stocking rate in the same period in 2012, 2013, 2014, and 2015. Four TNCA of about 1,100 m^2 each were established within large patches of shrub-encroached grasslands at comparable altitudes, as described in Tocco *et a*l. (2013). All cattle were confined for two consecutive nights within each TNCA, which was bordered by electric fences and an area of 7 m^2 per night was available to each cow, resulting in a stocking density of 1200 AU ha^{-1}. Each TNCA was considered as a treatment site and paired with a control site, which was not fenced.

2. Vegetation surveys

Botanical composition was determined using the vertical point-quadrat method along permanent linear transects (Tocco *et al*., 2013) and surveys were carried out in late June in 2011 (pre-treatment survey), 2012, 2013, 2014, and 2015. Within 1-m buffer around the transect line, the percentages of shrub and herbaceous covers were visually estimated. Furthermore, 20 measurements of the height of the herbaceous layer were randomly carried out with the sward stick method.

3. Data analysis

For each plant species recorded in each transect, the percent frequency of occurrence (i.e. an estimate of Species canopy Cover, %SC) and the Species Relative Abundance (SRA) were calculated as described in Pittarello *et al*. (2015). Each plant species was related to its phytosociological optimum at the class level, according to Aeschimann *et al*. (2004). Groups of classes with physiognomic, ecological and floristic similarity (called 'vegetation units') were defined and the sum of the %SC of the species belonging to each unit was computed (Pittarello *et al*., 2015). Moreover, an Index of Specific Quality (ISQ) was attributed to each species according to Cavallero *et al*. (2007) and forage pastoral value was calculated in each transect on the basis of SRA and ISQ.

Generalized Linear Mixed Models (GLMMs) were used to test for annual differences between treatment and control sites for vegetation variables. Treatment was considered as a fixed factor, whereas

vegetation transect was considered as a random factor nested within area. A Poisson distribution was specified for count variables which were not overdispersed, whereas a negative binomial distribution was used for overdispersed count data. When the normality of the distribution was met a normal distribution was used for continuous data, otherwise a gamma distribution was specified.

III – Results and discussion

Four years after the implementation of TNCA, the percentage of shrub cover was reduced, while the herbaceous cover increased (Table 1). Most of the reduction of shrub cover occurred due to the intense trampling damages caused by cattle and the occurring bare ground gaps have been progressively recolonized by herbaceous vegetation. The average herbaceous height constantly increased for four years after treatments, mainly due to the intense fertilization effect by dung and urine deposition within TNCA. Both herbaceous species belonging to meso-eutrophic grassland and fringe and tall-herb grassland vegetation units increased over time, while boreal shrubland and woodland species were reduced. Indeed, the cover of meso-eutrophic species was more than four times higher compared to the pre-treatment state. Enhanced availability of nitrogen in the soil deriving from intense fecal deposition favored the recolonization of the bare ground gaps by meso-eutrophic plant species, such as *Poa pratensis, Agrostis tenuis,* and *Poa alpina*. These species have also a high index of specific quality, so a significant improvement of forage quality of about 80% has been assessed four years after treatment. Even though species richness significantly increased in 2014, there was not difference between TNCA and paired control areas in the following year. This result shows the importance of inter-annual fluctuations in plant diversity patterns and the need of long-term vegetation monitoring to understand the overall effectiveness of grassland restoration practices.

IV – Conclusions

In conclusion, the implementation of temporary night camp areas was an effective pastoral practice to reverse shrub-encroachment, restore meso-eutrophic grassland vegetation and increase herbage mass and forage quality.

References

Aeschimann D., Lauber K., Martin Moser D. and Theurillat J.D., 2004. *Flora alpina (Alpine Flora)*. Zanichelli, Bologna, Italy.

Cavallero A., Aceto P., Gorlier A., Lombardi G., Lonati M., Martinasso B. and Tagliatori C., 2007. *I tipi pastorali delle Alpi piemontesi* (Pasture types of the Piedmontese Alps). Alberto Perdisa Editore, Bologna, Italy.

MacDonald D., Crabtree J.R., Wiensinger G., Dax T., Stamou N., Fleury P., Gutierrez Lazpita J. and Gibon A., 2000. Agricultural abandonment in mountain areas of Europe: Enviromental consequences and policy response. *Journal of Environmental Management,* 59, 47-69.

Pittarello M., Probo M., Lonati M. and Lombardi G., 2015. Restoration of sub-alpine shrub-encroached grasslands through pastoral practices: effects on vegetation structure and botanical composition. *Applied Vegetation Science* (In press). DOI: 10.1111/avsc.12222.

Tocco C., Probo M., Lonati M., Lombardi G., Negro M., Nervo B., Rolando A. and Palestrini C., 2013. Pastoral practices to reverse shrub encroachment of sub-alpine grasslands: dung beetles (coleoptera, scarabaeoidea) respond more quickly than vegetation. *PLoS ONE,* 8:e83344.

Table 1. Effects of temporary night camp areas (TNCA) on vegetation structure, vegetation units, number of species and forage pastoral value, with respect to paired control sites. Values shown are the mean and the standard error (SE) of the mean, and in 2011 they refer to pre-treatment. Asterisks represent the statistical significance level of differences between treatment and control sites: *** = P < 0.001; ** = P < 0.01; * = P < 0.05; . = P < 0.1; n.s. = not significant (P > 0.05).

	Treatment	Control	
	mean ± SE	mean ± SE	P
Vegetation structure variables			
Shrub cover (%)			
2011	56 ± 4	57 ± 4	n.s.
2012	29 ± 5	57 ± 5	***
2013	29 ± 5	58 ± 5	***
2014	21 ± 5	59 ± 5	***
2015	27 ± 6	55 ± 7	**
Herbaceous cover (%)			
2011	33 ± 3	32 ± 5	n.s.
2012	40 ± 5	33 ± 5	n.s.
2013	52 ± 6	33 ± 4	*
2014	64 ± 5	33 ± 4	***
2015	64 ± 6	41 ± 7	.
Average herbaceous height (cm)			
2011	10 ± 1	10 ± 1	n.s.
2012	13 ± 1	11 ± 1	*
2013	16 ± 2	10 ± 1	**
2014	19 ± 1	13 ± 1	***
2015	27 ± 4	15 ± 2	***
Vegetation units			
Meso-eutrophic grassland species cover (%)			
2011	8 ± 2.42	4.5 ± 0.99	n.s.
2012	14.8 ± 4.33	8.5 ± 2.42	n.s.
2013	17.3 ± 4.1	6.5 ± 1.87	*
2014	25 ± 4.6	8.3 ± 2.61	**
2015	33.5 ± 6.03	12.5 ± 3.66	*
Fringe and tall herb grassland species cover (%)			
2011	14.5 ± 3.43	12.3 ± 3.4	n.s.
2012	23.8 ± 5.13	14.8 ± 3.7	n.s.
2013	32.5 ± 6.22	13.8 ± 3.2	***
2014	36.8 ± 7.43	18.3 ± 4.64	**
2015	41 ± 8.123	20.5 ± 5.37	***
Boreal shrublands and woodland species cover (%)			
2011	71.8 ± 8.13	73.3 ± 5.5	n.s.
2012	48 ± 8.89	71.5 ± 5.85	n.s.
2013	44 ± 7.85	75.3 ± 5.8	***
2014	44.8 ± 8.24	76 ± 6.81	***
2015	53.3 ± 11.5	86.5 ± 8.9	*
Number of species			
2011	26.6 ± 2.97	27.6 ± 1.9	n.s.
2012	31.9 ± 3.22	31.6 ± 2.17	n.s.
2013	31.6 ± 3.08	28.2 ± 1.86	n.s.
2014	34.8 ± 3.42	26.9 ± 1.66	**
2015	33.6 ± 2.94	31.4 ± 2.61	n.s.
Forage Pastoral Value			
2011	9.1 ± 0.93	9.3 ± 0.79	n.s.
2012	12 ± 1.49	9.8 ± 1	n.s.
2013	12.6 ± 1.25	9.3 ± 1.07	**
2014	13.9 ± 1.4	9.9 ± 0.9	*
2015	16.4 ± 1.73	10.1 ± 1.05	***