Agriculture, Ecosystems and Environment 260 (2018) 1–10

Contents lists available at ScienceDirect

Agriculture, Ecosystems and Environment

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

Assessment of woodland grazing in southwest wisconsin

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ARTICLE INFO

Keywords:
Woodland grazing
Vegetation indicators
Silvopasture

ABSTRACT

Grazing of farm woodlots in the upper Midwest is generally thought to degrade timber value and damage soil health. Nonetheless, Wisconsin property tax law creates an incentive for this practice. Therefore, this project sought to determine the effects of cattle grazing on vegetation and soil conditions in woodlands under different grazing management. We compared eleven grazed woodlots under various livestock management regimes with five woodlots that have not been grazed for at least 30 years in the Kickapoo Watershed in Crawford County, WI. We conducted vegetation surveys in all the woodlands and measured soil properties in a subset. We talked to farmers about their cattle management practices and beliefs about farm woodlots. Grazed woodlands had higher frequencies of introduced shrubs, less litter depth, fewer seedlings and saplings, more grass cover, and higher soil bulk density compared with un-grazed woodlands. Grazing negatively impacted regeneration and condition of seedlings, saplings, and saplings of commercial value. In grazed woods, we noted a relation between the cattle stocking rate and edaphic variables including amount of bare soil, litter depth, and canopy cover, and a difference between dairy and beef cattle in shrub density. We validated a set of simple indicators and metrics for on-going comparison of grazed and un-grazed farm woodlots in this area. Introduced shrub species was the clearest indicator of change, followed by litter depth, regeneration status of trees, and soil bulk density. The study points to potential opportunities for silvopasture techniques that could mitigate vegetation and soil degradation such as careful management of livestock stocking rate and timing of grazing.

1. Introduction

Grazing by domestic livestock in forested ecosystems is common throughout the world. While this practice can provide food for livestock and can moderate extreme temperatures experienced by cattle, it can also produce negative effects. These include detrimental changes in species composition (Pettit et al., 1995), changes in the physical, chemical, and biological characteristics of an ecosystem, and changes in the plant community structure (Allen-Diaz and Jackson, 2005). With a long history of grazing and improper management, important impacts can be observed, such as changes in herbaceous cover and fire frequency (Adamoli et al., 1990), increased growth of exotic shrubs (Adamoli et al., 1990; Fleischner, 1994), greater areas of exposed bare soil (Alados et al., 2004), and decreased species richness (Fleischner, 1994, Alados et al., 2004). Grazing has a negative impact on tree regeneration, either by trampling or by browsing of seedlings and saplings (Dufour-Dror, 2007). In native plant communities, the changes in cover and composition created by grazing can promote the growth of undesirable plants (e.g., invasive and/or non-native annuals and shrubs) and inhibit the growth of others species (Fleischner, 1994). Effects on soil conditions also change with livestock grazing, such as compaction, which tends to increase in grazed areas (Allen-Diaz and Jackson, 2005).

Grazing can sometimes increase species richness in an ecosystem, as it can promote the growth of introduced species. A literature review by Proulx and Mazumder (1998) indicated that species richness under grazing pressure varies depending on the nutrient status of the ecosystem. For terrestrial nutrient-poor ecosystems, species richness was lower under high grazing intensity compared with low grazing intensity. However, nutrient-rich ecosystems had greater species richness with increased grazing intensity. An equilibrium might be reached depending on site conditions, described with an “intermediate disturbance” hypothesis that states that species would accumulate without becoming dominant if intermediate levels of disturbance occur, increasing biodiversity (Sousa, 1984). Grazing can promote the growth of understory species that cannot develop under shade by opening the tree canopy and clearing the understory, increasing light availability (Putman, 1996). Other mechanisms produced by grazing can stimulate the growth of new species (McEvoy et al., 2006): (1) eliminating dominant species by trampling or grazing; (2) introducing seeds from

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https://doi.org/10.1016/j.agee.2018.03.012
Received 14 November 2017; Received in revised form 9 February 2018; Accepted 19 March 2018

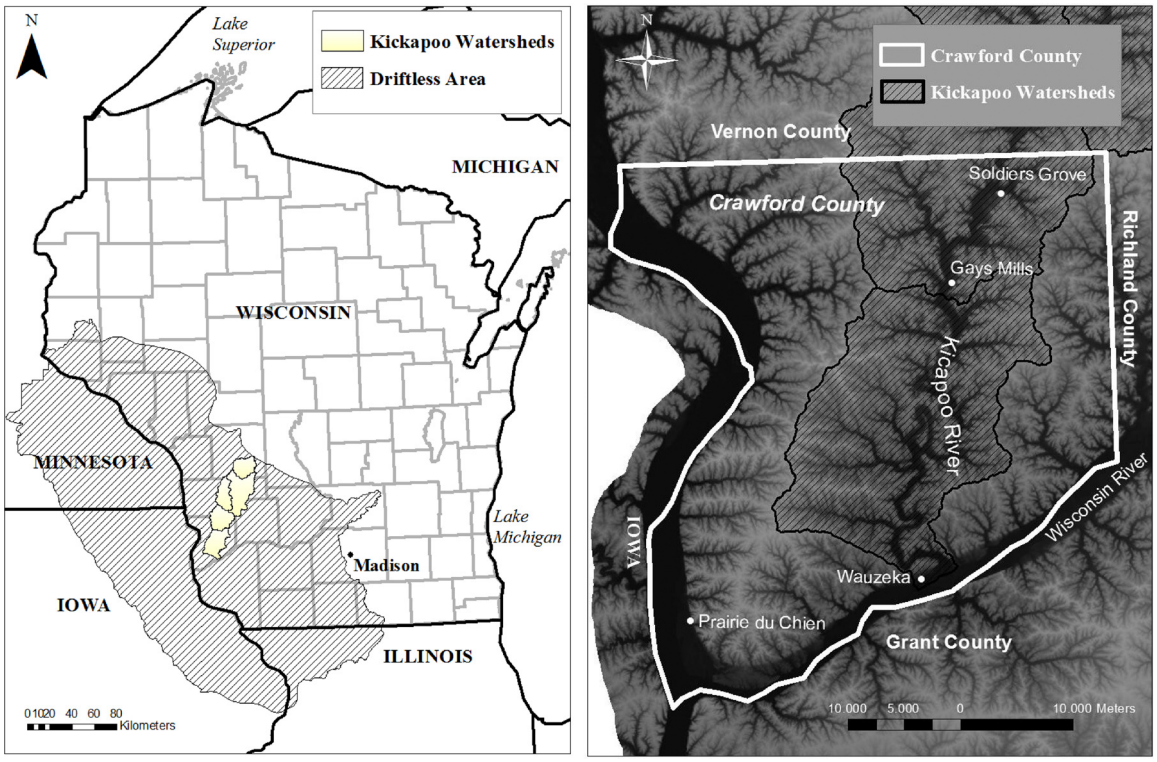

Fig. 1. Study Area in the Kickapoo Valley, Crawford County, WI.

the bodies of the animals or in their manure; (3) exposing bare soil by removing the herbaceous layer, creating good conditions for the growth of new species; (4) activating dormant seeds in the soil with trampling.

Increasing species richness by grazing is not necessarily beneficial to the ecosystem. Species richness as a sole indicator of the effect of grazing does not represent an accurate ecological indicator, as it does not differentiate species that could be common species with broad distribution and/or could be problems for conservation or restoration efforts (Leach et al., 1999). The information revealed by species richness should be further analyzed to determine growth forms, whether species are native, their potential to invade or dominate ecosystems, and to assess their conservation status.

Our research purpose was to evaluate grazing impacts on farm woodlots in the Kickapoo Valley (Crawford County, Wisconsin, U.S.). The Kickapoo Valley is located in the "Driftless Area," an area unaffected by the recent glaciation, where the dominant landform is ridges and valleys (Fig. 1). Flatter areas on the ridges and valley bottoms are used for row crops, while steeper hillsides are a mixture of open pastures and woodlands.

This and concurrent studies at the University of Wisconsin-Madison intend to identify management techniques that result in high quality pastured woodlots, defined as a private grazed woodland with intensive management that can sustain livestock production without ecologically significant degradation of vegetation and soil. This study provides base knowledge about the relation between degradation and grazing, including stocking density and cattle type. Using the agroforestry technique known as silvopasturing – actively managed pastured woodlands and associated practices – our long term goal is to show that proper management can improve both profitability and ecosystem services. Economic benefits from silvopasture are livestock fodder, timber, and other non-timber woodlands products (Garrett et al., 2004; Sulc and Franzluebbers, 2014). Such systems also sustain wildlife, maintain an herbaceous layer that protects soils from degradation, improve carbon sequestration and water quality, and conserve biodiversity. Silvopasture has the potential to simultaneously meet livestock production and woodland conservation goals.

A secondary goal of this research was to determine simple and reliable indicators such as presence of invasive species and soil surface characteristics that could be used more broadly to evaluate the impacts of grazing on farm woodlots. As described below, an extensive study made by Cawley (1960) of grazing impacts in this area was our starting point for study site criteria and the selection of indicators; Smith et al. (2008) and Kneeshaw et al. (2000) further informed our selections.

A century of professional recommendation and policy against grazing in woodlands has failed to eliminate the practice; it remains common due to countervailing incentives and perspectives. In the beginning of the 20th century, Tillotson (1916) identified grazing as the main factor in the degradation of woodlots in the U.S. Midwest. In those times, agricultural woodlots were not considered as highly valuable land for forestry. For this reason, forested ecosystems tended to be used for the production of livestock, which brought significant degradation of the woodlands. More than 60 years ago, Abbott (1954) specifically called for campaigns to reduce woodland grazing and accelerate restoration efforts. Since then, foresters have identified the importance of woodlands for forestry and water quality, and management recommendations and state policies have been made to improve their conditions. For example, state programs such as the Woodland Tax Law and Managed Forest Law require landowner conservation practices in woodlots to receive property tax reductions (Wisconsin Department of Natural Resources, 2017). Both programs prohibit livestock grazing in woodlands. Unfortunately, since the late 1990s, Wisconsin property tax law creates a financial motivation for grazing livestock in farm woodlots. *Agricultural use value assessment* bases property tax rates on the expected revenue from agricultural land use, instead of charging taxes according to the market land value (Wisconsin Department of Revenue, 2016). This reduces taxes paid by farmers that graze their wooded land ten to thirty times compared to land classified as productive forest (not in state programs) or residential. Besides this incentive to fence and graze woodlands, farmers in the Kickapoo Valley also perceive benefits of woodlot access to livestock (Mayerfeld et al., 2016). On this basis, this study was done with the assumption that farmers will continue to graze livestock on their farm woodlots.