Evaluation of Landscape-Level Grazing Capacity for Domestic Sheep in Alpine Rangelands

Author(s): Atle Mysterud , Yngve Rekdal , Leif Egil Loe , Michael Angeloff , Ragnhild Mobæk , Øystein Holand , and Geir-Harald Strand

Source: Rangeland Ecology & Management, 67(2):132-144. 2014.
Published By: Society for Range Management
DOI: http://dx.doi.org/10.2111/REM-D-12-00177.1
URL: http://www.bioone.org/doi/full/10.2111/REM-D-12-00177.1

Rangeland Ecol Manage 67:132–144 | March 2014 | DOI: 10.2111/REM-D-12-00177.1

Evaluation of Landscape-Level Grazing Capacity for Domestic Sheep in Alpine Rangelands

Atle Mysterud,[1] Yngve Rekdal,[2] Leif Egil Loe,[3] Michael Angeloff,[4] Ragnhild Mobæk,[5] Øystein Holand,[6] and Geir-Harald Strand[7]

Authors are [1]Professor of Terrestrial Ecology, Centre for Ecological and Evolutionary Synthesis (CEES), Department of Biosciences, University of Oslo, Oslo, Norway; [2,4]Senior Researchers and [7]Division Director of Grazing Research and Mapping, Norwegian Forest and Landscape Institute, Ås, Norway; [3]Professor, Department of Ecology and Natural Resource Management, Norwegian University of Life Science, Ås, Norway; [5]Doctoral Student and [6]Professor of Animal Husbandry, Department of Animal and Aquacultural Sciences, Norwegian University of Life Sciences, Ås, Norway.

Abstract

Balancing the number of grazing animals with the level of plant resources is a core issue in grazing management. Complete, full-coverage vegetation surveys are often used for this purpose, but these are expensive undertakings. We have presented a method to downscale information from regional sampling surveys by poststratification using a land cover map derived from satellite-based measures of reflectance values. This approach opens new prospects for landscape-level evaluation of productivity. We applied this method to eight grazing districts (19–245 km^2) in Setesdal Vesthei, Norway, in 2006. Sheep densities in three of eight grazing districts of Setesdal Vesthei fluctuated above the estimated grazing capacity. We fitted 43 sheep with Global Positioning System collars in two contrasting grazing districts in 2007–2008 to assess their selection of the land cover productivity classes in the map used for poststratification. In the area with high vegetation coverage, sheep selection increased in areas with an overall higher productivity, supporting the main basis of the approach. However, in the grazing districts with lower vegetation coverage, selection was higher for areas of overall low vegetation productivity. The likely explanation is the presence of small areas of snow bed vegetation with high-quality forage in areas with a generally rocky surface. Our study provides a first step toward a grazing capacity evaluation to achieve a sustainable management of sheep on alpine ranges of Scandinavia, and our approach is likely applicable to other open alpine ranges in the northern hemisphere.

Key Words: Global Positioning System, habitat selection, land cover, poststratification, resource selection functions, rangeland management

INTRODUCTION

The management of rangeland ecosystems for grazing is complex and challenging (Bestelmeyer and Briske 2012). Grazing by domestic animals is one of the largest anthropogenic influences on ecosystems worldwide. Due to economic drivers, domestic herbivores are often stocked at higher densities than their wild ancestors (Oesterheld et al. 1992). Heavy grazing on unstable soil or arid ecosystems may lead to erosion and reaching a lower productive state of the ecosystem (van de Koppel et al. 1999; van de Koppel and Rietkerk 2000; Chartier and Rostagno 2006). In less extreme cases, selective grazing may involve a shift in the competitive balance with an invasion of grazing-resistant plants (Holechek et al. 1999; Mysterud 2006). Examples of the latter are an invasion of *Nardus stricta* on some ranges with sheep grazing (Grant et al. 1996; Austrheim et al. 2007). Both continuous changes and thresholds can operate within the same ecosystem (see discussions in Briske et al. 2003, 2005, 2006; Steele et al. 2012). A recurrent theme in management is therefore how to optimize herbivore densities while avoiding degrading the habitat (Brekke et al. 2007; Ibanez et al. 2007; Skonhoft et al. 2010). There are a number of approaches to determine sustainable levels of grazing or browsing, either based on observations of animal performance or on indices of plant productivity (e.g., Holechek and Peiper 1992; Mysterud 2006). For domestic herbivores, it has been more common to use direct measures of plant production (Scanlan et al. 1994; Holechek et al. 1999).

Landscape-level evaluation of sustainability is made particularly difficult for livestock using extensive open alpine ranges. Factors affecting animal production in rangelands may differ markedly from those of improved pastures (Ash and Stafford Smith 1996). Domestic sheep (*Ovis aries*) have the ability to utilize grass forage resources in low-productivity landscapes, and sheep husbandry is a cornerstone of the economy in many marginal agricultural areas worldwide (Pasha 1991; Bertaglia et al. 2007; Degen 2007; Austrheim et al. 2008). Overgrazing by sheep in the North Atlantic region has caused collapses of human societies in historical times (Thomson et al. 2005). There have been some attempts to estimate appropriate sheep grazing levels (Holechek and Peiper 1992; Armstrong et al. 1997a, 1997b; Kawamura et al. 2005), but none of these are from alpine ranges in Scandinavia. The plant community in northern alpine areas form fairly distinct vegetation types (Rekdal and Larsson 2005). There is considerable experience in linking vegetation maps to grazing capacity for sheep at small spatial scales. Full-coverage vegetation mapping is, however,

Research was funded by the Research Council of Norway (Project 183268/S30).

Correspondence: Prof Atle Mysterud, Centre for Ecological and Evolutionary Synthesis (CEES), Dept of Biosciences, University of Oslo, PO Box 1066 Blindern, NO-0316 Oslo, Norway. Email: atle.mysterud@ibv.uio.no

Manuscript received 3 December 2012; manuscript accepted 25 November 2013.