Comparison of quadrate and transect survey methods to evaluate pastoral value (PV) in SE Sardinian rangelands

Vacca G., Camarda I., Brundu G., Sanna F., Caredda S., Re G.A.

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Comparison of quadrate and transect survey methods to evaluate pastoral value (PV) in SE Sardinian rangelands

G. Vacca[2], I. Camarda[2], G. Brundu[2], F. Sanna[1], S. Caredda[2], G.A. Re[1]

[1]CNR (Italian National Research Centre), ISPAAM (Institute for Animal Production System in Mediterranean Environment). Via La Crucca, località Baldinca, 3, 07100, Sassari, (Italy)
[2]University of Sassari, Department of Agriculture. Viale Italia 39, 07100, Sassari, (Italy)
*e-mail:gianni.re@ispaam.cnr.it

Abstract: Pastoral resources are considered economically less profitable and less valuable from the environmental point of view, when compared to forest resources. This underestimation is in contradiction with the new important services that are attributed to grazing resources. Natural or semi-natural rangelands, in addition to providing forage resources, similarly to forest resources, represent fundamental ecosystems for the maintenance of biodiversity. The present study reports a comparison of three survey methodologies used to determine the pastoral value of grassland plant communities, as well as their species composition and biodiversity value. The research aimed also to remark the importance of integrating different methodological approaches to provide effective tools for a sustainable management of grassland. Surveys to evaluate the plant communities were based on Daget-Poissonet (transect), Braun-Blanquet methodology (quadrate) and Argenti *et al.* (transect). According to our results there were significant differences between the three methods, with diverse accuracies in terms of the total number of recorded species and pastoral values.

Keywords. Pastoral value – Grassland management – Plant community.

Comparaison des méthodes des carrés et des transects pour évaluer la valeur pastorale (PV) dans des parcours au SE de la Sardaigne

Résumé. *Les ressources pastorales sont considérées en comparaison avec les ressources forestières, économiquement moins rentables et aussi moins importantes du point de vue environnemental. Cette sous-estimation est en contradiction avec les nouveaux et importants services qui sont attribués aux ressources pastorales. Les parcours naturels ou semi-naturels, en plus de fournir des ressources fourragères, similaires aux ressources forestières, représentent des écosystèmes fondamentaux pour le maintien de la biodiversité. L'étude présente une comparaison entre trois méthodes utilisées pour déterminer la valeur pastorale des pâturages naturels, ainsi que leur composition floristique et leur biodiversité. La recherche visait également à souligner l'importance d'intégrer différentes approches méthodologiques dans le but de fournir des outils efficaces pour la gestion durable des prairies. L'étude pour évaluer les communautés végétales a été basée sur les méthodologies de Daget-Poissonet (transect), Braun-Blanquet (carré), Argenti et al. (transect). Nos résultats montrent des différences significatives entre les trois méthodes, avec diverses précisions en termes de nombre total d'espèces enregistrées et valeurs pastorales.*

Mots-clés. *Valeur pastorale – Gestion des prairies – Communauté végétale.*

I – Introduction

Rangeland management must be supported by a deep knowledge of natural resources and by an accurate timing and level of grazing. It often happens that planning of pastoral and forestry resources use does not consider the characterization of forage resources. In particular, there is often a low interest on natural grasslands which disregards their value. This usually happens because the pastoral resources are considered economically less profitable and less important from an environmental point of view when compared to forest resources and because their evaluation is often carried out without the necessary pastoral knowledge (Sabatini *et al.*, 2001).

Argenti *et al.* (2006) proposed a simplified method for the assessment of pastoral resources, remarking that limited importance is often given to them due to the inadequate skills of forest technicians, as well as the need to reduce the effort of sampling procedures. This underestimation, however, is in contradiction with the renewed importance nowadays attributed to grazing resources. In fact, rangelands, in addition to the traditional role as forage resources providers, are fundamental ecosystems favouring the maintenance of biodiversity.

The quality of pastures might be influenced by a number of factors (e.g., seasonal availability and the palatability of plants, Hussain and Durrani, 2009) and change along seasons and environmental gradients. The attribution of a Specific Index to each plant of a given rangeland (i.e., species, subspecies or lower taxon), can be relevant for studies aimed at a preliminary evaluation of the rangelands productive potential.

The present study aims to compare three survey methodologies and to test their effectiveness in determining the pastoral value of grassland plant communities, as well as their species composition and biodiversity value.

II – Materials and methods

The research was carried out between May 2013 and July 2015 in the mountainous area of Ogliastra, located in central-eastern Sardinia (Italy) at an altitude ranging between 500 and 1,350 m a.s.l., on approximately 25,000 ha of land. The study focused on the rangelands included in the territories managed by the Sardinian Forest Agency (EFRS). These rangelands are also partly included within Sites of Community Importance (SCIs) and Special Protection Areas (SPAs) according to the Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora. The vegetation is characterised by conifer plantations, meso-Mediterranean silicicolous maquis, Sardinian holm-oak forests, Sardinian supra-Mediterranean holm-oak forests, Mediterranean riparian elm forests, Southern and Sicilian Italian *Quercus pubescens* woods, Mediterranean xeric grasslands, evergreen oak matorral and Juniper matorral, according to the CORINE biotopes legend (1991) and to the Map of the Habitats of Sardinia (Camarda *et al.,* 2010). Plant specimens were collected, pressed, dried and identified; nomenclature follows Arrigoni (2006-2015). According to the traditional management, different kinds of animals (sheep, goats, pigs, cattle, horses, donkeys), commonly graze this area, throughout the year. Field surveys aiming to characterise the plant communities and the pastoral values (PV) were carried out according to three different survey methods:

(1) Daget-Poissonet method (DPM) (1969): on a linear transect of 25 m, species presence was recorded for 50 points, at a constant distance of 50 cm. The evaluation of the PV was based on the Specific Indices (SI) for forage plants (scale 0-5, according to Delpech, 1960) reported by Roggero *et al.* (2002) and on original SI assessed during the field surveys of the present research. Pastoral Value was calculated as : $PV= 0.2 \times (\Sigma CSP_i \times SI_i)$, where CSP_i is the Specific Contribution (%) of a single species *i* and SI_i is its Specific Index (Roggero *et al.* 2002; Cavallero *et al.* 2007), $CSP_i=(FSI_i/\Sigma FSI_i)x100$. CSP- indicates the Specific Contribution Species; FS_i - specific frequency; SI_i - Specific Index (from 0 to 5 according to Delpech, 1960).

(2) Minimal area method (MAM): this methodology follows Braun-Blanquet (1951), with some modifications. Three vegetation layers were considered (tree, shrub, and herbaceous layer). The plot size was determined by constructing a species-area curve. There were sampled nested plots in a homogeneous area starting from a minimum size of 50x50 cm and then doubling the area of the survey until reaching an asymptotic trend in the cumulative curve of species richness. The average plot size corresponding to the asymptotic trend was 16 m^2. For each species the cover was recorded according to the Braun-Blanquet scale, replaced by the average value per class (Tommaselli, 1956): r = 0,1; + = 2,5; 1 = 7,5; 2 = 17,5; 3 = 37,5; 4 = 62,5; 5 = 87,5. This was used to calculate the specific coverage coefficient (CRS) and then obtain the Specific Contribution (CSP_i) (Bagella, 2001). $CSP_i=(CRS_i/CRS_{tot})$ x100, where: CSR_i

= Specific Coverage coefficient for each *i* species; CSR_{tot} = Specific Coverage coefficient of the community; therefore PV- Pastoral Value, was calculated as: PV= 0.2 x (ΣCSP_i x SI_i), where CSP_i stands for the Specific Contribution (%) of a single species *i* and SI_i is its Specific Index (Roggero *et al*., 2002; Cavallero *et al.,* 2007).

(3) Pastoral simplified method (PSM) for pastures assessment (Argenti *et al*., 2006): it is based on a 25 m linear transect, with 50 points at a constant distance of 50 cm. This method considers only a limited number of plant categories and one corresponding value for each of them, as follows: 1) Palatable Grasses (PG): 1.95; 2) Not Palatable Grasses (NPG): 0.00; 3) *Fabaceae* (Fa): 2.99; 4) Others (Ot): 0.29; 5) Thorny/Poisonous: (TP): 0.00; 6) Shrubs (Sh): 0.03.

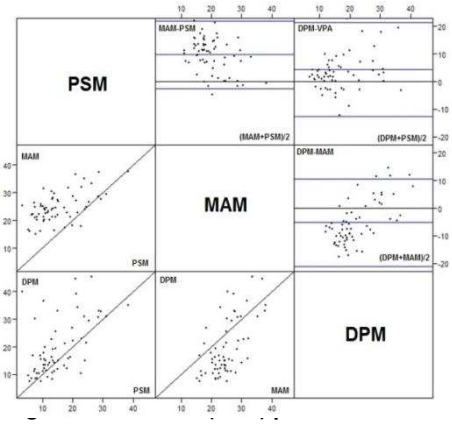
These three methods were applied on 64 plots, grazed by the end of May until the end of October, i.e. for about 150 days of grazing.

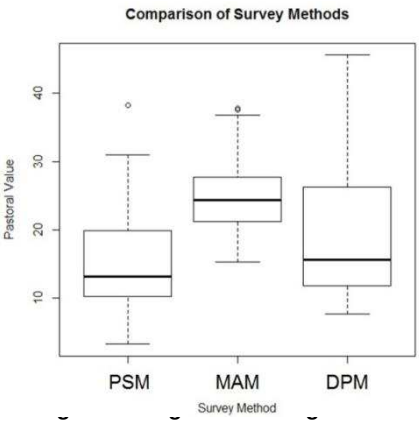
III – Results and discussion

Around 300 plant species were recorded in the 64 plots distributed in the study area, mainly *therophytes*, *hemicryptophytes* and *geophytes*, belonging to 49 Families, mainly to *Poaceae*, *Fabaceae* s.l. and *Asteraceae*, including many Sardinian or Sardinian-Corsican endemic species such as *Pancratium illyricum* L., *Plantago sarda* C. Presl, *Armeria sardoa* Spreng, *Paeonia morisii* (Viv.) Cesca, Bernardi et N. G. Passal, *Astragalus genargenteus* Moris, *Genista morisii* Colla and *Ptilostemon casabonae* (L.) Greuter. Each method has a different accuracy level when determining the PV and the total number of species. Pastoral Value ranged from 37.8 to 15.2 using the MAM, from 45.6 to 7.6 with the DPM and from 38.3 to 3.2 with the PSM. The three survey methods provided significantly different results (one way ANOVA, F value 24.26, p value 4.35 e^{-10}). Tukey multiple comparisons of means highlighted that the highest significant difference is found between the Pastoral simplified method (PSM) and the Minimal area method (MAM). This is certainly due to the very simplified categorisation of plant species used in the PSM. As the three different methods were applied to each single plot, we compared the PV resulting scores using Bland-Altman (B&A) plot (Fig.1) and Passing and Bablok (1983) regression (Fig.2) with the R package "MethComp" (Carstensen *et al*., 2015). The B&A plot is a simple way to evaluate a bias (mean difference) between two different quantitative assessments, estimating an agreement interval, within which 95% of the differences of the second method compared to the first one are included. This plot allows visualizing the intercept (α) as a measure of the systematic differences between the two methods and the slope (β) as a measure of the proportional differences. The 95% confidence interval for the intercept and for the slope can be used to test the hypothesis that α =0 and β =1. These hypothesis can be accepted only if the confidence interval for α contains the value 0 and β contains the value 1. If the hypothesis is rejected α and β are significantly different from 0 and 1 respectively and both methods differ at least by a constant amount. The B&A plot only defines the intervals of agreements, it does not say whether those limits are acceptable or not.

IV – Conclusions

Rangelands provide fundamental provisioning and regulating ecosystem services such as the conservation of plant species diversity and forage resources. The results of the present research show that there are marked differences among the three assessed methods, in the evaluation of the pastoral value. The difference between the maximum and minimum values obtained with the phytosociological method is much lower than that obtained with the transect method where Specific Indices are used. This difference of the pastoral value becomes higher when species are grouped into a few classes. Therefore, the decision of using one of the three methods rather than the other should always take into account these differences and the purposes of the assessment.





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