Conservation management of calcareous grasslands. Changes in plant species composition and response of functional traits during 25 years

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Abstract

Five management treatments have been applied to a calcareous grassland since 1974 to study their efficiency in maintaining high diversity of grassland species. The treatments were: continuing sheep grazing, mowing, mulching, burning and leaving fallow (unmanaged). After 25 years of management, the treatments mowing and mulching resulted in a species composition similar to that from grazing by sheep. Thus, mowing and mulching can be useful management alternatives to grazing. In contrast, both burning and leaving fallow considerably changed the species composition. The changes were similar in both treatments and neither can be recommended for management purposes. We also evaluated eight traits with assumed sensitivity to the treatments (life form, life cycle, growth form, runners, lateral spread, fecundity, seed mass, germination season). In 1999, all traits except life cycle were found to respond to the different treatments. Trait response is discussed in detail.

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1. Introduction

Over the last few decades, calcareous grasslands have become rare habitats in Europe owing to their low agricultural productivity (Willems, 1990; Van Dijk, 1991). Nowadays, they are threatened by abandonment, afforestation, and intensive land use practices which include fertilization. A major goal of nature conservation is to ensure the protection and the maintenance of these grasslands and their unique floristic and faunistic diversity.

Several management experiments on the maintenance of calcareous grasslands in Europe have been conducted as an alternative to the traditional land use practice of sheep grazing (e.g. Schreiber, 1977; Bakker, 1989; Bobbink and Willems, 1993). Still, long term studies of management treatments are rare, even when taking surveys of different terrestrial ecosystems into account (e.g. Krüsi, 1981; Schmidt, 1981; Kapfer, 1988). Most of these studies investigated the impact of management-induced shifts in nutrient conditions on changes in species composition. In recent years, there has been a growing interest in the role of biological characteristics of plants for vegetation changes induced by management (Hobbs, 1997). Hodgson (1990) demonstrated the significance of plant characteristics for identifying ecological processes in conservation management of calcareous grasslands. Briemle and Schreiber (1994) studied the effect of management treatments on life form and growth form of plants. Olff et al. (1994) observed changing germination strategies over 25 years of succession in grassland after the cessation of fertilizer application and Poschlod et al. (1998) found that dispersal and seedbank features are crucial for both the maintenance and restoration of calcareous grasslands.

In a functional approach we identify plant characteristics that respond to the dominant ecosystem processes (Keddy, 1992; Kelly, 1996; Gitay and Noble, 1997). These characteristics are called functional traits. Functional traits must be selected in consideration of the types of responses that are likely to be relevant (Hobbs, 1997). They can then be used in models of vegetation changes, predicting shifts in their relative abundance (Noble and Gitay, 1996; Thompson et al., 1996; Lavorel et al., 1997; Kleyer, 1999). The recent interest in functional characterisation of plants is due to the advantage that predictions can be made without having to resort to...