A management-based typology for European permanent grasslands

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Abstract

European permanent grasslands (PG) vary widely in their delivery of agricultural outputs and other ecosystem services and hence in their challenges and opportunities for sustainable grassland management. To facilitate communication and knowledge transfer, improve inventories, ease mapping and provide a framework for future data collection across the whole range of European PG, we have developed a two-level grassland typology that focuses on PG management (defoliation, fertilisation, renewal) and its determinants (productivity potential, presence of woody plants, additional site attributes affecting management). The typology consists of eight first-level and 18 subordinate second-level classes, based on management intensity, productivity potential, presence of woody plants and grassland renewal intervals. It is applicable both at field and regional scales and is cross-referenced with existing classification schemes such as the EUNIS and Natura 2000 habitats classes. We present the typology and its main classification criteria, and discuss options for its future implementation.

Keywords: management intensity, permanent grassland, typology

Introduction

The great diversity of permanent grasslands (PG) across Europe can be an obstacle for effective knowledge transfer and policy making. Identifying types of PG across countries that are similar in terms of ecosystem delivery, challenges and opportunities for sustainable management would greatly enhance communication between stakeholders and provide more meaningful inventories of European PG and their contributions to agricultural production and public goods. Recognizing this, the European Grassland Federation has proposed a classification of grassland types to be used in agricultural statistics (Peeters *et al.*, 2014). In it, PG are classified based on their management intensity into 'semi-natural' PG, 'improved' PG and PG 'no longer used for production', with semi-natural PG further subdivided into pastures and traditional hay meadows. Building on this, we propose a two-level PG typology that extends the classification to eight first-level and 18 subordinate second-level classes (Figure 1), complemented by a list of additional attributes. We here present the classification criteria used and provide an outlook on further implementation within the EU H2020 project 'Developing SUstainable PERmanent Grassland systems and policies' (SUPER-*G*).

Classification criteria

Management intensity – 'low', 'intermediate' or 'high' – forms a central criterion of the proposed typology. We quantify this based on two indicators, namely defoliation intensity and fertilisation intensity.
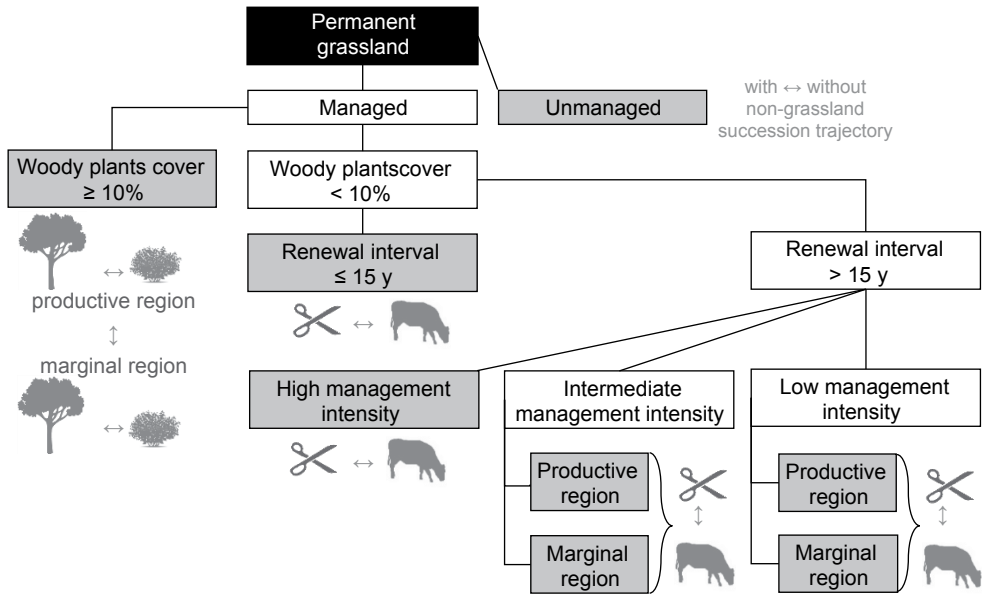
Figure 1. Overview of the proposed permanent grassland typology. First-level classes of the typology are in grey boxes, subordinate second-level classes are indicated either by text or by two different sets of symbols (tree- vs shrub-dominated; predominantly cut vs predominantly grazed).

Defoliation intensity integrates stocking rate of grazing animals (livestock-unit grazing-days per ha and year) and cutting frequency (number of mowing or mulching operations per year). Fertilisation intensity is quantified through the total agricultural nitrogen input from mineral and organic fertilisers as well as excreta of grazing animals on the site. Preliminary thresholds for each indicator have been set based on a multi-national stakeholder survey and will be further validated within the SUPER-*G* project. Management intensities for selected combinations of the indicators are shown in Figure 2.

Our concept of management intensity is input- rather than outcome-based. It does not, in itself, consider the site-specific PG productivity potential, which modifies the effect of a given management intensity and determines the maximum feasible intensity level. To take account of this important aspect, PG types result from the combination of management intensity and two classes of pedo-climatic productivity potential, called 'productive region' and 'marginal region' (Figure 1). In all these cases, subordinate second-level classes differentiate between predominantly mown and predominantly grazed PG.
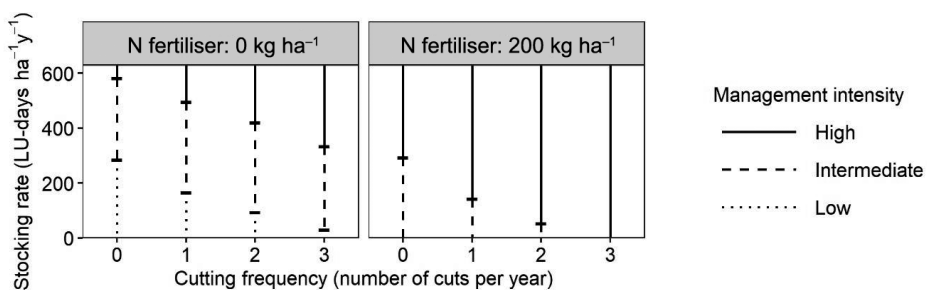

Figure 2. Illustration of management intensity classes resulting from selected combinations of cutting frequency, nitrogen fertiliser application and stocking rates of grazing animals.

As defined in the SUPER-*G* project, PG includes any land dominated by grasses or herbaceous forage that can be grazed/mown and has not been included in an arable crop rotation for five years. It thus encompasses habitats that also include shrubs or trees, grasslands that are not currently agriculturally used, and frequently renewed grasslands. Each of these three special cases forms a separate PG type (Figure 1). The first type consists of open habitats with a woody plant cover of 10% or more, as long as herbaceous plants make up 50% of the vegetation cover. This type is subdivided into four second-level classes, depending on pedo-climatic productivity potential and on predominance of either trees or shrubs among the woody plants. The second type includes PG with no management for at least three successive years. It is further differentiated into PG that will remain as grassland even without management ('natural grassland') and grassland that will enter a succession trajectory towards non-grassland unless management is resumed ('abandoned grassland'). Finally, grassland that is frequently resown after chemically or mechanically removing the existing sward, with a renewal interval of 15 years or less, forms a third type distinguishing it from older PG swards.

The PG types are complemented by further attributes that are important for management and the delivery of ecosystem services and that cut across the types. These include limitations to productivity by short vegetation period, extended summer drought or acidic soils; limitations to management by steep slopes, stony or shallow soil, and other characteristics strongly modifying ecosystem service delivery.

Implementation

The final typology will be made available as an atlas including an online classification tool that can link to PG type portraits and management options. To maximize transferability, the PG typology will be cross-referenced with the habitat types of the European Nature Information System (EUNIS, 2019). Maps of the PG types and attributes will be produced using available spatial data, especially the distribution of EUNIS habitats, and expert-based decision rules. Currently, insufficient spatial information about grassland management is the greatest obstacle for accurate mapping of PG types, but developments in remote sensing and big data analysis may alleviate this problem in the near future (Estel *et al.*, 2018). With its classes largely defined by management intensity, the typology aims to cover the full range of grassland uses in European farming systems and to provide an accessible knowledge base for conditions, challenges and opportunities linked to PG management across Europe.

Acknowledgements

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