Can digital camera images provide useful information for pasture management?

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Take home message Indices from proximity imagery were best correlated with pasture quality than with biomass.

Introduction The assessment of availability and nutritional quality of Mediterranean native pastures is a major challenge. Being multi-species they also present plant communities of high heterogeneity both in the vertical and horizontal planes. Pasture structure also changes along season as different plant species with different phenology mature. Therefore, frequent data collection with non-destructive methods, such as ground-based images (Inoue *et al,* 2014) should facilitate repeated measures across time on the same spot enabling the evaluation of spatial distribution of biomass along with insights on the evolution of pastures. The aim of this study was to determine the potential of the visible spectrum from digital images as a surrogate for biomass availability and quality of native pastures, compared with traditional clipping methods and other reflectance methods (NDVI).

Material & methods Sampling was conducted on a native pasture (2.3 ha), located at University of Évora, Portugal (38° 32.2′ N; 8° 01.1′ W). The site was grazed by 15 adult, non-lactating Black Merino ewes, equipped with Global Navigation Satellite System (GNSS) receivers. From April to mid-June pasture samples were collected on a weekly basis on 3 patches (400 m² each) identified as the preferential grazing sites on the previous 24 hours. Percentage time spent grazing per hour was the criteria used to select preferential grazing sites. Inside each patch, 3 sampling points were randomly assigned using a 0.25 m² frame. Before pasture sample clipping at each sampling point, multispectral bands of the area surrounding the frame were acquired (proximity sensor OptRx® AOS, Ag Leader, Iowa, USA) and a set of two nadir images captured at 0.8 m above the ground and centred with the frame (commercially available "action" camera mounted on a pole, GoPro, Inc., San Mateo, CA, USA). Vegetation within the frame were then clipped, stored in plastic bags for dry matter, crude protein and NDF determination. Image analysis was performed with spatial analysis tools from the software ADI (version 1.3.7) (www.dew.globalsystemsscience.org) and red, green and blue profile extracted and used for calculating several visible spectrum indices (Greenness Index (GI), Green Leaf Algorithm(GLA), RGB Greenness (RGBG) and Green-Red Vegetation Index(GRVI).

Results & discussion The indices used to determine plant greenness (Fig.1) obtained both from the proximal sensor and from digital imagery, have shown similar temporal trends. For instance RGBG obtained from digital images is highly correlated with NDVI from the proximal sensor ($r^2 = 0.94$). All the imagery indices provided poor estimations of green biomass (*e.g.,* for GRVI $r^2=0.07$; $P=0.005$). However RGBG index relates significantly with NDF content ($r^2=0.57$; $P< 0.001$; Fig 2), and with Crude Protein ($r^2=0.46$; $P<0.001$) evidencing the effect of phenological state of the pasture.

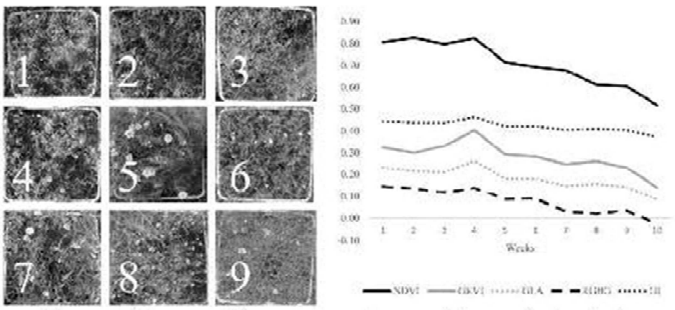

Figure 1 Temporal changes in pasture and in vegetation indices.

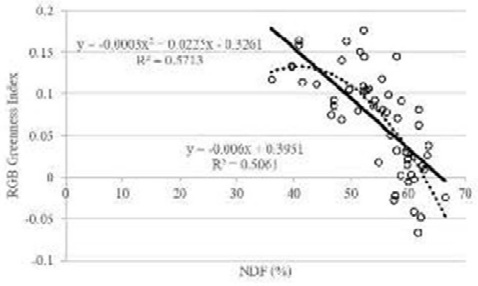

Figure 2 NDF estimates from images.

Conclusion Pasture ground-based imagery is an easy-to-perform and useful methodology for long-term *in situ* observations, and is a promising tool to estimate pasture quality parameters. Further developments include coupling with other sensors so that it may also be useful for estimation of biomass availability.

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References

Inoue T, Nagai S, Kobayashi H and Koizumi H 2015. Ecological informatics, 25, 1-9.