Agriculture, Ecosystems and Environment 234 (2016) 16–22

Contents lists available at ScienceDirect

Agriculture, Ecosystems and Environment

journal homepage: www.elsevier.com/locate/agee

Effects of year-round grazing on the vegetation of nutrient-poor grass- and heathlands—Evidence from a large-scale survey

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ARTICLE INFO

Article history:
Received 31 August 2015
Received in revised form 11 February 2016
Accepted 12 February 2016
Available online 2 March 2016

Keywords:
Abandonment
Grassland restoration
Pastoral systems
Sand grassland
Species richness
Vegetation structure

ABSTRACT

Year-round grazing by cattle and horses has recently become a common practice in conservation management in north-western Europe. Though many projects claim positive effects on vegetation development, evidence is still largely anecdotal. There are no comprehensive regional surveys allowing the detection of general patterns beyond single case studies. This applies even more to nutrient-poor sites where year-round grazing systems were only recently established and concerns about potentially negative effects on plant diversity are still prevalent. Hence, this study investigates the impacts of year-round grazing on plant species richness, species composition, and vegetation structure on nutrient-poor sites using a regional multi-site approach. Surveys were carried out at five different study sites in the diluvial plain of northwestern Germany and the Netherlands comprising sand grasslands, dry grasslands, and heathlands. Results show overall positive effects of grazing: Plant species richness, the number of endangered plant species, and the proportion of open soil were increased significantly. Contrary, green biomass, litter cover, vegetation height, and the cover of woody species significantly decreased. At grazed sites there were more small, light-demanding species than taller, mesophilic species. A distinct decrease of ruderal species and an increase of species following a competitive strategy was observed at abandoned sites. Based on broad regional evidence, we conclude that year-round grazing is a suitable tool for the restoration and management of open habitats on nutrient-poor sandy sites. Low sward biomass and poor nutritional quality raise, however, concerns about adequate fodder supply and animal welfare.

1. Introduction

In north-western Europe, grazing systems have created semi-natural open landscapes since the Neolithic Age (Härdtle et al., 2009; Webb, 1998). Traditional pastoralism in combination with other land use forms prevented succession to closed woodland and led to a wide range of habitats with substantial biodiversity (Webb, 1998). According to the mega-herbivore theory even before human activities vegetation development was influenced by large ancestors of domestic herbivores such as aurochs, bison, and horses were possibly able to create semi-open landscapes (Vera, 2000). Since these wild mega-herbivores are extinct today, they are no longer affecting the contemporary landscape. Only during the last two decades year-round grazing with large herbivores has become a common tool in conservation management of the studied landscape (Bunzel-Drüke et al., 2008). The objective of this management method is to simulate the effects large grazers once exerted on vegetation by introducing their modern relatives such as robust cattle or horses. They can be kept on the pasture all year round, ideally without additional feeding. Thereby, preferably large areas are grazed at low intensity without further human intervention, allowing spontaneous vegetation processes (Bunzel-Drüke et al., 2008).

The effects of such management on vegetation and the underlying mechanisms are so far not well documented and understood, although the number of grazing projects has increased rapidly during the last twenty years (Bokdam, 2003; Gilhaus et al., 2014). As demonstrated by Olff and Ritchie (1998) the effects of grazing e.g. on plant species richness change considerably along productivity gradients. So far mostly nutrient-rich year-round grazing sites have been studied (e.g. Ausden et al., 2005; Gilhaus et al., 2014) and it remains to be determined whether the results found can be transferred to nutrient-poor sites. These habitats harbor a high number of declining and endangered plant and animal species (Härdtle et al., 2009; Schwabe and Kratochwil, 2009; Veen et al., 2009). Their conservation and maintenance is of

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http://dx.doi.org/10.1016/j.agee.2016.02.015
0167-8809/

high importance at EU-level and heathlands as traditional pastoral systems also have a high cultural value (Härdtle et al., 2009; Ssymank et al., 1998; Webb, 1998).

In North Germany the land cover of heathland has decreased from about 50% to only 1–2% in the last 200 years, with a similar development in the Netherlands and other north-west European countries (Härdtle et al., 2009). The few remaining areas of nutrient-poor habitats are largely threatened by abandonment, conversion into intensive agricultural land by fertilization or afforestation (Bakker and Berendse, 1999; Härdtle et al., 2009). A further threat are increasing atmospheric nutrient inputs, which are currently debated to be a crucial factor in maintaining nutrient-poor habitats, because they lead to eutrophication and an accelerated acidification (Bakker and Berendse, 1999; Härdtle et al., 2006; Roem et al., 2002). Moreover, continued fragmentation of remaining habitats limits dispersal ranges and increases risk of extinction (Bakker and Berendse, 1999; Webb, 1998).

To maintain heathlands or sand grasslands, the (re-) introduction of disturbance regimes is crucial (Eichberg et al., 2007; Webb, 1998). Until today, traditional conservation methods include costly treatments like mowing and scrub cutting, which are affected by increasing labour costs (Bokdam, 2003; Poschlod et al., 2005). Alternative ways need to be found for managing the remaining areas at low costs. Year-round grazing seems to be a suitable method but its specific effects on plant species richness and vegetation structure are not entirely clear and still under debate (Newton et al., 2008).

Hence, this study aims at investigating the effects of year-round grazing on dry acidic grasslands and heathlands. We tested five different projects across north-western Europe for impacts of grazing on plant species richness, floristic composition, and vegetation structure as well as chemical properties of green biomass and soil parameters. Specifically we expected higher plant species-richness, shorter and more open vegetation structures, reduced grass and shrub encroachment as well as a higher proportion of ruderals and short-growing stress-tolerant species under grazed conditions.

2. Methods

2.1. Study area

The survey was carried out in five different study areas, four of them in north-western Germany and one in the Netherlands (Fig. 1). All sites exhibit oceanic to sub-oceanic climate with mild winters, rather cool summers, and permanently humid conditions. Mean annual temperatures range from 8.2 to 9.6 °C and mean annual precipitation from 750 to 900 mm (DWD, 2013). Soil types

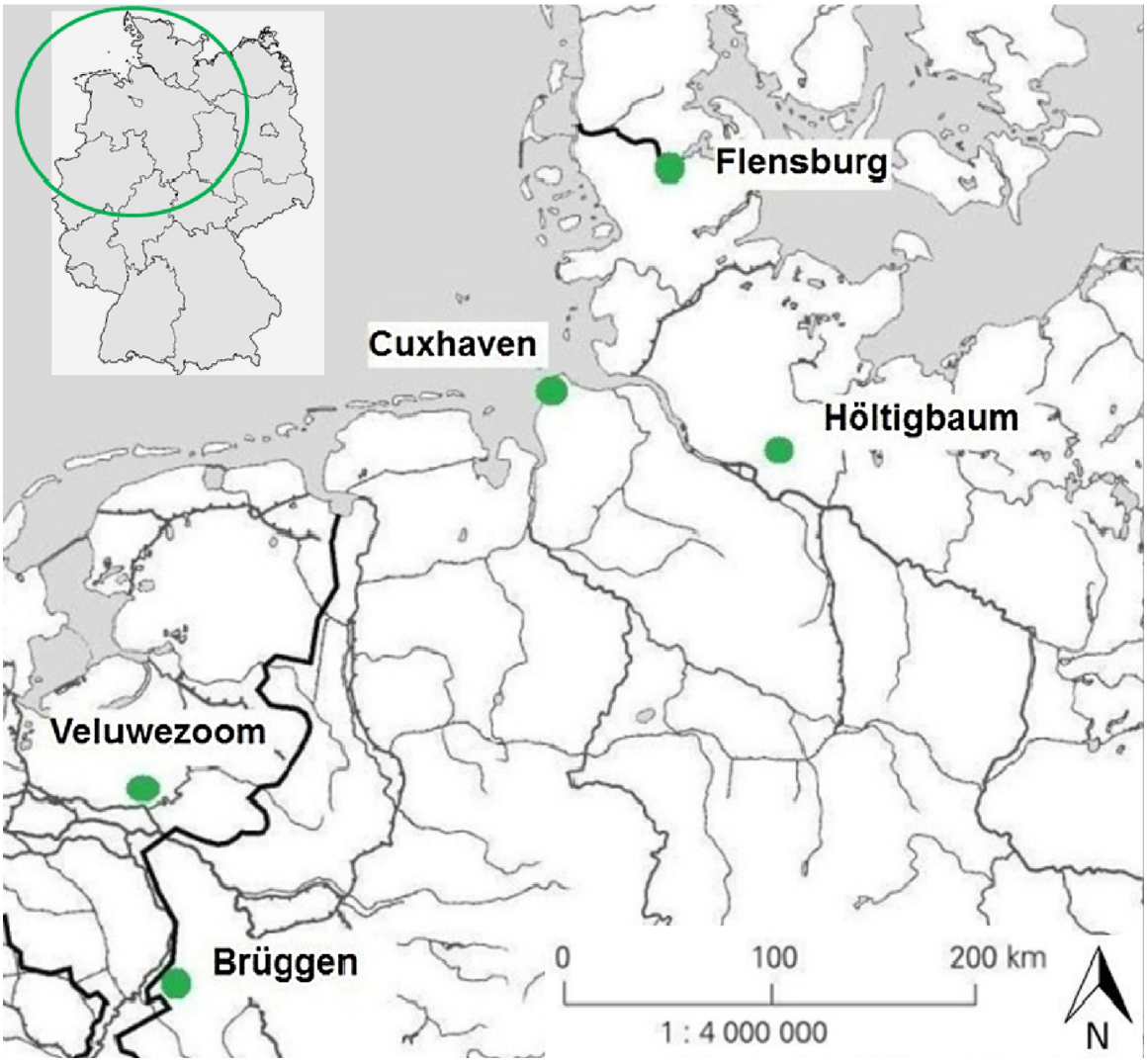

Fig. 1. Map of the five study sites in north-west Germany and the Netherlands.