



# Plant community responses to changes in management

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## Introduction

The development of settlements in the postglacial period in Europe has contributed to the expansion of numerous plant communities strongly dependent on human activity. Over the past century, changes caused by human activity have shaped contemporary vegetation on both a local and global scale, due to changes in land use methods and climate. With the rise in greenhouse gas emissions and resulting global climate change, the intensity and scope of human impact on the natural environment and the organisms occurring within has touched almost all global ecosystems, from the Arctic to Antarctica (Turner et al. 2005; Robinson et al. 2018; Węgrzyn et al. 2018). These changes portend a bleak future for terrestrial and aquatic ecosystems. Considering their particular sensitivity to changes in temperature, ecosystems will undergo transformations that threaten their stability and biodiversity (Nolan et al. 2018). Ecological extinction and declining ecosystem biodiversity, particularly of specialist species, has been reported for many years (IUCN Reports). The human impact on the environment is exhibited primarily in the extinction of key native dominant species, resulting in significant changes in primary productivity, along with many other ecological phenomena such as changes in species ranges or invasion of alien species (Hooper et al. 2012; Allen et al. 2015; Mang et al. 2018). Another important factor responsible for changes in plant communities is land use change and improvements in farming systems, which have a strong influence on vegetation, especially on a local scale. Economic transformations in recent decades are the

catalyst for significant changes in the use of natural, semi-natural and anthropogenic plant communities in many parts of the world, largely due to human population growth and increasing demand for food and raw materials. One of the most endangered plant communities are grasslands and agricultural vegetation. In Europe, these ecosystems have been associated with agriculture since the Neolithic, and they are currently exposed to strong intensification of agricultural treatments (Burrlicher et al. 1993; Isselstein et al. 2005). Understanding the impact of management on the diversity and stability of vegetation is a key challenge for nature conservation. It was also the inspiration for the Special Issue on “Plant community responses to changes in management”, which was initiated by the Managing Editor of *Biologia* together with the Chairman of the Organizing Committee of the 27th Congress of the European Vegetation Survey (IAVS Working Group, <http://euroveg.org/>) in Wrocław, Poland. In the current Special Issue of *Biologia*, we present eight research articles summarising plant community responses to changes in management. The articles also highlight some general problems of monitoring systems for improving nature protection.

## Main problems discussed in the presented studies

One of the studies provides insight into the regeneration management problems of the rare, charismatic dragon’s blood tree *Dracaena cinnabari* on Yemen’s Socotra Island. This tree is an endangered species with limited distribution, which is likely the result of two factors: changes in environmental conditions and overgrazing by goats (Nadezhdina et al. 2019). Based on field experiments, the authors suggest that grazing has a substantial impact on the natural regeneration of the dragon’s blood tree, and they develop a conservation strategy for restoration of this plant in indigenous habitats.

Much attention has recently been focused on agricultural field diversity and the ecosystem services they provide. Arable fields belong to habitats whose vegetation is seriously threatened by the intensification of agriculture (Meyer et al. 2013). Modern

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agriculture has greatly simplified crop diversity and crop rotation; this in turn limits the occurrence of many ancient weed species (archaeophytes), which have declined dramatically in Europe (Anioł-Kwiatkowska and Kački 2006; Meyer et al. 2010; Knox et al. 2011). On the other hand, a considerable increase in alien species in agricultural crop communities has been observed (Lososová and Simonová 2008). The extinction of segetal species is also strengthened by increased crop yields and crop plant density (Storkey et al. 2012). Nowak et al. (2018) demonstrated on experimental plots that crop density has an important role in limiting the growth of species accompanying crops, and this applies to both ancient weeds and ruderal species (including neophytes). This result is important for weed control planning and arable plant conservation. However, in Europe, semi-natural vegetation plays the most important role in maintaining biodiversity and providing high-value ecosystem services, where extensive management helps to sustain high biodiversity in agricultural landscapes (García-Feced et al. 2015). According to Navrátilová et al. (2019), areas of semi-natural grasslands on organic soils have decreased in comparison to other plant communities as a result of land cover changes in the Czech Republic over the last 150 years. Generally, two processes are observed in land use changes in Europe, namely increasing agricultural production in some areas, and the abandonment of traditional practices, both of which have a large influence on plant communities and biodiversity (Halada et al. 2011; Timmermann et al. 2015). Abandonment causes changes in species composition and soil properties in grasslands (Swacha et al. 2018), and promotes invasion by species with special competitive adaptations (Prévosto et al. 2011). In the current Special Issue, Pätsch et al. (2019) provide insight into the expansion of *Elytrigia repens* on Baltic low-growing salt meadows due to the abandonment of grazing. Salt meadows are considered endangered vegetation in the EU (Janssen et al. 2016); thus, to protect these grasslands, a monitoring approach has been proposed. Heavily destroyed landscape in post-industrial areas is dominated by anthropogenic vegetation. This interesting type of habitat can be studied to show plant community responses to succession depending on habitat quality and restoration practice (Prach 2003). Newly made coal mine spoil heaps are places for spontaneously developing vegetation on poor initial soils characterised by different soil fractions and chemical properties. The relationship between physicochemical properties of heaps and vegetation is discussed here by Kompała-Bąba et al. (2019). The authors found that different soil fractions influenced the development of vegetation, with fine-particle-size soil fractions having the strongest influence on vegetation diversity. These results have important implications for vegetation management and land restoration in industrial coal mining areas.

Different problems are connected with forests, which are usually considered natural vegetation. Forest management has influenced most of the woodlands in Europe, and the natural forest cycle has been altered by human interference. At the same time, deadwood abundance has been reduced

considerably, despite its significant role in maintaining biodiversity (Harmon et al. 1986; Bobiec et al. 2005). The abundance of standing deadwood and logs in different stages of decay is dependent on many factors. Natural and anthropogenic factors that influence the diversity of bryophytes and lichens found on deadwood and other organic substrates are discussed in the Special Issue (Staniaszek-Kik et al. 2019; Vondrák and Kubásek 2019). Standing wood in the Giant Mountains (Czech Republic) is an important habitat colonised mostly by lichens. Species diversity in this group is strongly linked to vegetation type and the occurrence of snags, the distribution of which is related to forest management introduced after dieback of spruce caused by pollution in the 1980s (Staniaszek-Kik et al. 2019). A relationship between vegetation type and lichen distribution and diversity was also found by Vondrák and Kubásek (2019). Human-made forests, especially plantations of Norway spruce *Picea abies*, are less favourable habitats for lichens than natural forests. On the other hand, air pollution and climate change likely promote some groups of lichens, whereas others decline rapidly. In the Šumava Mountains, notable winners are epixylic nitrophilous species, whose population tends to increase.

Plant communities respond to changes in management in many different ways. The assessment of consequences for vegetation diversity is essential to protecting nature and biodiversity conservation. This is especially important for poorly recognised vegetation such as the class *Rhamno-Prunetea*, which can be distinguished based on problematic species of the genus *Rubus* (Haveman and de Ronde 2019). Marginal fringe vegetation plays an important role in maintaining biodiversity in agricultural landscapes. Unfortunately, due to changes in land use, bramble scrubs have been altered significantly, although there is still little known about the dynamics and diversity of this vegetation (Huwer and Wittig 2012).

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