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Research priorities for grassland science in the Eastern Mediterranean Region

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Abstract. Grasslands and rangelands have long been solely considered as a place for livestock grazing with no regard to the many other ecosystem goods and services that they provide. Mismanagement affects significantly the forage production and the biodiversity in the Mediterranean grasslands. The study of functional traits of plant species related to their response to grazing or other agronomic practices could contribute to the further understanding of various management effects on these ecosystems. For the appropriate management techniques to be applied, the multifunctionality of these ecosystems and the climatic change should be taken into account.

Keywords. Climatic change – Functional traits – Mismanagement – Rangeland.

Les priorités de recherche pour la science des prairies dans la région de la Méditerranée orientale

Résumé. *Les prairies et les pâturages ont longtemps été considérés seulement comme des endroits pour le pâturage du bétail, sans tenir compte d'autres nombreux biens et services écosystémiques qu'ils fournissent. La mauvaise gestion affecte de manière significative la production de fourrage et de la biodiversité dans les prairies méditerranéennes. L'étude des traits fonctionnels des espèces végétales liées à leur réponse au pâturage ou d'autres pratiques agronomiques pourrait contribuer à une meilleure compréhension des effets de la gestion sur ces écosystèmes. Pour que les techniques de gestion appropriées soient appliquées, la multifonctionnalité de ces écosystèmes et le changement climatique doivent être prises en compte.*

Mots-clés. *Changement climatique – Traits fonctionnels – Mauvaise gestion – Parcours.*

I – Introduction

Mediterranean grasslands and rangelands are important natural resources with an area covering up to 48 per cent of the whole Mediterranean region (Le Houerou, 1981). Although these ecosystems have traditionally played an important role in the evolution of human societies (Jouven *et al.,* 2010), and are still the key element in the production of high quality animal products (Boyazoglu and Morand-Fehr, 2001) have been considered merely as a mean for providing feed for domestic ruminants. The significance of these ecosystems has not been fully acknowledged.

The fact that the Mediterranean basin is a global biodiversity hotspot with an extremely high number of endemic plant species (13,000) (Myers *et al.,* 2000) is strongly related to the long-time management practices, including grazing. Livestock grazing is the major factor in these ecosystems which besides quantity and quality of forage (Henkin *et al*., 2011), strongly affects vegetation dynamics, species, and landscape diversity (Olff and Ritchie, 1998; Perevolotsky, 2005).

Grasslands and rangelands are essentially providing ecosystem services such as forage production, biodiversity conservation, habitat for wildlife, carbon fixation, prevention of erosion and nutrient storage. Despite their ecological, economic and social importance they received limited scientific and media attention on their conservation merits. This is mainly because they

are widely perceived as degraded land suitable only for grazing. However, recently they are recognised for contributing to the quality of life (Arabatzis and Kyriazopoulos, 2010).

A major shift in grassland science has to occur, from considering their main function as pastures with a specific focus on livestock production to a much broader concept of natural resource management. Sustainable management should be about striking a balance among environmental conservation, livestock production and socio-economic development. The objective of this paper is to present some new aspects of grassland science focusing in the eastern Mediterranean region.

II – Research priorities

Grassland and rangeland ecosystems have to be managed with multi-purpose objectives corresponding to the different functions assigned to grassland: environment, biodiversity, landscape ecology, and livestock production with socio-economic outputs (Dahlberg, 1986). Predicting trade-offs between sustainable forage production and impacts on other ecosystem services, such as biodiversity, remains a challenge to grassland scientists.

Communal uncontrolled grazing which is predominant in the eastern Mediterranean region (Redman and Hemami, 2008; Papanastasis, 2009a; Pasho *et al*., 2011) is often associated with the absence of monitoring and planning of stocking rates and leads to overgrazing and degradation of grasslands and rangelands, due to mismanagement. It is also connected with land abandonment (Hadjigeorgiou and Zervas, 2009) which is also widely recognized as a serious problem of grasslands and rangelands in the Mediterranean region and elsewhere, especially in semiarid environments. Undergrazing or the total abandonment of grasslands leads to heavy encroachment of woody vegetation (usually shrub species). It has to be noted that this phenomenon has been related to overgrazing by non browsing herbivores (Archer *et al.,* 1995), however in the eastern Mediterranean region is strongly related with the significant decrease of goats browsing in rangelands (Landau *et al*., 1995; Kyriazopoulos *et al*., 2012). Woody species encroachment in the Mediterranean grasslands is associated with an increase in wild fires (Papanastasis, 2009b) and it might threaten to decrease biodiversity (Perevolosky and Seligman, 2008). The effects of grassland abandonment on plant community composition and standing biomass have become the object of a few studies on Eastern Mediterranean (Papanastasis, 2007) but gaps in knowledge concerning the overall impact on grassland structure and regeneration remain.

Several grazing behaviour studies have documented a positive effect of browsing of goats on the control of woody vegetation encroachment (Aharon *et al*., 2007). These studies in the future should include two key aspects: a) the nutritional, which examines the ability of the goat to collect sufficient nutrients to meet requirements for maintenance, growth, reproduction and lactation and b) the ecological, which examines the impact of the goat on the plant community or other organisms that are part of the ecosystem (Glasser *et al*., 2012). Furthermore, future grazing behaviour studies should take into account the floristic composition of grasslands, the stage of maturity and their impact on animal products (Goetsch *et al*., 2011).

Grazing and other management practices alter floristic composition and consequently affect compositional diversity (Belsky, 1992; Mishaud *et al*., 2012). Changes in floristic composition reflect intra- and inter-specific competition and are caused by environmental and management influences. Grassland science has tried to understand the mechanisms of competition by focusing mainly on species adaptation (Woodard *et al*., 1997). Diversity of grassland and rangeland vegetation has been described in terms of species number and botanical composition. Only recently, attempts have been made to explain diversity of grassland vegetation by functional traits (Lavorel and Garnier, 2002). Functional traits are plant characteristics that respond to the dominant ecosystem processes (Keddy, 1992). The advantage of such an approach in comparison to the taxonomic one is the fact that it manages

to link floristic diversity to the different functions the plants have to play within the ecosystem (primary production, competition for light and for soil resources, and interactions with herbivores). So, the study of functional traits of species related to their response to grazing or other agronomic practices contribute to further understanding of various management effects on these ecosystems. This procedure is essential to promote sustainable management. Furthermore, limited information is available on the relationship of species diversity with the diversity of the functional traits within species (Gubsch *et al.*, 2010). Future studies in vegetation dynamics need to include information on temporal and spatial heterogeneity which is a dynamic component of the grassland ecosystem.

Climate change is a major environmental concern. It is predicted that in the Mediterranean region precipitation will significantly reduce (Bates *et al.*, 2008). The predicted warmer and drier climate conditions will considerably affect the grassland ecosystems' goods and services, such as fodder production, CO_2 sequestration, soil nutrient cycling and biodiversity (Cheddadi *et al.*, 2001). Thus, significant reductions in productivity as well as in biodiversity are expected rendering studies of the grassland vegetation response to climate change necessary in order to adopt appropriate management techniques. Testing new drought tolerant grass and legume species or genotypes (Gulumser *et al.*, 2010; Basaran *et al.*, 2011) will be a helpful tool to maintain forage production.

III – Conclusions

Grasslands and rangelands have to be considered not only as grazing areas for producing forage for livestock, but also for providing a variety of ecosystem goods and services. Consequently, multi-disciplinary research and multi-scale approaches are required. Grassland science needs to carry on long term experiments for monitoring all the environmental outputs and ecological goods and services associated to grassland management allowing for the ramifications of the climate change.

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