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Grazing with Galloway cattle for floodplain restoration in the Syr Valley, Luxembourg

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ABSTRACT

Three years after a river restoration scheme in the Syr Valley (Luxembourg) we investigated habitat development and habitat use of Galloway cattle deployed in a low-intensity grazing system on a permanent floodplain pasture. Habitats were delimited with a mobile GPS/GIS mapping system and their spatial development was assessed over three consecutive years. During these three years, the patches of the six habitats decreased to 40% of mean initial size, and a rapid net area expansion of wetland habitats (large sedge swamps: +100%, marsh and tall forb grasslands: +43%) was observed. The behavioural patterns and grazing preferences of the cattle were observed directly during the vegetation period in June, August and November. These observations were complemented by a transect analysis of cattle impact indicators in June and November. The cattle grazed the different habitats very selectively, as they preferred the mesophilic, and ruderal grasslands 1.6, and 5.6 times more than expected respectively. During the growing season, the grazing niche breadth declined (3.92 in June to 2.68 in November), and less preferred forage habitats like large sedge swamps were grazed primarily in the autumn. We used bite and step rates to investigate grazing intensity by habitat type. During summer, grazing intensity correlated with forage quality in the different habitat patches, whereas in autumn it was obviously influenced by the effort required to access the desired forage plants in a given habitat. The impact indicators revealed a matter transfer from riparian areas to the valley edge. Here, we give a first insight into habitat development and habitat use of Galloway cattle in a recently restored floodplain area and derive recommendations for the adaptive management of future projects.

Introduction

The development of European agricultural landscapes during the 20th century – with the intensification of agriculture on fertile sites and the concurrent abandonment of traditional practices in marginal areas – led to a rapid decline in semi-natural grassland ecosystems (Pykälä, 2000). Areas of floodplain grasslands and wetlands in Europe especially have been reduced dramatically as a consequence of river canalisation, drainage measures and land use intensification (Paul & Meyer, 2001; Ward et al., 1999). Natural and semi-natural floodplain ecosystems are characterised by high biodiversity, and are of recreational and aesthetic value (Middleton, 1999; Tockner & Stanford, 2002). Consequently, attention is increasingly being given to conservation and restoration of such floodplains in national and European landscape protection policies and research (Isselstein et al., 2005; Joyce & Wade, 1998).

In Europe, grazing is frequently used in the management of grasslands, mainly as a tool to hinder forest encroachment and preserve and enhance biodiversity (Bakker, 1998; Pykälä, 2004; Sutherland, 2002). The potential of such management schemes to restore different habitats has been discussed for mesic grasslands (Pykälä, 2003), subalpine grasslands (Jewell et al., 2005) and inland sand ecosystems (Stroh et al., 2002; Suess, 2005). In contrast, there has been little research into the use of low-intensity grazing to restore degenerated floodplain grasslands. Since low-intensity grazing, in particular, can mimic the impact of wild megaherbivores and represents a cost-efficient management option, this strategy is also recommended for re-establishing spatial and temporal dynamics in wetland ecosystems (Gander et al., 2003; Wallis de Vries, 1995).

The effects of free-ranging livestock on ecosystem characteristics are expected to be far more complex and dynamic than other landscape management tools, e.g., mowing. Habitat selection by, and the diets of, domestic livestock are determined by environmental factors such as forage quality (Bailey et al., 1996), plant community structure (Distel et al., 1995), topography (Ganskopp et al., 2000; Gómez-Sal et al., 1992), water supply, mineral sources, and fences and buildings (Ganskopp, 2001). At the same time, animal-related factors like type and breed (Rook, Dumont, et al., 2004), familiarity with the grazing area

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(Ganskopp & Cruz, 1999) and individual preferences (Laca et al., 2001) influence livestock grazing patterns. Given the wide variety of wetland types on the one hand, and the many types and breeds of domestic livestock on the other hand, only limited knowledge is available about the behavioural patterns of the different types of livestock and their effects on wetland habitats. Consequently, quantitative data for the establishment of guidelines for appropriate grazing management are lacking in many regions (Gander et al., 2003; Menard et al., 2002; Rook, Dumont, et al., 2004).

We aimed to quantitatively assess the development of habitat types and patterns of habitat use by Galloway cattle on a floodplain pasture in the Syr Valley (Luxembourg) after rewetting. For the low-intensity, year-round grazing regime planned, Galloway cattle were selected because they endure cold weather conditions, are light in weight and able to graze fibre-rich forage. We hypothesised that cattle would use all habitats on the restored floodplain. To assess the potential of low-intensity grazing to restore the floodplain, and to derive recommendations for adaptive management for conservation, we investigated cattle behaviour in this restoration programme from the outset. The following research questions were addressed in the study:

- Do Galloway cattle use the mosaic of habitat types initiated by the river restoration selectively?
- Do cattle also reveal specific foraging behaviour and preferences in the different habitats?
- Is cattle grazing associated with a matter transfer across the floodplain?

Methods

Study site

The vegetation development study was conducted in a 20 ha floodplain pasture in the upper part of the Syr Valley in south-eastern Luxembourg between 2004 and 2006, and the grazing behaviour and its impact monitored over several months in 2006. The site is located within the boundaries of the municipalities Betzdorf, Niederanven and Schuttrange (49°38′N, 6°17′E) and extends 2 km along the Syr River. The upper Syr Valley geomorphology is characterised by softly undulating downs, with slopes of 0-10°, and wide open valley bottoms. The climate of the region is temperate; western European-type with mild, rainy winters and warm, humid summers. The area receives rainfall of between 700-750 mm annually and the annual temperature averages between 9-9.5 °C (Administration des Eaux et Forêts, 1995). The floodplain soil is a 4-5 m thick loamy gley on alluvial and keuper formations. The mean discharge from the Syr River in September 1999 was 305 l s^{-1}.

Due to the occurrence of wetland, and meadow breeding birds, the study area has been declared part of the EU NATURA 2000 network. Formerly, the drained floodplain was used for hay cutting twice a year. Consequently, open mesic grasslands with little structural diversity dominated the floodplain before restoration measures were implemented. In winter 2003, the Syr River was restored by redirecting it from a channel at the valley edge into a partly modelled river bed in the valley bottom. In August 2004, a low-intensity, year-round grazing system with Galloway cattle was introduced on the rewetted floodplain meadows.

Grazing management

The experimental herd, which consisted of Galloway cows, bulls and their offspring, was managed in a year-round grazing system. Galloway cattle for this trial stem from rotational pastures (1-3 ha sizes) of a nearby low mountain range in Germany. There they grazed wet grasslands, sedge swamp and reed habitats in the valley bottoms as well as mesic and dry grasslands at the hillsides before they came to the Syr valley. The number of cattle on the Syr pasture was managed to permit selective grazing and to ensure adequate forage to maintain the physiological condition of the cattle throughout the study period. Permanent barbwire fencing kept cattle in the 20 ha area. The River Syr supplied water. To ensure the health of the animals, a shelter was established on the pasture. During the observation period, which spanned June to November 2006, a stocking density of 1.0 livestock units ha^{-1}, comprising breeding or lactating cows, eight heifers, one adult bull, and two young bulls, was maintained on the study site. No supplementary forage was given during the study period.

Botanical composition of the pasture

We surveyed the habitat development of the study site over three consecutive years from 2004 to 2006. Vegetation types were classified and vegetation patches distinguished, first according to the dominant plant species ($>$25% of total vegetation cover) and then on the basis of physiognomic vegetation parameters and site characteristics (Bonham, 1989). The vegetation patches were delimited as GIS polygons in the field using a GPS/GIS professional data mapper. Position data were corrected differentially using the satellite-based European Geostationary Navigation Overlay Service (EGNOS), thereby minimising the potential spatial error to $<$3 m. To evaluate habitat selection by Galloway cattle at an scale appropriate for animals of this size, we pooled physiognomically similar vegetation types into habitat types (Duncan, 1983). We identified six vegetated habitat types (Table 1).

Direct observation of cattle behaviour

A focal animal sampling design based on Altmann (1974) was chosen for the direct observation of cattle activities. This approach allowed multiple data (animal location, feeding behaviour, forage plant selection) to be collected simultaneously with a large number of replications to provide a statistically apt representation of the whole herd. Intensive daytime observations were carried out on six focal animals within the herd, marked with coloured collars. Lactating or pregnant cows (high energy demand) over two years of age (grazing experience on Syr floodplain pasture) were selected as focal animals (Bailey et al., 1996; Blanchard, 2005). Prior to data collection, a four day period served to familiarise the herd with the observer. Afterwards, one focal animal was observed per day over a period of six hours. We monitored the animals for 48 days in total over three periods in the grazing season; 12 days in June, 24 days in August and 12 days in November. Due to diminishing daylight hours in the autumn, we observed the animals for 18 days in the morning, 19 days in the afternoon and 11 days in the evening. The focal animal observed was chosen randomly before beginning each observation session.

The behaviour of the focal animal was recorded at 10-minute intervals to avoid auto-correlation effects, as the animal could potentially reach any position on the pasture within this interval. At each recording we noted the habitat type occupied by cattle, the exact position using a hand-held GPS and the main activity according to one of three categories: (a) grazing; (b) resting; and, (c) other such as moving, social behaviour, drinking or defecating. If the focal animal was grazing, forage was specified at the plant functional group level and, in a 3-minute period, a bite and step