

# European permanent grasslands mainly threatened by abandonment, heat and drought, and conversion to temporary grassland

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## Abstract

Permanent grassland (PG) covers around 60 Mha in the EU-28. Across Europe, PG exists in many contrasting managed or unmanaged environments where it contributes to feed supply, biodiversity, carbon sequestration, aesthetic value, recreation, clean water and prevention of soil loss. The delivery of these PG ecosystem services is under threat by land use change, climate change, and sub-optimal management. We carried out a survey among agronomists, ecologists, soil scientists, foresters and agri-environmental consultants to assess the threats for PG within their countries. Respondents described the main PG types and their areas, and assessed to what extent a particular PG type is threatened by intensification, land use change, climate change or nitrogen deposition. Threats were scored on a three-point scale: no, small or great. Replies were received from 34 experts in 11 countries (CH, CZ, DE, ES, HU, IT, ME, NL, PL, SE, UK). The dataset contained 83 PG types on a total area of 25 Mha. Abandonment, heat and drought stress, and conversion to temporary grassland were considered as the largest threats, concerning PG types covering 8 to 9 Mha. The second group of great threats comprised N deposition, conversion to arable land and intensification, causing a great threat on PG types covering 4 to 5 Mha.

**Keywords:** abandonment, climate, intensification, land use, N deposition, expert survey

## Introduction

Permanent grassland (PG) covers around 60 Mha in the EU-28 (EUROSTAT, 2019), representing 35% of the utilised agricultural area. Throughout Europe, PG exists across different biogeographic zones in many contrasting environments, which often but not necessarily rely on regular management. PG is key to the delivery of multiple important ecosystem services (ES). It is mainly utilised to provide feed for ruminants, but also contributes to other ES such as biodiversity, pollination, carbon sequestration, provision of clean water, erosion prevention, aesthetic value and recreation (Bengtsson *et al.*, 2019). However, PG maintenance and the delivery of its ES are under threat by different drivers such as land use change, climate change, and nitrogen (N) deposition. Even though these threats are quite universal, their occurrence and impacts are regionally specific. For example, in north-west Europe, large areas of PG have been converted into arable land to cultivate maize for animal feed or for use in biogas production

(Taube *et al.*, 2014). In southern and eastern Europe, the desiccation of grasslands due to climate change is a serious threat to PG (Griffin-Nolan *et al.*, 2019). The objective of the present paper is to assess regionally specific threats to PG across Europe. The assessment will help to raise awareness and improve PG-related decision making by policy makers and farming sector businesses.

## Materials and methods

We carried out an expert survey, among 34 agronomists, ecologists, soil scientists, foresters and agri-environmental consultants working in research and extension services, to assess the major threats affecting PG in Europe. For each country, a lead representative collected information from several respondents, describing the main country-specific PG types and their areas, and assessing to what extent a particular PG type is threatened by intensification, land use change (abandonment, conversion to temporary grassland, arable or forest), climate change (heat and drought stress) and N deposition. PG types were mainly based on habitat, management intensity and plant species composition. Threats were scored on a three-point scale: no, small or great threat. In this study, threat is interpreted quite broadly, either as the disappearance of PG and conversion into other land uses, or the negative effect on any of the ES. Replies were received from 11 countries or regions (CH, CZ, DE, ES-Andalusia, HU, IT, ME, NL, PL, SE, UK), representing the main biogeographic zones in Europe. Together these countries and regions cover nearly 25 Mha, representing 40% of PG in the EU-28 plus CH and ME. Overall, 83 PG types were assessed. On average, there were 8 different PG types described per country, ranging between 4 and 11 types. The 83 PG types belong to the following EUNIS categories: dry grasslands (E1; 34%), mesic grasslands (E2; 27%), (sub) alpine grasslands (E4; 10%) and (seasonally) wet grasslands (E3; 5%). The remainder comprised, among others, woodland fringes (E5), steppes (E6), wooded grasslands (E7) and heathland (F4).

## Results and discussion

All assessed PG types were considered to be under some kind of threat (Figure 1). In most cases, PG types were under either a single threat or a combination of two or three threats. The area of PG types that is affected by land use change increased in the order of conversion to forest, arable and temporary grassland. Conversion to forest is a great threat on PG types covering 3 Mha in CH, CZ, ME, PL and UK, mainly in extensively used hilly and mountainous areas. Conversion to arable land (5 Mha) or temporary grassland (8 Mha) is a great threat in parts of CH, CZ, DE, ES, IT, PL, SE and UK, relatively more on (semi-) intensively used lowland areas. Land use change is considered a small threat on a larger scale, on PG types covering around 9 Mha. Intensification was considered as a great threat on 4 Mha in parts of CH, CZ, ES, HU, IT, SE and UK and a small threat on another 14 Mha. Many of the PG types where intensification is not seen as a threat are already under intensive use. At the opposite end of the intensification – extensification scale, 9 Mha in CH, CZ, DE, ES, IT, ME, PL, SE and UK were considered to be under great threat of abandonment. These areas comprise almost all areas that were identified under threat from conversion to forest, as well as many additional PG types. Heat and drought

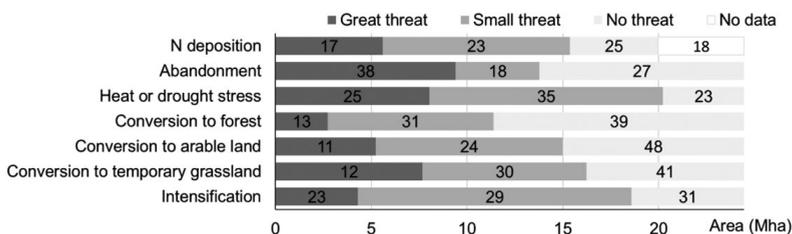


Figure 1. Permanent grassland (PG) area (bars) and number of PG types (figures inside bars) under a small threat, great threat and without a threat.

stress were considered to be a great threat on 8 Mha, not surprisingly in the warmer and drier regions of Europe (CZ, ES, HU, IT, ME and PL) and a small threat on 12 Mha, also in the cooler and wetter regions (CH, NL and UK). Finally, N deposition is a great threat on 5 Mha in CH, IT, NL, SE and UK, and a small threat on 10 Mha.

The overview of threats to PG is the outcome of an expert survey, and thus has its limitations and uncertainties. The national PG classifications used in this survey do not necessarily always match between countries or with the Eurostat classification. The expert panel was a mixture of ecologists and agronomists, with their own perception of PG threats, and inherent biases. For example, intensification may be seen as a threat to biodiversity, but may also be valued to enhance feed production. The level of detail also differed between countries. Furthermore, within PG types there may be relevant local variations that are not accounted for in this assessment. Therefore, the assignment of threats to the land areas of PG types may overestimate the actual threat as not all areas within a PG type will be affected to the same extent, or may not be affected at all.

## Conclusions

All PG types were considered to be under some kind of threat. Abandonment, heat and drought stress, as well as conversion to temporary grassland were seen as the most major threats, followed by N deposition, conversion to arable land and intensification. This situation implies the need to more intensely address threats to PG by agricultural policy to ensure the delivery of the many crucial ES delivered by grassland ecosystems.

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