Journal for Nature Conservation 22 (2014) 358–368

Contents lists available at ScienceDirect

Journal for Nature Conservation

journal homepage: www.elsevier.de/jnc

Status, future prospects, and management recommendations for alkaline fens in an agricultural landscape: A comprehensive survey

Franziska K. Seer*, Joachim Schrautzer[1]

Department of Applied Ecology, Institute for Ecosystem Research, University of Kiel, Olshausenstrasse 75, 24118 Kiel, Germany

ARTICLE INFO

Article history:
Received 21 March 2013
Received in revised form
20 December 2013
Accepted 7 March 2014

Keywords:
Caricion davallianae
Fen restoration
Grazing
Habitat enlargement
Mowing
Phytodiversity

ABSTRACT

Due to agricultural intensification and cessation of traditional land use, alkaline fens of the Caricion davallianae alliance (EU-FFH 7230) are among the most endangered ecosystems in Europe. This study exhibits a vegetation analysis of these systems in Schleswig-Holstein (Northern Germany). We analyzed across three scales the effects of grazing and mowing on phytodiversity of core areas and recorded their adjacent vegetation to estimate the capability for habitat enlargement of fen species. Results revealed that species richness, evenness and number of endangered species varied insignificantly between mowing and grazing treatments, regardless of scale. The high proportion of fen species and Red-Book-listed species in core areas, along with a state-wide representation of only 2 ha of these vegetation types, underlines the need for further conservation measures. Floristic differences between grazed and mowed sites derived from the individual appearance of species within one treatment. Thus, to preserve the species pool of alkaline fens, both management strategies have to be considered. Moreover, as most small sedge reed species are low-productive and light-demanding, sufficient biomass removal of dominant tall-growing species is required. One cut per year in late summer, the traditional management, does not satisfy the requirements of target species, which is indicated by an increase of Phragmitetea species at larger plot sizes. Additionally, in grazed fens, vegetation adjacent to the core areas consisted mainly of more eutrophic wet grasslands, and, in mowed fens, mainly of reeds or woods. We recommend therefore several changes in current conservation measures that include an increase to two cuts per year in mowed fens, and stocking rates of at least 2 LU ha^{-1} (summer grazing) or 0.7 LU ha^{-1} (year-round grazing).

Introduction

Alkaline fens (EU-FFH 7230) of the Caricion davallianae alliance are among the most threatened ecosystems of Europe. Under natural conditions, these small sedge reeds are part of peat-forming systems ("fen mires") which develop on nutrient-poor, permanently waterlogged sites with a soligenous or topogenous supply of base-rich or calcareous groundwater (EU 2007). Primary habitats are small spring mires of alpine and arctic regions. Secondary habitats are low intensively used fen meadows of the low mountains and lowlands of Central Europe that have developed since the Middle Ages in conjunction with large-scale deforestation. Phytosociologically, these secondary habitats tend to transition into the Molinion alliance(Dierßen & Dierßen 2001; Grootjans et al. 2006).

As shown in many studies, one reason for the dramatic decline of such "fen meadows" during the last decades has been the cessation of management due to decreasing agricultural use (Diemer et al. 2001; Grootjans et al. 2002; Moog et al. 2002; Schrautzer et al. 2007). Furthermore, dramatic intensification of drainage and fertilization have accounted for the degradation of these systems and their transition to highly productive grasslands (Šefferová et al. 2008; Stammel 2003). At present, however, there are no detailed data concerning the distribution and the state of preservation of these ecosystems in Central Europe (Van Diggelen et al. 2006). Management regarding fen restoration requires optimization of external environmental conditions and stabilization of the hydrological regime. Thus, strategies to restore secondary alkaline fen grasslands focus mainly on rewetting with base-rich groundwater, topsoil removal to restore nutrient-poor conditions, and, due to often depleted seed banks, the introduction of target species by, for example, hay transfer (Klimkowska et al. 2010; Lamers et al. 2002). Without continuous removal of phytomass, however, only limited restoration success toward a characteristic species composition can be possible (Rasran et al. 2007). In this regard,

* Corresponding author. Tel.: +49 431 8801199.
E-mail address: fseer@ecology.uni-kiel.de (F.K. Seer).
[1] Tel.: +49 431 8804595; e-mail: jschrautzer@ecology.uni-kiel.de.

http://dx.doi.org/10.1016/j.jnc.2014.03.003
1617-1381/

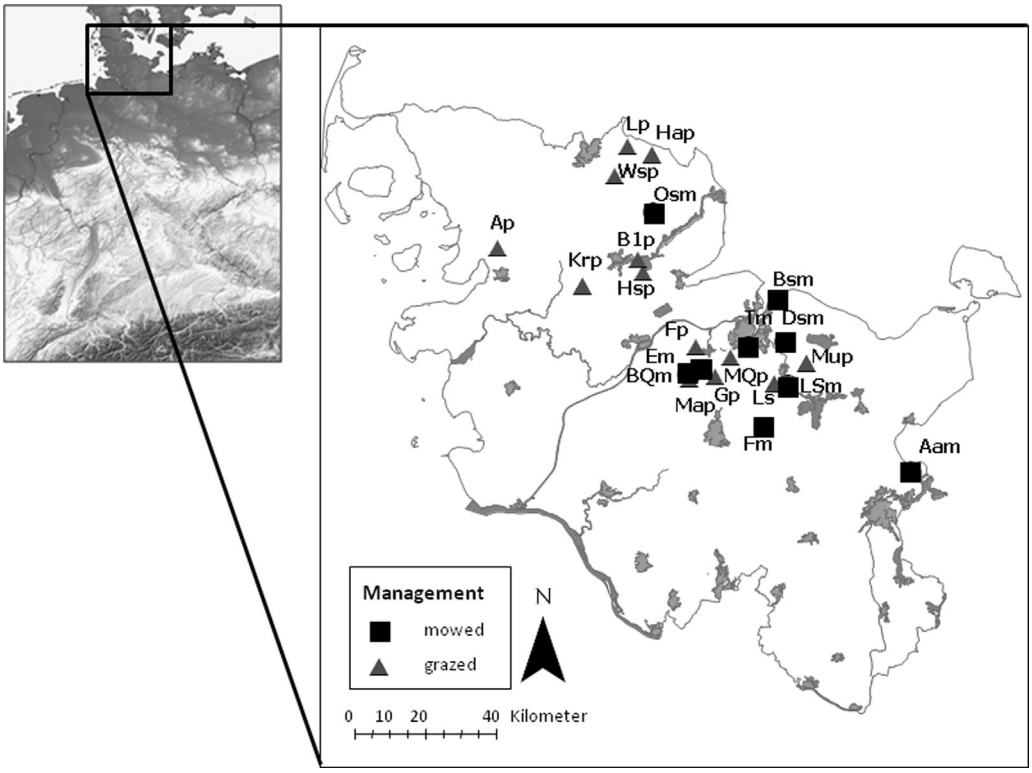

Fig. 1. Studied alkaline fens in Schleswig-Holstein (Northern Germany). (Triangles: grazed sites; quadrates: mowed sites. Aam, Aalbeck; Ap, Arlauniederung; BQm, Blocksdorfer Quellhang; B1p, Burg; Bsm, Lake Barsbeck; Dsm, Dobersdorfer See; Em, Enkendorf; Fm, Lake Fuhlensee; Fp, Felde; Gp, Grevenkrug; Hap, Habernisser Au; Hsp, Lake Holm; Krp, Klein Rheide; Lsm, Lehmkuhlener Stauung; Lsp, Lake Lanker; Map, Manhagen; MQp, Meimersdorfer Quellhang; Mup, Mucheln; Osm, Os at Süderbrarup; Tm, Tröndelsee; Wsp, Winderatter See.)

mowing is the favored method because it assures regular nutrient output. The consequent low phytomass production is an essential precondition for the survival of light-demanding, low-growing fen species (Kotowski et al. 2006; Kotowski & Van Diggelen 2004; Schrautzer & Jensen 2006). Management of fen grasslands through grazing, in contrast has been controversial until now, due to contradictory results concerning the effects on plant diversity. Thus, Stammel (2003) observed lower species richness in grazed alkaline fens. Schaich and Barthelmes (2012), on the other hand, detected higher species richness in grazed fen grasslands of a rewetted Luxembourgian river valley. Voß (2001), also, has documented higher species richness in moderately grazed fen grasslands than in mowed fen grasslands and explained this result with the small-scale development of distinct ecological niches for plants. Detailed and generalizable knowledge concerning effects of grazing on plant diversity of fen grasslands, however, remains scarce. In this study we investigated in Schleswig-Holstein, the northernmost state of Germany, all alkaline fens which have been detected within the scope of the European Habitat Directive (FFH-type 7230). Moreover, we completed the dataset with habitat knowledge from local experts. Approximately one half of these fen areas was grazed and the other half was mowed. In some areas, managers strived to establish higher stocking densities necessary for complete removal of above-ground phytomass of the alkaline fen. In such cases, overgrazing of the surrounding, more productive grasslands was accepted in order to fulfill the management requirements of the target fen system. Other alkaline fens are located in larger pastures where development toward a landscape consisting of a mosaic of successional stages is aspired to ("semi-open pasture", Finck et al. 2001; Irmler et al. 2010; Rosenthal et al. 2012; Schaich et al. 2010). Based upon results of vegetation relevés in these areas and surveys of adjacent environments, we answer the following questions:

a. What is the status quo of preservation the alkaline fens of Schleswig-Holstein are currently in?
b. Do grazed and mowed alkaline fens differ in terms of species richness and species composition?
c. Do different plot sizes affect species richness and species composition?
d. Is grazing a recommendable alternative to mowing in order to conserve species-rich alkaline fens? If so, what grazing strategy should be favored?
e. Which management options can be recommended to improve conditions for alkaline fens?

Methods and Material

Study sites

Vegetation and management were investigated on 22 alkaline fens in Schleswig-Holstein (Fig. 1, Table 1). Geographical range of the study region is between 9°05′–10°49′ E and 54°49′–53°59′ N. Climate in this region is oceanic with moderate temperatures during the year. Most of the fen areas are located in the eastern uplands of Schleswig-Holstein and all are fed by base-rich groundwater.

Environmental site conditions were estimated by the Ellenberg-Indicator-Values (Ellenberg et al. 1992). There were no significant differences between the two management treatments concerning the Ellenberg-Indicator-Values for moisture, light, nutrients and reaction (Mann–Whitney-*U*-test: $p > 0.05$, Table 2). All sites exhibited a high proportion of species with high moisture values and a high proportion of light demanding species (Table 2). According to previous investigations of Schrautzer (2004), the extant alkaline fens of Schleswig-Holstein belong to the water class 2 (mean yearly ground water tables between −12 and −2 cm below soil surface).