ELSEVIER

Journal of Arid Environments 64 (2006) 298–322

Journal of Arid Environments

www.elsevier.com/locate/jnlabr/yjare

Changes in plant functional types in response to goat and sheep grazing in two semi-arid shrublands of SE Spain ☆

T. Navarro[a,*], C.L. Alados[b], B. Cabezudo[a]

[a]*Dpt. Biología Vegetal, Universidad de Málaga, Apd. 59, 29080 Málaga, Spain*
[b]*Instituto Pirenaico de Ecología, Avda, Montañana 1005, Apd. 202, 50080. Zaragoza, Spain*

Received 2 July 2003; received in revised form 4 October 2004; accepted 10 May 2005
Available online 1 August 2005

Abstract

In Mediterranean plant communities, grazing induces severe floristic changes affecting the life histories of grazed and non-grazed species. Alteration of the grazing regimen causes important changes in the structure and dynamics of the plant community and ecosystem stability. To determine the susceptibility of different plant functional types to landscape management, we measured changes in Plant Functional Types (PFTs) in response to grazing by goat and sheep in an inland dwarf-palm matorral and a marine-exposed thorny-shrub matorral in Cabo de Gata Natural Park (SE Spain). We classified the major life forms into PFTs, and identified six PFT shrubs (dwarf-palms, sclerophyllous small trees, xeric thorny-shrubs, spiny legumes, glaucous dwarf-shrubs, and xeric half-shrubs), four PFT forbs (leafy stem herbs, xeric prostrate herbs, rosette herbs, and clonal spiny herbs), and two PFT grasses (steppe and short grasses). Morphological traits measured include sclerophilly, leaf presence, leaf size, shape of leaf margins, hairiness, position of dormant buds (growth form), clonality, plant coverage, canopy structure, phenological deciduousness (drought resistance), and regeneration (reproduction type, pollination type, inflorescence position, and seed size). There was a higher correlation within and between morphological growth forms, leaf and phenological traits, than within regenerative traits (only seed size was correlated with main dispersal type). We analysed the importance of these PFTs at several sites of the two

Abbreviations: PFT, Plant functional type

☆For Nomenclature see: Tutin et al. (1964–1980), Castroviejo (1986/2003).

*Corresponding author. Tel.: +34 952 134220; fax: +34 952 131944.
E-mail address: tnavarro@uma.es (T. Navarro).

doi:10.1016/j.jaridenv.2005.05.005

communities, which were subjected to different livestock rates. In inland and marine-exposed communities, the same PFTs decreased in response to medium-high grazing: sclerophyllous small trees (*Quercus coccifera, Olea europaea* var. *sylvestris*), glaucous dwarf-shrubs (*Phlomis* and *Cistus* spp.) and short grasses (*Brachypodium retussum*). In both communities, the decrease of these grazing-susceptible PFTs was widely associated with an increase in steppe grasses (*Stipa tenacissima*, "alfa-grass") and xeric prostrate herbs (*Fagonia cretica, Paronichia sufruticosa*), the latter of which is a reliable indicator of degradation in semi-arid systems. Instead, different PFTs behave as either grazing-averse and/or grazing-tolerant in each community: Dwarf-palms (*Chamaerops humilis*) and xeric thorny shrubs (*Periploca laevigata*) in the marine-exposed community, and xeric half-shrubs (*Thymus hiemalys, Sideritis osteoxylla, Teucrium* spp., *Artemisia herba-alba)* in the inland community. The latter functional group resists disturbances, such as medium-moderate grazing and drought, in semi-arid zones and is an indicator of long-term degradation.

Keywords: Plant functional type; Grazing disturbance; Xeric plant trait; Semi-arid Mediterranean shrubland; Xeric half-shrub; Steppe grass

1. Introduction

Ecosystem disturbance is associated with vegetation changes, such as floristic variation and vegetation regression (Connell and Slatyer, 1977; Pickett et al., 1987). Nevertheless, it is difficult to describe and analyse the dynamics of vegetation regression because communities often represent an intermediate position between two different stages (Quezel and Barbero, 1990) and the vegetation units are arbitrary products of classification, rather than natural units that are clearly defined in the field (Whittaker, 1956). Such units are merely composed of plant species that coexist at a given point in space and time. To resolve that problem, numerous approaches have been developed to study vegetation changes (Clements, 1916; Tilman, 1985; van der Maarel, 1988; Millet et al., 1998), and they lead to the conclusion that vegetation changes, such as vegetation regression, can be explained by the attributes and interactions between different species. Thus, study of the attributes of individual species is of primary importance in understanding vegetation changes and the response to disturbance.

Plant Functional Types (PFTs) place a species in a group, the members of which have similar combinations of functional attributes (Solbrig, 1993) and respond similarly, or are similarly sensitive to environmental disturbance (Aguiar et al., 1996; Gitay and Noble, 1997; Lavorel et al., 1997). Functional classifications provide a framework for describing vegetation changes in natural ecosystems in terms of functional traits as a response to disturbance (Grime et al., 1997) and grazing in Mediterranean ecosystems (Fernández-Alés et al., 1993; Hadar et al., 1999; Diaz et al., 2001). Additionally, they provide predictive models of vegetation dynamics and vegetation changes (Box, 1996; Skarpe, 1996; Lavorel et al., 1997; McIntyre et al., 1999b; Diaz et al., 2002) and reduce the complexity of species diversity to a few key plant types, which helps to predict the composition and functioning of ecosystems in