Biological Conservation 191 (2015) 1–9

Contents lists available at ScienceDirect

Biological Conservation

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

Governing nature by numbers — EU subsidy regulations do not capture the unique values of woody pastures

Simon Jakobsson *, Regina Lindborg

Biogeography and Geomatics, Department of Physical Geography, Stockholm University, 106 91Stockholm, Sweden

ARTICLE INFO

Article history:
Received 24 February 2015
Received in revised form 25 May 2015
Accepted 4 June 2015
Available online xxxx

Keywords:
CAP
Diversity
European Union
Plant
Tree density

ABSTRACT

A vast majority of European farmers are dependent on EU subsidies, which makes subsidy regulations through the Common Agricultural Policy (CAP) powerful tools in shaping agricultural landscapes. Unfortunately, steering recommendations are sometimes arbitrary, like in the case of pasture management, where 50 trees per hectare constitute an upper limit to qualify for subsidies. Although pasture biodiversity is well studied and the core of many CAP conservation programmes, it is seldom studied as direct effects of subsidy systems. In this paper, we examine plant diversity in relation to the impact of subsidy systems in Swedish woody pastures along a gradient from 3 to 214 trees per hectare. We selected 64 sites where we recorded vascular plants, soil properties and canopy cover. We found a general increase in γ- and β-diversity along the gradient, whereas α-diversity and the number of grassland specialists remained indifferent along the gradient. Additionally, tree density, organic content and C:N-ratio were the strongest predictors of species composition. Hence, when CAP regulations encourage tree cutting for pastures to qualify for subsidies there is risk of homogenisation of EU grasslands, leading to decreased γ- and β-diversity. If a general target for the subsidies is to increase biodiversity, there is need to scrutinise these regulation details to preserve the high values of woody pastures. We argue that habitat variation, species diversity and low intensity management, rather than a specific number of trees, should be the main incentives for financial support to preserve biodiversity.

1. Introduction

Biodiversity is threatened worldwide by agricultural intensification and therefore policy regulation is often crucial to mitigate biodiversity decline (Rands et al., 2010; Tilman et al., 2001). Within the European Union (EU), almost 40% of the total budget goes to agricultural support through the EU's Common Agricultural Policy (CAP) (European Commission, 2013) and farmers throughout Europe are highly dependent on these subsidies at both the European and national level (European Commission, 2012). Hence, subsidy regulations may constitute a powerful tool in structuring agricultural landscapes and preserve biodiversity across Europe. Although recent CAP reforms aim for a greener, more environmentally friendly agriculture (European Commission, 2013), the ongoing homogenisation of agricultural systems to increase production still threatens valuable habitats (Beaufoy et al., 2011; Miklín and Čížek, 2014). Some regulations may therefore counteract biodiversity conservation if they are not implemented appropriately.

Woody pastures are habitats within the agricultural landscape that are well known for their high biological values, especially the high species richness at small spatial scales (Babai and Molnár, 2013; Bergmeier et al., 2010; Hartel et al., 2013; Lindborg et al., 2008). Their high biological value is a legacy from long continuous low intensity management with historical importance for humans all over Europe (Albery, 2011; Hartel and Plieninger, 2014; Holl and Smith, 2002; Moreno et al., 2012; Sjögren, 2006). Woody pastures are key to wildlife preservation (Dicks et al., 2014) as many species can co-exist in these heterogeneous environments. Definitions and characteristics of woody pastures vary among countries in Europe, ranging from relatively open pastures with scattered trees in Romania to boreonemoral grazed woodlands in Sweden (Bergmeier et al., 2010). As woody pastures with more than 10% tree cover also fit into the EU's forest definition, these systems often face problems with proper governance (La Cañada, 2010; Monbiot, 2014) as they are trapped in a dichotomy between agriculture and forestry.

As consequence of this dichotomy, the prevailing CAP has restricted the number of trees to 50 trees per hectare on pastures to qualify for financial support from the EU (Beaufoy et al., 2011). This regulation aims at preserving pasture biodiversity by encouraging farmers to keep their pastures as open as possible. Thus, the tree limit has resulted in a reduction in the number of trees and shrubs to ensure subsidy allowance, or abandonment of non-beneficial (in terms of EU subsidies) woody

Abbreviations: CAP, Common Agricultural Policy; EIV-L, Ellenberg Indicator Value for Light; EIV-N, Ellenberg Indicator Value for Nitrogen; NE, not eligible; SBA, Swedish Board of Agriculture.

* Corresponding author. Tel.: +46 707496620.
E-mail addresses: simon.jakobsson@natgeo.su.se (S. Jakobsson), regina.lindborg@natgeo.su.se (R. Lindborg).

http://dx.doi.org/10.1016/j.biocon.2015.06.007
0006-3207/

pastures (Hartel and Plieninger, 2014). This has resulted in management effects where a grazed ex-field that has been grazed for only five years, with low or no biological value, qualifies for EU financial support (King, 2010), whereas a traditional woody pasture with 55 trees/ha does not. National adaptations do occur where for example Sweden has a limit of 60 trees/ha, or 100 trees/ha if the woody pasture is defined a highly valuable by the County Administration (Beaufoy et al., 2011).

Although the subsidy system could appear arbitrary, it is partly funded in basic ecological theory. Higher tree densities imply reduced light availability and changed soil properties (Abdallah and Chaieb, 2012; Häkkinen et al., 2010). Increased competition for light reduces plant species diversity (Newman, 1973), and changed soil characteristics alter nutrient competition prerequisites (Raynaud and Leadley, 2004). For most situations, an increase in nitrogen reduces plant diversity through competitive exclusion of more stress tolerant species (Grime, 2006; Hardin, 1960; Huston, 1979) and species richness shows a unimodal response to pH (Watkinson et al., 2001). Thus, tree density, light availability and soil properties are important drivers of plant diversity and plant community composition of woody pastures (Aavik et al., 2008; Dorrough et al., 2006; Gillet et al., 1999; Söderström et al., 2001).

Although a large numbers of studies have examined biodiversity in semi-natural grasslands and woody pastures, surprisingly little is known about how woody pasture tree density, more specifically, affects plant species diversity and composition. Effects of tree removal or abandonment on biodiversity have been documented (e.g. Dahlström et al., 2010; Debussche, 2001; Halpern et al., 2012; Pykälä et al., 2005) but few studies have studied effects of present tree density on biodiversity and species composition. Those that have, have found diverging results (e.g. Aavik et al., 2008; Dorrough et al., 2006; Gillet et al., 1999; Söderström et al., 2001), and there is no evidence of an optimum tree density of woody pastures for plant diversity. To our knowledge, no study has specifically targeted the tree limit regulation to investigate the relationship between biodiversity and amount of trees. To inform evidence based policymaking the tree limit regulation needs to be evaluated to successfully preserve biodiversity in highly valuable habitats, such as woody pastures. In this study, we target the CAP tree limit regulation directly to answer the questions: 1) How are vascular plant communities in woody pastures affected by tree density along a gradient from almost open to dense pastures? and 2) Which proportions of plant diversity and which species could we gain and lose, respectively, if governing woody pasture management by certain tree limit regulations? We estimate small-scale (α) diversity, species spatial turnover (β), large-scale (γ) diversity (total number of species per pasture) and species composition within woody pastures. In addition to tree density, we also examine effects of the co-varying factors: stand structure and diversity, canopy cover and soil conditions.

2. Method

2.1. Study area

Our study area (Fig. 1; Jakobsson and Lindborg, 2014) constitutes the major part of the UNESCO biosphere reserve *East Vättern Scarp Landscape*, situated in the boreonemoral zone of southern Sweden. It stretches about 60 km from north (64° 52′ 80″ N) to south (63° 92′ 20″ N) and covers approximately 70 000 ha. The hilly mosaic landscapes

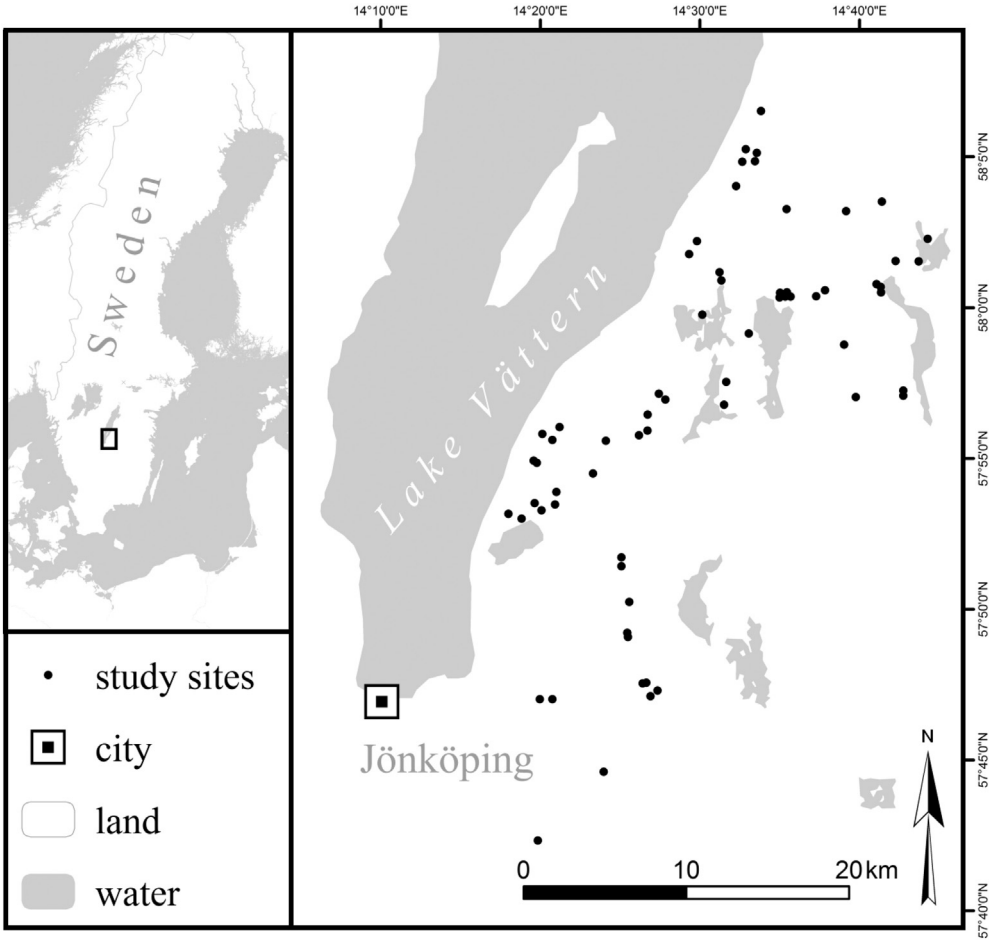

Fig. 1. Location of the study sites, within the biosphere reserve *East Vättern Scarp Landscape* in southern Sweden.