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The LUCAS Grassland Module Pilot – qualitative monitoring of grassland in Europe

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Abstract: The Land Use/Cover Area-Frame Survey (LUCAS) is a European inventory carried out every three years and coordinated by Eurostat. It aims to provide information for policy and science on land use, land cover and environmental parameters by surveying a statistically representative sample of points spread across the EU countries. In 2018, a new grassland module was piloted within the survey. This pilot aims to collect detailed information on the environmental and ecological quality of the grassland, as well as its type and intensity of use. Between April and July 2018, 3734 grassland points in 26 countries were surveyed using this standardised methodology. Of these points, 747 underwent an additional quality control to check the accuracy of the survey method. This is the first time a standardised methodology has been used to collect ecological data on grasslands in a coordinated manner over so wide a geographical range in Europe. The analysis of the data from this survey is ongoing, so the purpose of this article is to briefly describe the method used in the new grassland module and inform readers about how this pilot was developed.

Keywords: biodiversity; EU; field survey; grassland; indicator species; land use; long-term monitoring; quality control.

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Eurostat has carried out the LUCAS (Land Use/Cover Area frame Survey: http://ec.europa.eu/eurostat/web/lucas, accessed 13.11.2018) campaign every 3 years since 2006. Its aim is to identify changes in land use, land cover and selected environmental parameters in the European Union. LUCAS relies on a grid of sampling points, based on a regular 2 km grid with over 1,100,000 points overlain across the territory of the EU. Only a subset of these points are included in each survey: this year saw the most recent iteration of the survey, in which 337,854 points were assessed in the EU-28 either via photointerpretation (almost 30% of the points) using the most up to date orthophotos available or in-situ. For the in-situ points, surveyors travel to the point in the field and record the preselected parameters for that point. They categorise land use and land cover following a defined classification system, as well as recording environmental parameters such as vegetation type, evidence of human activity such as drainage or irrigation management and structural elements in the landscape. Soil samples have also been collected at more than 25,000 points to determine soil properties. In 2018, 1000 of these points were also selected for a pilot survey of soil biodiversity.

This campaign is a huge undertaking: in 2018, more than 800 surveyors were employed for the fieldwork. The data from the LUCAS surveys provides important information for some of the major EU policy areas, such as the Common Agricultural Policy, the European Climate Change Programme, EU Biodiversity Strategy and the Europe 2020 Strategy. LUCAS data allows to monitor trends in e.g. land abandonment, sealing of surfaces, soil organic carbon, landscape elements and the findings are used to inform policy and measure success at meeting targets. The results are freely available via the Eurostat website (https://ec.europa.eu/eurostat/web/lucas/overview).

Development of the LUCAS grassland methodology

In recent years, demand has been growing among policy analysts in the EU to increase the depth of information that LUCAS delivers on grassland quality. This was requested in the context of the important role grassland plays in meeting urgent environmental (e.g. climate change, water quality) and biodiversity targets. There is little systematic field data available on grassland types and quality at the European level, making such a grassland quality survey potentially of great use for the scientific community as well as for policy makers.

In 2016, an in-depth grassland survey was designed, based on input from a group of experts in grassland ecology and conservation from across the EU. To be selected, a parameter must be able to be accurately and rapidly re-

Habitat type (e.g. EUNIS type, presence of structural species)
Environmental conditions (e.g. slope in degrees, orientation, heterogeneity of soil surface)
Age of grassland (estimated based on visible evidence)
Use type (e.g. type of grazing animal, evidence of abandonment, presence of agroforestry)
Use intensity (e.g. evidence of reseeding or fertiliser application)
Structure of vegetation (e.g. heights and coverages of different elements of vegetation layers)
Biodiversity value (e.g. presence of indicator species, balance of elements of herb layer)
Pollinator value (e.g. number of flowering species, flower density)

Box 1. Aspects of grassland ecological and environmental conditions for which information was collected in the 2018 grassland pilot (and examples of relevant parameters from which estimations can be derived).

corded by non-experts with only a small amount of training. Over 50 individual parameters were defined, addressing the aspects of grassland ecology and management shown in Box 1.

The parameters are recorded on a transect of 20 m in length and 2.5 m in width, giving a total surveyed area of 50 m² (Fig. 1). Certain parameters regarding the wider habitat, such as presence of fertilisation or cover of trees, are observed on a larger transect of 10 m width or at parcel level. The transect is always laid to the east of the LUCAS point, to avoid subjective selection of the vegetation surveyed.

One of the most important ecological parameters is the list of key, or indicator, species (Fig. 2). This was also the most complex parameter to design, and is based on the experience of the experts surveying different types of grasslands in their home countries.

The aim of the indicator species is to reflect the vegetation diversity and (to some extent) use history, in a way that is relatively easy for non-experts to record (Fig. 3). The concept has been used successfully e.g. in results-based agri-environment schemes for species rich meadows in regions of Germany, Switzerland and France (Oppermann & Gujer 2003; Fleury et al. 2015; Herzon et al. 2018). The challenge with the scale of this survey is to make the list of indicator species robust enough to be relevant for the huge range of grassland habitat present in the EU. The survey area is thus subdivided into simplified biogeographic zones: in addition to a core list of 10 indicator species or species groups (e.g. *Geranium* sp. with flowers > 1 cm) that are recorded in every zone, each zone has a further 10 species that are specifically selected for that zone.

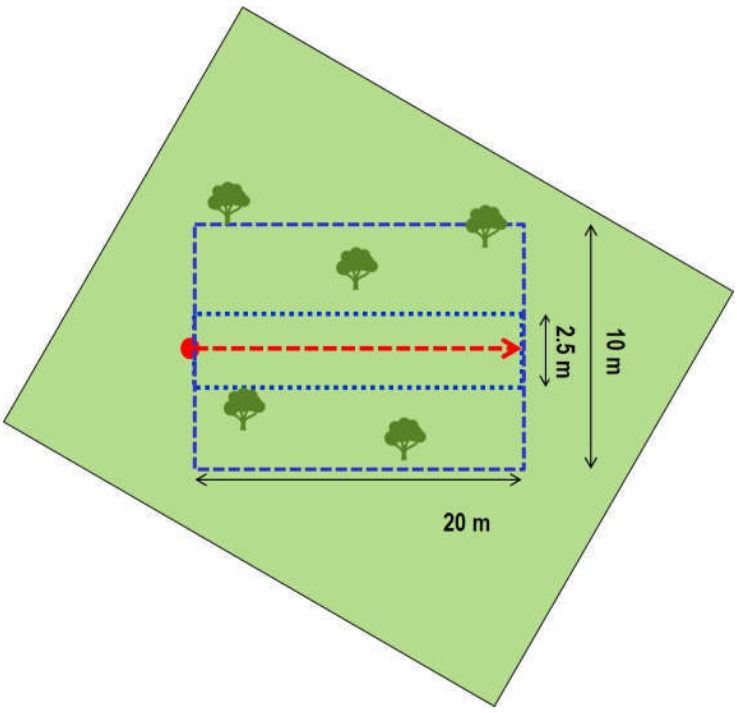

Fig. 1. Grassland transect methodology. Photo: D. Gómez.

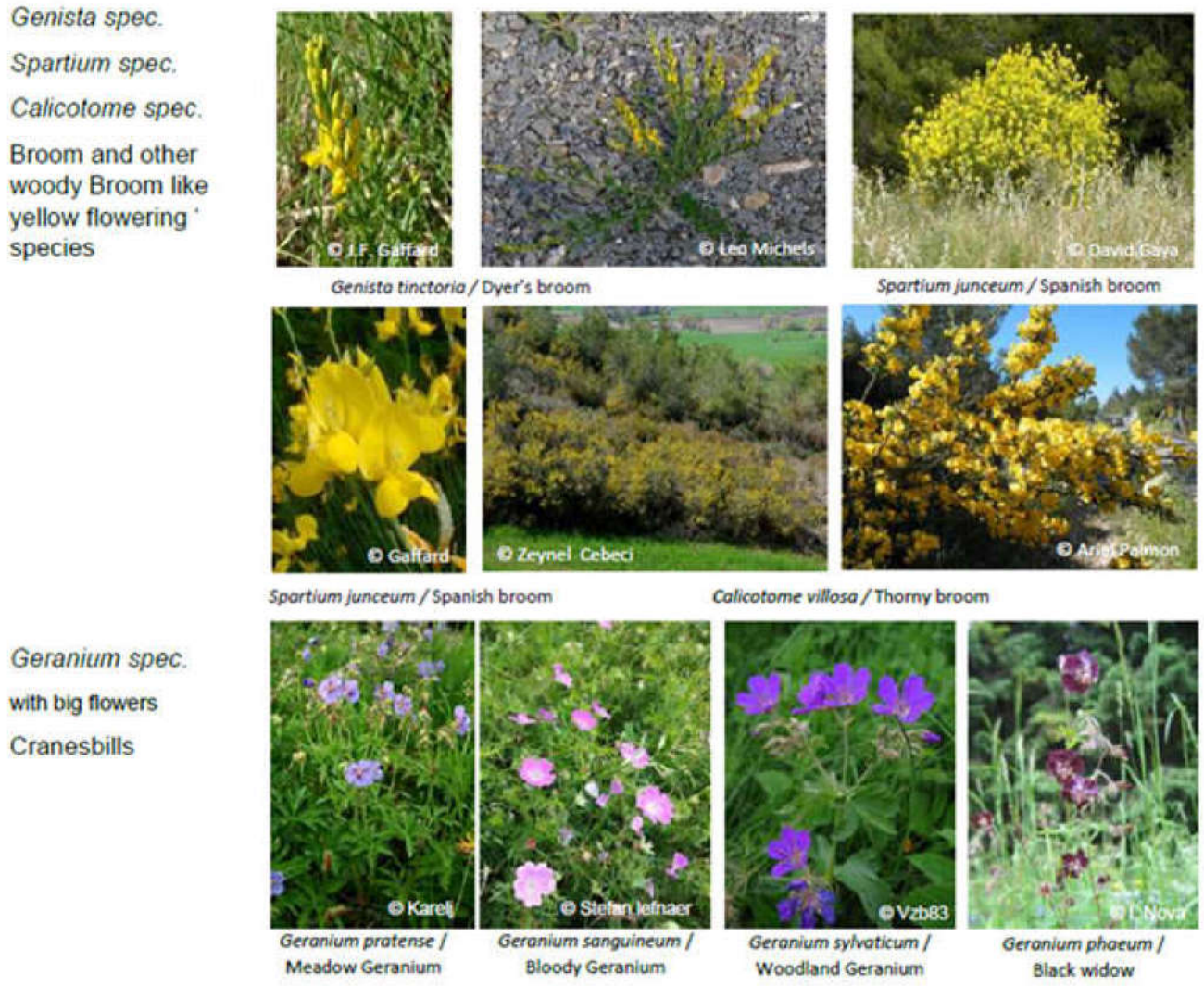

Fig. 2. Examples of indicator species taken from the guidance booklet for surveyors © Eurostat.

Survey implementation in 2018

This methodology was implemented for the first time in the LUCAS survey in 2018. A subsample of 3734 points were selected for the pilot: these points had been recorded in the last survey as being dominated by non-arable herbaceous vegetation and cover all elevation zones up to 1500 m a.s.l., all biogeographic zones and LUCAS land cover categories (Fig. 4, https://ec.europa.eu/eurostat/web/lucas/data/primary-data/2018 [accessed 05.12.2018]). Between 80 and 90 points were selected randomly in each of the aforementioned strata (elevation, biogeographic zone and the LUCAS land cover categories "grassland with sparse tree/shrub cover", "grassland without trees", "spontaneously revegetated surfaces", "shrubland with trees", "shrubland without trees"). In addition to this random stratified sample, eight clusters were selected to assess specific natural environments in the biogeographical regions where they can be found: broad-leaved forests with significant grass cover in Boreal and Mediterranean zones, temporary grasslands in Boreal, Atlantic and Mediterranean zones and fruit trees and berries with relevant grass cover in Continental and Mediterranean zones.

A total of 164 surveyors, as well as most coordinators and quality controllers were trained in the methodology in April/May 2018 before the survey was carried out. For each biogeographic region and elevation zone, an optimum time frame of 15 days is defined during which the survey must be carried out. This is important to ensure that the parameters can be recorded accurately, as most of them depended on a vegetation that is well developed but not yet cut or heavily grazed. An earlier start or later finish for the survey of 5–10 days is possible if weather conditions mean that the phenology is earlier or later than usual. The earliest surveys started in Cyprus in mid-April, and the latest ended in mid-July in northern Scandinavia.

The usual challenges of fieldwork applied: points had to be abandoned and alternatives sought out when the land use had changed (e.g. fallows that had been classified as grassland and subsequently recultivated), animals were present, or access to the land was not possible through blocked

Fig. 3. An easy way to count the number of flowering or indicator species is to collect an example of each during the transect walk. Photo: R. Oppermann.

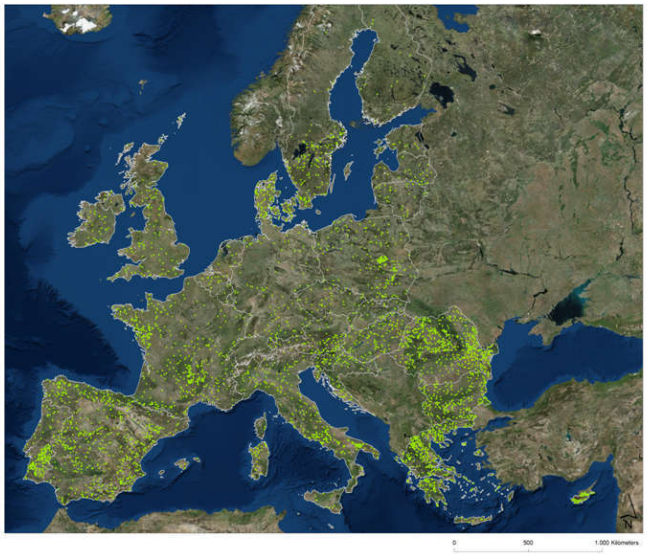

Fig. 4. Distribution of the surveyed grassland points in Europe.

roads or difficult terrain (Fig. 5). This meant that not all points had valid records at the end of the survey.

Quality control

To check the accuracy of the recording, a further subsample of 747 of the grassland points were surveyed a second time by an experienced botanist. We recruited 35 botanists from 19 countries, who in addition to recording the grassland parameters, also carried out full vegetation inventories (relevés) on the transect area of 50 m². The wide range of grasslands surveyed (Fig. 6) led to a high diversity of species – in total, 2672 species and subspecies were recorded. This in-depth species data is important to verify the usefulness of the parameters related to habitat type and diversity.

Analysis and next steps

The analysis of the survey results is ongoing, and the first results should be available in mid-2019. As a pilot study, a major goal of the analysis is to validate the approach, to check the accuracy of implementation by non-botanists and to identify improvements to the survey methodology (removing redundant parameters or those that were not well implemented, simplifying parameters that were misunderstood, etc.). Although the small sample size of the pilot means that the results will not be statistically representative for the areas surveyed, they will provide an interesting insight into the state of the EU's grasslands and the potential of this survey to deliver regular monitoring information in the future. If the results show that the parameters provide useful and meaningful results, Eurostat will

Fig. 5. As with most fieldwork, there were some unexpected challenges. Photos: F. O'Neill & N. Velev.

Fig. 6. The huge variety in the types of grassland surveyed was a challenge when designing the parameters. From top left clockwise: Portugal (Photo: C. Pinto Cruz), Finland (Photo: L. Kasari), Romania (Photo: T. Ursu), Spain (Photo: D. Gómez).

decide on the integration of the grassland module into future LUCAS surveys.

Author contributions

R.O. developed the survey concept, all authors helped to coordinate the field sampling, L.M.E.S. drafted the manuscript, and all authors critically revised the manuscript.

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