

European Monitoring of Biodiversity in Agricultural Landscapes

EMBAL

Survey Manual 2021



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from

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and the Environment Agency Austria (EAA)



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1 Purpose of the EMBAL field survey

The EU Biodiversity Strategy to 2020 aims to halt the loss of biodiversity and the degradation of ecosystem services in the European Union (EU). In this process, agriculture should contribute substantially to the maintenance and enhancement of biodiversity. Among the measures applied to achieve that it seeks to increase the contribution of agriculture to maintaining and enhancing biodiversity. The Common Agricultural Policy (CAP), in interaction with other relevant agricultural and environmental policies and programmes, is the main tool for achieving this. In order to effectively maintain and enhance biodiversity in agricultural areas, the evaluation of the biodiversity strategy and evaluations of the contribution of other policies, namely the CAP, are necessary and allow effective adjustments of policy mechanisms. However, this requires good data on the state of biodiversity, both in terms of spatiotemporal coverage and quality, which currently does not exist. A robust process for monitoring biodiversity in agricultural landscapes would ensure systematic collection of such data.

EMBAL (European Monitoring of Biodiversity in Agricultural Landscapes) is a robust monitoring tool for the European Member States. As a sampling approach based on field surveys, EMBAL serves several purposes:

- Recording of the current situation of land cover and biodiversity throughout European Member States in order to obtain up-to-date data, constantly updated by a continuous monitoring cycle;
- Recording the types, quality and extent of land cover and landscape elements within the agricultural landscape with a common European-wide approach.

The EMBAL 2020 pilot is designed to test the methodology with respect to its technical implementation and workflow, as well as the performance of the ecological field parameters in several regions with contrasting environmental conditions and agricultural systems. It is intended to expand the survey to cover all EU Member States in future. It is therefore harmonized with European approaches, like the Land Use/Cover Area Survey (LUCAS), in order to achieve synergy effects.

The data obtained from the EMBAL field survey allows the interpretation in the following seven main sectors, relevant to a wide range of agricultural and environmental concerns:

1. Land cover and land use
2. Landscape elements
3. Nature value of all surveyed land use units and landscape elements
4. Habitat types (EUNIS classification)
5. Biodiversity of grassland, arable land, fallow land as well as plot biodiversity
6. Nature value of the landscape
7. Pollination potential through the assessment of flowering species, their density and distribution.

In the following, guidance to the field survey is provided, beginning with the structure and timing of the survey, followed by a detailed description of the parameters recorded in the field, a “frequently asked questions” section, and the field survey sheets.

2 Definitions of elements in the agricultural landscape

2.1 Agricultural landscape and landscape elements

In the study, only areas under agricultural use are surveyed. The differentiation between agricultural and non-agricultural areas is based on the definition of the Regulation (EU) 1307/2013, Art. 4:

“Agricultural area means any area taken up by arable land, permanent grassland and permanent pasture, or permanent crops”;

“Arable land means land cultivated for crop production or areas available for crop production but lying fallow, including areas set aside [...], irrespective of whether or not that land is under greenhouses or under fixed or mobile cover”;

“Permanent grassland and permanent pasture (together referred to as permanent grassland means land used to grow grasses or other herbaceous forage naturally (self-seeded) or through cultivation (sown) and that has not been included in the crop rotation of the holding for five years or more; it may include other species such as shrubs and/or trees which can be grazed provided that the grasses and other herbaceous forage remain predominant as well as, where Member States so decide, land which can be grazed and which forms part of established local practices where grasses and other herbaceous forage are traditionally not predominant in grazing areas”.

The survey focuses on three types of land use: **arable (annual and perennial) crops**, **grassland** (permanent and temporary) and **landscape elements**.

Landscape elements can be linear (recorded from a minimum width of 1 m) or another form, and include:

- Wood/tree/bush elements
- Grass-herb elements
- Reed-sedge beds
- Water elements (streams, ditches, ponds)
- Stone, rock, raw soil and terrace elements
- Roads and tracks
- Artificial structures such as sheds and wind turbines

Landscape element complexes, e.g. a traditional stone wall that is partly overgrown by trees and bushes, are also frequently found in some parts of Europe.

2.2 Non-agricultural elements

Elements that do not form part of the *agricultural* landscape are delineated and numbered on the map like other elements. Their contribution to the structure of the plot is therefore included, but they are not further evaluated in the field. They include:

- Official roads and railways and adjacent landscape elements;
- Big rivers, lakes and marine waters and their banks/shores;
- Elements of settlements including parks and public green areas, and privately used (not agriculturally) and fenced green areas on the outskirts of villages (e.g. allotment gardens);
- Wetlands including marshes, bogs and intertidal flats;
- Forests.

A summary of the EMBAL land cover codes and according definitions is provided in the following table, the full list of codes is provided in Annex 7.1.

Tab. 2-1: Overview of codes and definitions for land cover categories and landscape elements used in the EMBAL methodology. See Appendix 7.1 for a more detailed version of the types of land cover and landscape elements.

LC code	Landcover	Category	Code	Specification	Extent min/max
eA	Arable land	Non permanent crops	eA11- eA71 eA80 eA81	All kinds of different arable cultures Fallow arable land, arable set aside Flower areas or strips on agricultural land	>25 m ²
eB	Permanent cultures	Permanent cultures with trees and bushes	eB11- eB18	Fruit orchards, vineyards, olive groves, nurseries etc. - To be assigned only as LC2-code	>25 m ²
eC	Grassland	Meadows Meadow or pasture Pastures Other grassland	eC11- eC15 eC16 eC21- eC25 eC31 eC41 eC51	Mown grassland Signs of both mowing and grazing (or no signs) Grazed grassland Ruderal / fallow grassland (not mown, not pastured) Amenity grassland Other kinds of grassland, including natural grassland	>25 m ²
eD	Shrubland	Shrubland with sparse tree cover	eD10	Shrubland with >70% shrub and tree cover from 0-70%	>25 m ²
eE	Landscape element	Woody elements	eE11 eE12 eE13	Isolated trees Tree lines and avenues Hedges, woody strips, field coppices and riverine scrub	>4 m height ≥4 trees >25m ² ≤0.5 ha
		Grass-herb elements and reed-sedge beds	eE21 eE22	Grassy strips, including field margins, embankments and buffer strips Reed or sedge beds	1-20 m width >25 m ² , ≤0.5 ha
		Water elements	eE31 eE32 eE33	Inland channels of fresh water Standing small water bodies Ditches including banks and riparian vegetation up to 5 m on either side	1-20 m width >25m ² , ≤0.5 ha 1-20 m
		Stone, rock, raw soil and terrace elements	eE41 eE42 eE43 eE44 eE45	Dry stone and natural stone walls, or terraces, at least 1 m wide or 1 m high including the adjacent vegetation. Field stone heaps and cairns Sand, clay and loess escarpments. Isolated rock outcrops larger than 1 m diameter Raw soil sites (stone, sand, dirt surfaces with little or no vegetation)	≥1 m width / ≥1 m height
		Roads and tracks	eE51- eE53	Dirt / Grass track (permanent), Gravel track, Paved farm tracks	≥1 m width
		Man-made structures, artefacts, other elements	eE61- eE66	Field barns, solar panels, pylons etc.	≥1 m width
eN	Non-agricultural elements	Forest Wetland Open water Settlement area and infrastructure Other open, non-agricultural	eN10 eN20 eN30 eN40 eN50	Forest, both natural forests and afforestations (plantations) Inland and coastal wetlands Large inland or coastal running or standing water bodies Settlement areas, industrial areas, buildings, villages and garden areas, official roads and railways Other anthropogenic but not agricultural or forestry land use/land cover	≥0.5 ha ≥0.5 ha ≥0.5 ha or >20 m width ≥25 m ² ≥25 m ²
eZ	Pre-classification unclear	Pre-classification unclear	eZ	Classification during Pre-processing (CAPI) unclear. Code cannot be selected during field work.	≥25 m ²

3 Overview of the EMBAL field survey

3.1 Structure of the survey

The field survey is organised as follows:

- Based on the regular grid of 2 x 2 km across European Member States used in the master LUCAS sample (Land Cover/Use Area Frame Survey: <https://ec.europa.eu/eurostat/web/lucas/data/lucas-grid>), a defined number of plots are surveyed in each country.
- Only plots with a minimum 10 % open land according to CORINE landcover are preselected for survey.
- The plots to be surveyed have a square shape with a side length of 500 m, thus cover an area of 25 ha (Figure 3-1). Each parcel within a plot is recorded once in a survey year during optimum vegetation conditions. Within each plot, five points are defined, which serve for the identification of the locations where at which the recording of vegetation/biodiversity data takes place.

3.2 Terminology



Figure 3-1: Example of a 500 x 500 m EMBAL plot.

Blue lines define the individual (agricultural) land use parcels, which have been pre-defined with the expected class of land use/land cover type (but not the final code). Four transect pairs (red lines A-D) are positioned at the closest access point to the four yellow crosses in the corners, and a single transect starting at the central cross.

Plot: square of 500 x 500 m, within which all agriculturally used parcels, non-agricultural areas and landscape elements are mapped

Parcel: management unit of agricultural land, which exceeds an area of 25 m² (LC classes eA-eD); non-agricultural elements will be classified in LC class eN. Temporary (usually electric) fences that are moved every few weeks or months do not count as a parcel border: only permanent border structures are relevant here.

Landscape element (LE): usually linear and small objects with individually defined threshold values for height, width or area (LC class eE). For most LE there is a minimum size of 25 m² and a maximum size of 0.25 ha, with a few exceptions (please see table 7.1 at the end of this manual).

Transect: line of 20 m length and 2.5 m width on which more detailed parameters are recorded in grassland and arable parcels. The locations of the transects is predefined during digital mapping, but may have to be shifted by the surveyor.

3.3 Elements to be surveyed

Each plot consists of 1 to >300 parcels (i.e. management units) and landscape elements, which are mapped prior to the field survey based on orthophotos and assigned a unique code. Since it is not possible to see the same detail of management via the images, these parcels will in many cases have to be corrected in the field.

In each plot, the field survey comprises two elements:

1. Checking, and if necessary correcting, the borders of all parcels and landscape elements within the plot and recording their land cover/use and specific parameters. The parameters cover aspects such as provision of pollinator resources (flower density) and production intensity (crop coverage /vigour of grassland vegetation).
2. Detailed records of predefined transects: additional biodiversity parameters will be recorded on up to nine transects in each plot (four transect pairs and one central transect). The transects are 20 m long and 2.5 m wide and performed only in either arable fields or grassland.

More detail about each of these elements is given in the next section.

Depending on the complexity of the plot and the number of changes needed to be made, it can take between 1 and 6 hours to complete a plot.

3.4 Accessing and observing parcels and landscape elements

Parcels and landscape elements should be surveyed from the nearest access point (i.e. where a road or track touches the parcel). Apart from to walk a transect, surveyors should not enter the parcel. However, it may be necessary to change viewpoint (i.e. walk round the edge, or drive to the other side) to get a good overview, as there are several parameters for which the average value for the whole parcel should be estimated. The estimation on parcel level obviously depends on how big the parcel is, how hilly the terrain is and whether there are trees and bushes blocking the view. Binoculars can be useful to determine structures from a distance. When parameters for a parcel or landscape element are recorded, the app will automatically save the position. When working with paper sheets instead of the app, the positions of observation should be marked on the map.

3.5 Preparation of the survey

Before beginning with the survey in the field, some preparation will be necessary. The most important part is careful reading and understanding of the content of this survey manual, which defines the parameters and rules that need to be applied during the fieldwork.

The rules in this manual provide the baseline for any decisions taken in the field. In case certain structures or elements are not covered by the manual and according rules, feedback to the coordinator is essential so the manual can be adapted to specific situations. Uncertainties should always be communicated to the coordinator in order to prevent any misunderstandings or misinterpretations in the field. In case no direct communication with the coordinator is possible, reasons for the decision or uncertainty should be noted in the remarks section of the respective plot.

The daily route should be set up in advance to reduce the effort and time needed to approach the single plots. A navigation system in the car or proper map material might be necessary for the preparation. However, access to plots might be difficult and require more time than planned, so a buffer time should be included in the daily schedule.

3.5.1 Survey period

Since the EMBAL survey consists of both the mapping of the land cover and the recording of vegetation, the **timing of the fieldwork is crucial**. Depending on the biogeographic region and the elevation of the plots, the optimum time for carrying out the vegetation transects may vary considerably. It is important that surveys take place during the height of the growing season, which might already be in April for the southern Mediterranean countries or in late June for the Scandinavian countries. This means that the vegetation is well developed and many species are flowering, but meadows have not yet been cut and crops have not yet been harvested.

The recommended timeframe is based on the expert appraisal of phenological variation in the EU implemented in the LUCAS grassland module, shown in section 7.5.

3.5.2 Surveyor kit – what to take into the field

The main tool to navigate the plot and record the data is an **android smartphone** (or tablet) using the Open Data Kit (ODK) app (opendatakit.org) configured specifically for the EMBAL 2020 survey. **Note that the ODK app does not run on iPhones.** The smartphone should have at least 16 GB of free space.

In case it is not possible to work with the app, the following analogue back-up and additional materials should also be taken into the field:

- Powerbank to recharge smartphone
- Compass
- Sufficient print-outs of the recording sheets
- Camera with a resolution of at least 1600 x 1200 pixel, extra battery and SD-card
- Overview maps as orientation in the field (optimum scale 1:25,000)
- Maps of the plots (provided by survey coordinators)
- Pencils (should be suitable for writing on colour prints)
- Clipboard
- Survey manual
- Navigation system for the car

- Binoculars
- GPS
- Mobile phone
- Field guide for the vegetation (see Annex 7.6 and 7.7)
- Measuring tape
- First aid kit

3.5.3 Safety

Surveyors are responsible for their own safety and insurance during the survey in the field and assessing and avoiding possible risks. The surveyor should not place their own or other people's safety or health at risk.

Surveyors are required to carry a smartphone during fieldwork: through the app synchronization (when a data connection is available), it will be able to roughly track the surveyor's progress with the plots, but surveyors should communicate their position to their coordinator daily. Parcels with livestock or in difficult terrain, e.g. with steep slopes, should not be entered unless the surveyor is sure that it is safe. Surveyors are also responsible for using proper field equipment, like protection against the sun and rain and suitable footwear for the terrain.

4 Parameters

The following describes the parameters to be recorded on all parcels in the plot, with some additional parameters for arable and grassland parcels. For reference, the paper version of the survey is given in the Annex (sections 7.2, 0 and 7.4).

4.1 All parcels

Unless otherwise stated, the parameter is assessed **considering the whole parcel**.

4.1.1 Number on map / ID

Each parcel with land cover and each landscape element is assigned a parcel ID. Each plot will have been digitally mapped based on orthophotos before the fieldwork, but they may need to be modified in the field, because e.g. land use has changed since the image used for mapping was created, or differences in management visible on the ground were not visible on the screen. Please note that temporary (usually electric) fences that are moved every few weeks or months do not count as a parcel border: only permanent border structures are relevant here.

If new parcels are created, or old parcels are split, they should be assigned a unique parcel ID by adding a fourth digit (e.g. 1 => 1001, 2001, 3001,.....12001). For example (see also the examples in Figure 4-1):

- A parcel identified in CAPI (computer assisted photo interpretation, i.e. digital pre-processing) as number 2 is split during fieldwork in 3 parts with three different land cover codes: Old ID: 2 -> New IDs: 2, 1002, 2002
- Parcel number 5 is split in 2 parts, one arable area and one landscape element: Old ID: 5 -> New IDs: 5, 1005
- 2 parcels are merged, where the second parcel is larger than the first: Old IDs: 7,8 -> New ID: 8

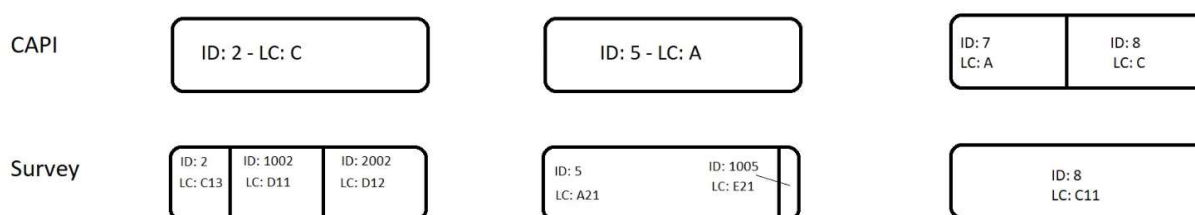


Figure 4-1: Renumbering of parcels when splitting and joining during the survey.

In post-processing, the project coordination will recalculate these new IDs to achieve an ascending ID sequence again.

The vegetation transects are given letters (A_1, A_2, B_1, B_2, C_1, C_2, D_1, D_2, E.), where 1 indicates the transects at the edge of the field and 2 indicates the transects inside (with the exception of E, which is a single transect at the centre point of each plot).

The app does not automatically check if a parcel number has already been assigned, so surveyors need to pay attention if new numbers have to be assigned. If a number is assigned twice, this can be repaired during post-processing of the data using the GPS data on the position of the survey.

4.1.2 Inaccessibility and irregularities

All parcels should be surveyed from their edge – that means that the surveyor should walk on the footpaths and field tracks as well as alongside the border of parcels (e.g. edge of grassland or arable land alongside the border of a forest or alongside a water course or ditch). In case a parcel cannot be surveyed from the edge (e.g. there is a fence with a dense hedge around it), or only some of the parameters can be observed, this should be noted as “No” to the question “Can be observed?”

Any other irregularities also have to be noted in the “Further remarks” section, such as problems with land owners, outdated aerial photos, problems in the coding of items from the list (e.g. crop/habitat type recognition), burnt areas, etc.

4.1.3 Stage of the vegetation

This parameter describes how reliably the other parcel parameters can be observed, depending on to what degree the parcel has already been cut or grazed (in the case of grassland) or sown/harvested (in the case of annual arable crops).

The options are:

1. record is possible
2. record is difficult but possible
3. record is not possible

For grassland or arable land that means:

not mown or pastured (grassland)/ crop is visible/ developed

partly mown/pastured (grassland)/ crop partially developed

already mown or heavily pastured (grassland)/ crop not yet germinated or recently harvested

4.1.4 Land cover 1 (LC1)

Indicate the code of the land cover (**see Annex 7.1 for the full list of land cover codes**) as observed in the field. LC1 is the **ground layer** of the parcel, and is obligatory. If there is mixed land cover, an additional layer (LC2) can also be added, as explained in the next section.

If an element is assigned to one of the following categories, the exact plant species or assemblage should be noted (if possible):

- eA17 Other cereals
- eA23 Other root crops
- eA45 Other legumes and mixtures for fodder
- eA61 Other non-permanent crops

Surveyors who are familiar with the LUCAS (Land Use/Cover Area frame survey) or EUNIS (European Nature Information System) should be aware that the land cover codes are different for EMBAL.

4.1.5 Land cover 2 (LC2)

Many agricultural uses have **mixed land cover on a single parcel/ management unit**. For some types of land use such as e.g. fruit orchards, Dehesas or agroforestry systems, the land cover consists of two layers (Figure 4-2 shows an example).



Figure 4-2: Example of agroforestry systems.

Left: Dehesa in Spain: barley with holm oaks. LC1 = eA13 (barley) + LC2 = eA96 (other trees), Coverage 5 %

Right: Fruit orchards in Germany: fruit trees with grassland. LC1 = eC11 + LC2 = eB11 (fruit orchard), Coverage: 40 %

LC1 is the ground layer (arable land, grassland, fallow land) and **LC2 is typically the woody layer** (could be a permanent culture such as fruit trees, vineyards or berries). For example, meadows and pastures (i.e. grassy vegetation as LC1) may be partially covered by shrubs or trees. If both land cover types are on the same level, the ground cover must be recorded as LC1 and the bush / tree cover as LC2.

LC1 is the ground layer (arable land, grassland, fallow land) and LC2 is typically the woody layer (could be a permanent culture such as fruit trees, vineyards or berries or could be also shrub scattered across grassland).

LC2 can also be used to indicate landscape element types, such as hedges and scrub (eE13) or patches of stones (eE44), that are so frequent that it is difficult to delineate each individual patch of scrub (see the list of examples of LC combinations below).

If there are more than two applicable LC codes (including at least one agricultural land cover, eA or eC), then where possible the parcel should be split into separate polygons to disentangle the land cover types. For example, a hillside with a high density of small terraces that is grazed grassland could be coded as a single polygon (LC1 = eC23, LC2 = eE41). However, if the same terraced hillside still has an active vineyard with bare soil under the vines, the agricultural use should be coded LC1 = eA71, LC2 = eB15. The stone walls forming small terraces then need to be split into new parcels and coded as eE41.

Landscape elements can also consist of different land cover types. These can be coded as LC1 and LC2, but if there are three or more types that are clearly distinguishable, such as a row of trees with a stone wall and a grassy strip, which are so intertwined that they are not possible to delineate as individual elements, then indicate the most dominant landscape elements, LC1 as ground layer and LC2 as “vertical layer” with its percentage (e.g. grass-herb strip eE21 with a row of walnut trees eE12 with 60 % coverage and some bushes and shrub eE13 with 15%

coverage → then indicate the grass-herb strip eE21 as LC1 and the row of walnut trees eE12 as LC2 with 60 % coverage and ignore the bushes with shrub eE13 as LC code but give a short note in the comment section).

Note that codes for woody vegetation may only be entered as LC2, and cannot occur as LC1 (see the more detailed descriptions in the list of land cover codes in Annex 7.1). The following list provides some examples of LC1/2 combinations.

Description	LC1	LC2 (coverage)
Vineyards with bare tilled soil between the rows	eA71	eB15 (45%)
Vineyards with alternating bare soil and grassy vegetation between the rows	eA71	eB15 (45%)
Fruit orchard with old, standard trees (i.e. not espalier plantations) at a low density and moderately intensive pasture underneath	eC22	eB11 (60%)
Olive grove with a dense canopy and bare tilled soil underneath	eA71	eB14 (85%)
Pasture with scattered oaks covering >5% of the parcel (if <5%, each tree has to be delineated individually)	eC23	eE11 (10%)
Grazed vegetation with a dense canopy of hornbeam, beech and ash covering >70% of the parcel	eC25	eN (80%)
Abandoned pasture with scrub encroachment	eC31	eE13 (50%)
Occasionally grazed pasture with a high density of stones covering the surface	eC24	eE44 (10%)
Line of trees with a grass strip underneath that is mown to keep short (mulched) and not cut for hay or any other agricultural use	eE21	eE12 (30%)
Hedge consisting of bushes with individual trees (>4 m) sticking out of it and <30% grassy vegetation	eE13	None, because trees and <30% grassy vegetation are included in the description
Asphalt/concrete track with a central grass strip	eE53	None (included – it is differentiated via nature value)
Solar farm with a large number of individual panels over mulched grassland	eC41	eE64 (85%)



Figure 4-3: Vineyards (LC2 = eB15) with different types of ground vegetation as LC1
From left to right: eC41 – mulched grassland, eA81 – flower strips, eA71 – mainly bare soil, eA71 – mainly bare soil also including some herbaceous vegetation.

eN codes as LC1 code cannot be combined with other LC2codes. If a parcel is non-agricultural (eN), the major land cover has be coded as LC1.



Figure 4-4: Example of a complex landscape element.

The landscape element consists of a stone wall (eE41), and small groups of trees (eE11) and a small herbaceous strip alongside (eE21) the stone wall. The two most dominant landscape elements are assigned as LC1 and LC2 (LC1= stone wall eE41, LC2=small group of trees eE11 with coverage 10%).

4.1.6 Coverage of LC2

If an LC2 is present (see previous section) then its coverage has to be entered as if viewed from above (the orthophoto of the plot should be helpful in estimating this). The coverage of LC1 is not recorded in this section.

If tree cover is <5% of the parcel, individual trees or groups of trees (with a crown radius of 3 m and/or height of >4 m) are mapped as individual trees (eE11). Above 5% they should be assigned as LC2 to the LC1 codes eA-eE.

The coverage is entered in these percentages:

In manual	In ODK [Pull-Down-Menu in %]	Value in table
0%	0	0
1-3%	1-3	3
4-8%	4-8	8
9-15%	9-15	15
16-25%	16-25	25
26-40%	26-40	40
41-60%	41-60	60
61-80%	61-80	80
81-100%	81-100	100

4.1.7 Irrigation (arable and grassland)

Irrigation is often a sign of intensive arable land use. This can sometimes be visible on the aerial photo (e.g. circular patterns of different coloured vegetation, regular canals that are used to draw water – see Fig. 4-4) and/or through signs on the ground such as irrigation pipes. This parameter has three possible levels:

- Irrigated
- Maybe irrigated (e.g. if there are irrigation pipes, but they seem not be used the last few years)
- No obvious irrigation



Figure 4-5: Example of circular irrigation patterns in the vegetation visible on aerial/satellite images.

4.1.8 Presence of extensive field strips

Some agri-environment schemes require farmers to leave an unsprayed (and sometimes unfertilized, or unmown) margin around their arable or grassland fields (Figure 4-6).

This is visible in arable fields as a much lower crop cover and a much higher density of non-crop plants/flowers at the edge compared to the interior of the field.

In grassland, this takes the form of either a strip of longer grass at the margin, several metres wide, that is left as a refuge for insects and other animals or as unfertilised strip with a lower type of vigour and much higher density of flowers.

If there is evidence of this in the parcel, then the option “Yes” should be selected.



Figure 4-6: Examples of extensive field strips in cereals (left and middle) and grassland (right).

4.1.9 Width of extensive field strips (arable and grassland)

If “Yes” was selected for the previous question, the width of these in m should be entered here.

4.1.10 Flower density

For large parcels it might be difficult to estimate flower density for the whole parcel, therefore select a representative part of the parcel and estimate the parameter from looking into the field from the nearest access point. Estimate the average visible flower density according to the following scale. This ranges from no flowers to the densest possible flower coverage. Note that category 5 does not imply 100% flower coverage, as this does not occur outside of e.g. oilseed rape monocultures, but the densest coverage that is naturally possible. Note that only flowers in the herbaceous vegetation on the ground are considered, and not the flowers on trees and shrubs, and not flowering annual crops such as sunflower or oilseed rape. Fig. 4-5 gives a visual guide.

- 0 no flowers
- 1 very few flowers
- 1.5 between very few and a few scattered flowers
- 2 a few scattered flowers
- 2.5 between a few scattered flowers and medium flowering
- 3 some medium/regular but not dense flowering
- 3.5 between medium and dense flowering
- 4 dense flowering, but not a continuous “flower carpet”
- 4.5 between dense and a “flower carpet”
- 5 dense, continuous “flower carpet”

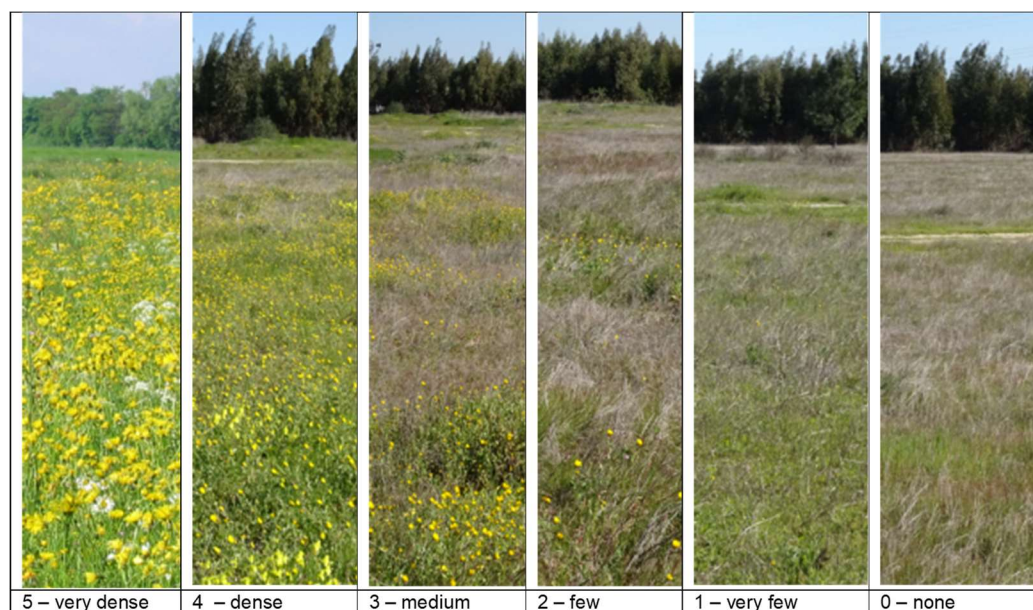


Figure 4-7: A range of flower densities from very dense on the left to none on the right.

4.1.11 Colours of flowering forbs (arable and grassland)

Each type of flower colour from herbaceous plants that can be seen is selected. The colours of flowering forbs are observed in an observation window of approximately 20 m along the parcel edge. The colour is selected only once, even if more species of the same colour occur (Figure 4-8). There are 10 colour categories, including the category “mixed”. Mixed means that the flower has at least 2 colours and that at least 20 % of the flower is of another colour than the dominant colour (e.g. a daisy with yellow disc flowers in the centre and white ray flowers surrounding it).

The number of present colours will be calculated automatically in the app from the selection (on the paper sheet, they will need to be counted by the surveyor).

Note that only wildflowers in the herbaceous vegetation on the ground are considered, and not the flowers on trees and shrubs, and not flowering annual crops such as sunflower or oilseed rape.

4.1.12 Further remarks

This field is for remarks concerning anything related to the observed land use, nature value and biodiversity of the plot as well as related to the study methodology.






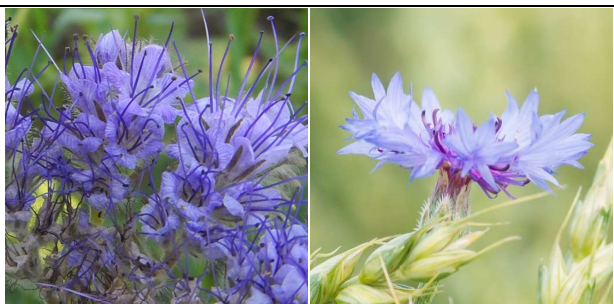




<p>White</p> 	<p>Magenta/ pink</p> 
<p>Yellow</p> 	<p>Purple/ violet</p> 
<p>Orange</p> 	<p>Blue</p> 
<p>Red</p> 	<p>Green</p> 
<p>Brown</p> 	<p>Mixed</p> 

Figure 4-8: Examples of the 10 different flower colours.

4.2 Arable parcels

4.2.1 Non-woody crop coverage

The coverage of non-woody crop plants – i.e. annual crops, and a few perennial crops that are non-woody, such as asparagus or strawberries – is estimated in % **on the parcel level**. The coverage is recorded in categories (0 %, 1-3 %, 4-8 %, 9-15 %, 16-25 %, 26-40 %, 41-60 %, 61-80 %, 81-100 %): see Fig. 4-9 for an example. The coverage may be heterogeneous over the parcel, so the surveyor should try to estimate an average value for what can be seen of the parcel. In the case of perennial crops with a woody canopy (eB codes), such as olives or wine, this information is recorded in the coverage of LC2, therefore “0%” can be entered here.



Figure 4-9: Crop cover, left 9-15 %, right 0 %.

4.2.2 Wild plant coverage

The coverage of non-woody, non-crop (wild) plants is estimated in % (0 %, 1-3 %, 4-8 %, 9-15 %, 16-25 %, 26-40 %, 41-60 %, 61-80 %, 81-100 %) **on the parcel level**. This may be heterogeneous, so try to estimate an average value for what is visible of the parcel. Wild plants excludes crop species that are growing spontaneously from the previous crop (“volunteers”).

4.3 Grassland parcels

4.3.1 Vigour of vegetation

Grassland types are often characterized by their often quite different types of vegetation height and density (vigour), ranging from very meagre (nutrient-poor and/or dry sites) to very dense vigour (naturally or artificially fertilized sites). The type of vigour in the parcel is indicated on a scale of 1-5 (see Figure 4-10).

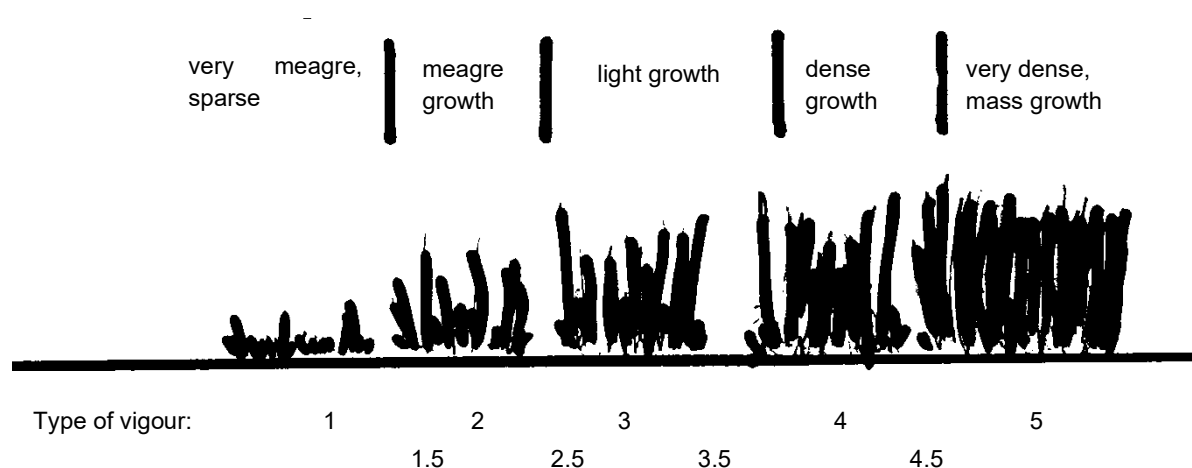


Figure 4-10: Illustration of the different vigour types in grassland.

The height is not relevant for the type of vigour as the height depends mainly on the dominant species. The main characteristic for the type of vigour is the density, which limits the extent of sunlight that can reach the low plant species near the ground. Look vertically down at the ground and consider how easy it is to see the ground. Type 1 is a very sparse vegetation where the low-growing plant species or open soil can be seen fully; type 3 is light growth where the sunlight can reach almost all layers but with medium shading effects given through higher plants; type 5 is very dense vegetation where only the highest plants receive sunlight.

Evaluating vigour may be difficult when the grassland is grazed or has already been mown. The type of vigour is indicated when the vegetation is in full development in spring; thus grazed patches may be judged with the help of ungrazed patches remaining on the pasture. Meadows before the first cut should be judged according to the density that will be reached when the most of the grass species are flowering. For example, a score of 4 or 5 can be expected if one or few highly productive species dominate, whilst the grassland will probably be 1, 2 or 3 if there is space between the tall grasses and forbs and sunlight reaches the ground. Meadows cannot be judged adequately after the first cut.

4.3.2 Graminoid-forb ratio

Enter values for the ratio of cover of graminoids (grasses, sedges, rushes, reeds) to forbs (i.e. non-woody, broadleaved plants including fern species). The sum is always 100, also if the total coverage of this layer is only 50 % (and 50 % of bare layer or 50 % of bushes and dwarf shrub). Thus the values can be indicated as follows:

100:0, 90:10, 80:20, 70:30, 60:40, 50:50, 40:60, 30:70, 20:80, 10:90, or 0:100.

4.4 Landscape elements

4.4.1 Type of element

There are 23 categories of landscape elements (eE codes): enter the code here following the description in Section 7.1.

Please note that for some elements, Land Cover 2 needs to be noted as well. This applies for example to grass-herb-elements (eE21-eE22) with woody vegetation. The LC1 eE21 (grass-herb elements) can have up to 70% of woody coverage and still counts as eE21. However, the coverage of the woody vegetation needs to be noted as LC2, e.g. eE13 (hedges and woody strips).

4.4.2 Width of landscape elements

For landscape elements, the width of linear and punctual elements with a size of ≥ 1 m and < 5 m is measured roughly at the survey point. Elements < 1 m should be ignored except stone walls – here the height has to be indicated.

Some elements have a variable width, but only the width at the survey point is recorded here. The survey point should be as far as possible observing a representative part of the landscape element.

4.4.3 Length of landscape elements < 20 m

If the landscape element is linear and shorter than 20 m in length, the length should be recorded here (measured roughly, using step length to estimate). Please note, that only the length inside the plot is recorded (also if e.g. the hedge continues outside the plot borders).

4.4.4 Nature value of landscape elements

The nature value of **parcels** is calculated automatically from a combination of other parameters. For **landscape elements**, the surveyor is required to estimate the nature value according to the following categories which will be described more in detail in the following section:

1	very low nature value
1.5	between very low and rather low nature value
2	rather low nature value
2.5	between rather low and moderately high nature value
3	moderately high nature value
3.5	between moderately high and rather high nature value
4	rather high nature value
4.5	between rather high and very high nature value
5	very high nature value

Many landscape elements have a specific minimum degree of biodiversity due to their habitat structure, which is why for these types only the values 3, 4 and 5 are recordable. In the following, a description of the estimation of the nature value for the major types of landscape elements is

given (for an overview on the types of the landscape elements and some definitions see also section 7.1). For combinations of landscape elements, e.g. eE21 grassy strips with eE12 tree avenues, both LC1 and LC2 should be considered in the evaluation. However, the combinations of habitat resources shall receive only one nature value as a combination: please give a “medium value” with considering more the main element according to its nature value.

4.4.4.1 Wood/ Tree/ Bush elements (eE11-13)

Wood/tree/bush elements include isolated trees, tree lines and avenues and hedges, woody strips, field coppices and riverine scrub. They provide habitat value through dense growth, structural richness (i.e. different layers at different heights), old wood e.g. with hollows and coarse bark and diversity of woody species.

Code / Type	Definition	Nature value
eE11-13 Wood/tree/bush element	Small and/or young trees, or small, closely cut hedges with few woody species and low structural richness.	3
	Trees of medium size and age, hedges or scrub of moderate size and density including >2 species.	4
	Large and/or old trees with obvious habitat features such as hollows or dead branches. Hedges or scrub are richly structured with layers at different heights, and include several different woody species.	5

4.4.4.2 Grass-herb elements (eE21)

Many embankments or small patches between parcels or buffer strips are characterized by a heterogeneous grass- and / or herb vegetation. These can have a very diverse appearance, due to the cutting regime, use of herbicides or the site-specific conditions. Elements that are cut several times per year or sometimes sprayed with herbicides will in general be species-poorer and less structured than extensively managed elements. Therefore, the surveyor should take into account the management practice – if visible – when assigning the nature value for grass-herb elements (Figure 4-11, left picture).

Code / Type	Definition	Nature value
eE21 Grass-herb elements	Species-poor, mainly grass-dominated or dominated by few forb species (e.g. nitrophytes like stinging nettles <i>Urtica spec.</i>).	3
	Moderately species-rich (not species poor, not species-rich) or moderately structured	4
	Species-rich and structured	5



Figure 4-11: Examples for grassy strips with differing nature values

Left - mulched buffer strip along grass track, nature value 3, middle - species-rich buffer strip along farm track, nature value 5, right - moderately species-rich embankment, nature value 3-4.

4.4.4.3 Reed and sedge beds (eE22)

Moist and wet patches of parcels or alongside ditches are often characterized by reed or sedge vegetation. This vegetation often is species-poor but nevertheless it has a high nature value as far as it is not “disturbed” by the growth of nitrophytic plants. The nature value is the following:

Code / Type	Definition	Nature value
eE22 Reed and sedge beds	Reed and sedge beds with a high percentage (35 – 75 %) of nitrophytic or neophytic plants such as stinging nettles <i>Urtica dioica</i> or <i>Solidago spec.</i> .	3
	Reed and sedge beds with a typical structure and wet character, nitrophytes and neophytes only in a small extent (5 – 35 %).	4
	Typical reed and sedge beds, species rich or structure-rich or but without occurrence of “disturbing elements” (< 5 %).	5

4.4.4.4 Water elements (eE31-33)

Water bodies (including the vegetation directly surrounding them up to 5 m from the edge of the water) are evaluated according to their structural diversity of the watercourse, structure of the ditch, structure of the bank and/or riverine vegetation.

The accompanying vegetation (e.g. trees, hedges) up to 5 m width have not to be recorded separately if they belong to the water body/ water course (on the bank / embankment) and are not a separate strip alongside the water course.

Code / Type	Definition	Nature value
eE31-33 Water elements	Fully artificial water bodies with stone or concrete banks and grounds.	1
	Partly artificial water bodies with parts of the ground and the banks being built artificial with stone or concrete.	2
	Moderately near-natural water bodies with low structural diversity e.g. only grass banks / embankments.	3
	Near-natural water bodies with an average structural diversity; indicators of human disturbance or disturbed structures less than 25 %.	4
	Natural or near-natural water bodies, naturally high structural diversity; minor pollution; indicators of human disturbance or disturbed structures less than 5 %.	5

4.4.4.5 Stone, rock, raw soil and terrace elements (eE41–45)

The categories eE41–45 are rather diverse and comprise different kinds of stone, rock, raw soil and terrace elements, - often or mainly man-made, but also influenced or overgrown by nature.

The nature value for most elements will be between 3 and 5, only pure cement walls are judged with 1 (nearly no nature value) or 2 (low nature value). The nature value for these elements can be judged according to their structural diversity, e.g. a stone wall with a lot of gaps and holes might be a valuable habitat for lizards or insects and judged with a high nature value (Figure 4-12). Vegetation growing on a wall or terrace might also be judged with a high nature value, because it can be a habitat for plants, refuge for animals and insects.

The elements have a minimum height/width of 1 m.

Code / Type	Definition	Nature value
eE41-45 Stone, rock, raw soil, terrace elements	Cement wall, without vegetation.	1
	Brick wall, with vegetation.	2
	Monotonous stone walls or terraces, habitat with hardly any structure and/or vegetation.	3
	Stone walls, terraces or other stone or rock elements with moderately diverse habitat structure, e.g. through vegetation.	4
	Stone walls, terraces or other stone or rock elements with a very diverse habitat structure, e.g. overgrown walls with a diverse vegetation structure.	5



Figure 4-12: Example for judging the nature value of landscape elements.

Here, there is a stone wall (LC1 = eE41) with trees (LC2 = eE11). The combination of stones and trees serves as habitat for a variety of animals and could be judged with a nature value of 4.5.

4.4.4.6 Roads and tracks (eE51–53)

Width of paved and unpaved paths at least 1 m (Figure 4-13). This excludes paths that are hard to distinguish from the adjacent area on the one hand (these should not be mapped) and asphalt public roads and highways, whose main purpose is not agricultural traffic, on the other (eN40).



Figure 4-13 – Examples for different roads and tracks

Above: Left - paved farm track with grass/gravel strip, NV (nature value) 1, middle - paved farm track with grass/gravel strip, NV 2, right - dirt/gravel track, NV 2-3;

Below: Left grass track, NV 3-4, right species rich field track, NV 5.

Code / Type	Definition	Nature value
eE51-53 Roads, tracks	Asphalt tracks (E53)	1
	Pure gravel-tracks (E52) or paved asphalt tracks (E53) with grass strip in the middle.	2
	Dirt track (E51) or gravel tracks (E52) with a simple grass or grass/herb strip in the middle or species-poor grass tracks (very obvious track function).	3
	Dirt tracks with a species rich grass/herb strip or medium species-rich grass tracks, sometimes small structures or wet patches occur (E51).	4
	Very species rich track structures, sunken roads or also pure dirt and grass tracks; small structures such as earth embankments or wet patches are present (E51).	5

4.4.4.7 Other man-made structures and other elements (eE61–66)

Man-made structures and artefacts are only recorded if they are completely surrounded by agricultural land use; they are not recorded if they occur adjacent to villages, houses and farms. The element is recorded separately from the adjacent natural structure such as a hedge or a grass-herb strip, regardless of the extent of the different structures. These elements primarily have a non-natural function (e.g. barns or refuges). Elements such as ditches – though man-made – are defined as “water element” (codes eE31-33).

Other elements (eE66) may occur, which are not described in this manual yet and which do not fit into the categories eE11 – 65. These should be described briefly (and will serve for the further development of the list of land cover codes).

Code / Type	Definition	Nature value
eE61-66 Other man-made structures, artefacts, other elements	Man-made structure without or with very low nature value (e.g. electric transformer tower with hardly any buffer strip).	1
	Man-made structure with low nature value (e.g. electric transformer tower with a small grass-herb buffer strip).	2
	Man-made structure with medium nature value (e.g. electric transformer tower with a broad and partly species rich grass-herb buffer strip).	3
	Man-made structure with high nature value (e.g. wooden field barn which serves as nesting place for birds and which is surrounded by a grass-herb buffer strip).	4
	Man-made structure with very high nature value (e.g. wooden field barn which serves as nesting place for birds/owls and which is surrounded by a species rich grass-herb buffer strip and a small hedge or a tree; but still the man-made artefact dominates).	5



Figure 4-14 – Example for a man-made structure: here an animal shed eE62 with nature value 4 (offers different habitats for many wild animals through the open structure and different materials as well as the direct edges not being cut or grazed)

4.4.4.8 Flower areas and strips (eA81)

In many agricultural landscapes, flower areas and strips are sown on arable land. They might cover just a strip of a few meters width or a whole parcel. Therefore and as they usually are sown on arable land they occur as eA-code and not as eE-code. The structure and species composition can be quite different.

Code / Type	Definition	Nature value
eA81 Flower areas and strips	Flower area or strip with medium nature value, composed only of a few species like <i>Sinapis arvensis</i> or <i>Phacelia tanacetifolia</i> and generally homogeneous structure.	3
	Flower area or strip with high nature value, several different species in flower, vegetation structure somewhat heterogeneous (e.g. some bare soil, some denser and higher parts).	4
	Flower area or strip with very high nature value, a complex species composition, different structures e.g. due to old sunflower stalks, areas with different plant densities that serve as habitat for a great variety of animals.	5



Figure 4-15: Examples of flower areas and strips.

Top left: NV 3, mainly *Phacelia*, species-poor, top right: NV 4, diverse species composition, bottom: NV5, many species and different structures, including old stems.

4.5 Plot description

For each of the plots, a short description should be given here. The description might only consist of a few words, e.g. when the plot has a dominant landscape type, such as “species rich Dehesa” or “small-scale, species rich vineyards”, etc.). If the plot is more complex, up to 256 characters are allowed.

4.5.1 Plot nature value (overall estimation)

The overall estimation of the plot nature value serves as a rough and subjective estimation in order to compare the sum of the detail records with the overall impression. It needs to be explored in detail whether this overall estimation can be used as additional information in the long term.

The item comprises the following categories 1 to 5 and their intermediate stages:

1	very low nature value
1.5	between very low and rather low nature value
2	rather low nature value
2.5	between rather low and moderately high nature value
3	moderately high nature value
3.5	between moderately high and rather high nature value
4	rather high nature value
4.5	between rather high and very high nature value
5	very high nature value

A low plot nature value (1) is given when the whole plot comprises arable fields or grassland with highly intensive use and/or no or very few indicator species (Figure 4-16).

If in addition to these intensively used agricultural land with some landscape elements and structures occur (they have a nature value of 3 or 4 as singular elements) then the plot nature value raises to the value 2.

A plot nature value of 2 is also given if the majority of arable land and grassland has at least a few indicator species, or if most parcels have no or very few indicator species but one or two have many. Then, depending on the extent and the nature value of landscape elements (nature value of singular elements 3, 4 or 5) the plot nature value may rise to a value of 2.5 or 3.

The same principle applies to the further categories: the dominant land use type with its number of indicator species/land use intensity determines the plot nature value to the main extent but depending on extent and nature value of additional structures the plot nature value may raise for a half or 1 value score up to a maximum value of 5 (very high nature value).

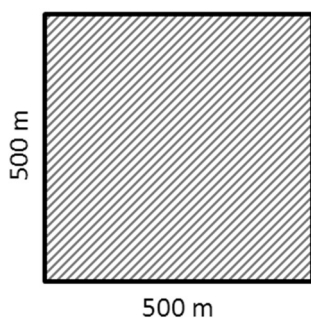


Figure 4-16: Examples for plots with differing nature values (NV)

upper left - intensive agricultural fields, but also much species rich grassland and a great number of hedgerows – plot NV 4; upper right: no landscape elements and only intensive arable fields are present – plot NV 1; lower left: mix of arable land and grassland of differing nature values, individual trees and bushes – plot NV 3.5; lower right: mix of grassland and arable land, grass-herb strips between agricultural fields, but without any arable fields or grasslands with a nature value of more than 3 – plot NV 2 to 2.5.

Note: the plot as a whole can have a high nature value even if not every single parcel has a high nature value. For example, a plot with a mosaic of high-quality landscape elements, some species rich extensive agricultural parcels and some intensively used species poor parcels can have a high or very high nature value (same value as compared to complete species rich use of the whole plot); in detail it depends on the individual situation on the plot.

This is indicated in the following examples:

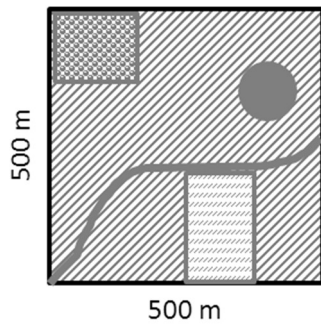


Example 1a) the whole plot is extensively-used species-rich grassland. There are no structural elements. Because of the species richness and the typical grassland vegetation, the plot can be given NV 4 or 5.

Example 1b) the vegetation in the plot is extensively used but species-poor = NV 3.

Example 1c) the plot is intensively used = NV 1 or 2.

Like in the example above,.



Example 2a) most parts of this plot are extensively-used species-rich grassland, but there is also an intensively used arable parcel (with use of fertiliser and plant protection products) taking up <20% of the plot, a complex of hedges and shrub and an orchard. The plot can have a NV of 5 despite the intensively used parcel, as it is “compensated” by a higher structural diversity.

4.5.2 Plot remarks

This field is for remarks concerning anything related to the observed land use, nature value and biodiversity of the plot as well as the study methodology.

5 Transect parameters

Transects are 20 m in length and the observation area is 1.25 m to each side of the surveyor.

It is advisable to walk the 20 m transect first with a step length of 1 m to determine the end point and then walk the transect back to the starting point doing the observations.

Transects are only recorded in grassland and arable land: these are pre-defined in the app/survey documents. There are four possible transect pairs per plot (field margin and field interior) and one transect in the plot centre, in case that this point is located on grassland.

In the case of the four transect pairs, the margin transect (A_1 - D_1) should run along the edge of the parcel (from the first seeding row in arable fields, or 0.5 m into the grassland parcel). The field interior transect (A_2 - D_2) should run in the direction of the seeding rows in the case of arable land or at a roughly 90° angle to the margin transect, wherever possible. It starts 10 m into the field from one end of the margin transect.

5.1 Both arable and grassland transects

5.1.1 Transect possible?

There might be some situations in which it will not be possible to walk a transect. In these cases, the transect should be skipped without replacement. Possible reasons for this might be:

- Access to land is denied or not possible, e.g. due to a fence, cattle on the pasture etc.
- The surveyor is not able to reach the point without serious risk to health or safety, e.g. when the point is located on a very steep slope in mountainous areas.
- Land use is not agricultural grassland

If the answer “No” is given, a reason is required (free text). If the parcel is accessible but the pre-defined transect is not possible or meaningful, then the transect should be shifted (see section 5.1.3).

5.1.2 Stage of the vegetation

This parameter describes how reliably the transect parameters can be observed, depending on to what degree the parcel has already been cut or grazed (in the case of grassland) or sown/harvested (in the case of arable land). The options are:

1. not mown or pastured (grassland)/ crop is visible/ developed: record is possible
2. partly mown/pastured (grassland)/ crop partially developed: record is difficult but possible
3. already mown or heavily pastured (grassland)/ crop not yet germinated or recently harvested: full record is not possible

5.1.3 Photos

Three or four photos should be taken:

- One photo from the starting point in the direction of the transect;
- One at the end of the transect backwards;
- One photo of the flower posy of the flowering plants of the transect.

- Optional: vegetation structure – aslant photo into the stand of the vegetation



Figure 5-1: Transect photos from the start and from the end, and a photo of the flowering plants from the transect

5.1.4 Transect shifted?

If the pre-defined transect cannot be done, but a transect is possible in the same parcel, answer “Yes” here and give a reason (free text). Possible reasons for shifting a transect are:

- It is not in an area of homogenous vegetation (e.g. there are deep wheel ruts running through the transect)
- The margin transect (A_1-D_1) is no longer at the field edge, e.g. because field borders have been shifted since the digital mapping during the preprocessing was carried out
- There is a blockage on the area of the transect (e.g. bales of silage have been placed at the field edge)

The transect should be shifted to the closest possible region of representative vegetation within the same parcel. In the case of the four transect pairs, the margin transect (A_1 - D_1) should run along the edge of the parcel (from the first seeding row in arable fields, or 0.5 m into the grassland parcel). The field interior transect (A_2 - D_2) should run in the direction of the seeding rows in the case of arable land, or at a roughly 90° angle to the margin transect in grassland, wherever possible. It starts 10 m into the field from one end of the margin transect. If the margin transect is shifted, the interior transect should be shifted to be in the matching position (even if it would have been possible at the original position).

The transects should not be within 10 m of the field corner (except in very small parcels).

Please draw the new transects in the map and indicate the coordinates of the start point.

If it is not possible to carry out the transect pair in the originally intended parcel, it can be shifted to a neighbouring grassland or arable parcel, as long as there is not already another transect pair in that parcel.

5.1.5 Inclination (arable and grassland)

The degree of slope on the area of the transect should be classified as follows: flat = (0) = 0%; (1) ≥0-3%; (2) 4-8%; (3) 9-15%; (4) 16-25%, (5) 26-40%, very steep slope (6) ≥40%

5.1.6 Site exposition (arable and grassland)

Note the exposition of the transect (not the direction of the transect!) – in which direction would a ball run if it were to be placed it on the ground (N, NE, E, SE etc.)?

If the slope is “flat”, the exposition will be automatically set to 0.

5.1.7 Flower density

Indicate the flower density **on the transect** according to the scale:

- 0 no flowers
- 1 very few flowers
- 1.5 between very few and a few scattered flowers
- 2 a few scattered flowers
- 2.5 between a few scattered flowers and medium flowering
- 3 some medium/regular but not dense flowering
- 3.5 between medium and dense flowering
- 4 dense flowering, but not a continuous “flower carpet”
- 4.5 between dense and a “flower carpet”
- 5 dense, continuous “flower carpet”

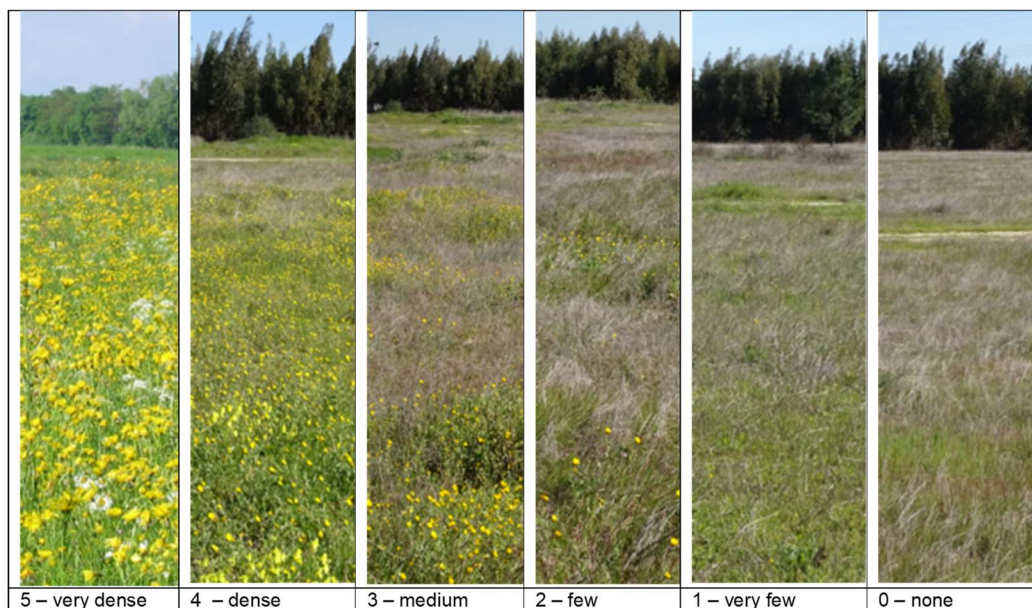


Figure 5-2: A range of flower densities from very dense (left) to none (right).

5.1.8 Colours of flowering forbs

Each type of flower colour that is visible **on the transect area** should be selected. The colour is selected only once, even if more species of the same colour occur. The number of colours will be calculated automatically in the app from the selection (on the paper sheet they will need to be counted by the surveyor). See section 4.1.11 for a more detailed description.

5.1.9 Number of species of flowering forbs

Count the total number of currently flowering forb species (also the species which have well developed flower buds almost ready to flower, and species which have just finished flowering and the dead flowerheads can be seen). This applies to **all insect-pollinated plant species**, i.e. species with mostly colourful flowers, no grasses/sedges, no plants with inconspicuous flowers like *Plantago* spec.

Watch out -also for very small flowers (e.g. flower diameter 3 mm) and flowers that look somewhat similar but belong to different plants (e.g. *Lotus corniculatus* and *Hippocrepis comosa*). The number of flowering forbs can be entered from 0 to 33 (it's extremely unlikely that there are more than 33 flowering species).

As a photo of a posy of the flowering forbs should be taken as documentation (Figure 5-3), the best way to count the number of flowering forbs is to do the counting by picking one flowering individual of each flowering plant species and afterwards taking the posy photo.



Figure 5-3: Example of a photo of a flower posy, showing 12 species of flowering forbs.

5.1.10 Record of indicator species

Lists with plant indicator species (or species groups) can serve as surrogates for biodiversity. For both grassland and arable land there is one indicator species list covering all biogeographic regions. There are many species on the arable list which may not occur at all in a given region. The indicator species are easily identifiable in the field, and neither very common nor very rare (see Annex 7.6 and 7.7 for the full list and pictures of the plants).

The method of recording indicator species on transect walks has proved to be effective in several grassland schemes in France, Germany and in Switzerland. However, on the European level such an approach for arable land has not been applied yet. The species which are on the EMBAL arable list are “potential” indicator species, and their usefulness as indicators will be analysed using the results of this survey.

While walking slowly along the transect line, the indicator species that are present and flowering should be noted (presence only – no estimation of coverage). If there are several species of one group (e.g. two *Campanula* species, for example *C. rotundifolia* and *C. patula*) the indicator species group is selected only once.

5.1.11 Remarks

In the remarks section for the arable and grassland transects, any comments that concern the vegetation survey are welcome.

5.2 Arable transects only

5.2.1 Height of crop

The height is measured in cm. It refers to the average height of the crop, not the highest stalk.

5.2.2 Coverage

The coverage is divided into the ground layer (<1.5 m) and the canopy layer (>1.5 m). Coverage values are recorded in % (0 %, 1-3 %, 4-8 %, 9-15 %, 16-25 %, 26-40 %, 41-60 %, 61-80 %, 81-100 %). Please note: although the crop coverage as well as the coverage of wild plants are already covered in the general observation of the parcel, the situation in the vegetation transects might be different, which is why it is recorded again here.

The **ground layer** may consist of different components, but the coverage of these must sum up to 100%.

- **Crop:** The coverage of the crop plants is estimated on the transect area in %. If a field has been sown but the seedlings are not yet (or only just) visible, 1 % should be selected.
- **Wild plants:** The coverage of non-crop (wild) plants is estimated in % on the transect area, excluding crop species that are growing spontaneously from the previous crop (“volunteers”).
- **Underseed:** Some annual crops are undersown with a seed mix to suppress weeds, for example cereals undersown with grass. Underseed plants show a much more regular pattern than wild plants.
- **Bare soil and stones:** Open soil with bare ground or stones which can be seen from above by looking down at the ground from approximately 1.5 m height (a standing position).
- **Woody layer** on the ground: this includes small or dwarf shrubs <1.5 m in height as well as bracken. Woody plants in the ground layer are very rare in arable fields.

The canopy layer is all woody plant material >1.5 m in height and recorded in % in addition to the ground layer.

- **Orchard:** usually fruit trees that shade a crop
- **Olive groves:** olive production can be mixed with arable crops
- **Others:** all other types of trees
- **(Shrubs:** all woody plants between 1.5 and 4 m in height) but please note that shrub normally doesn't occur in arable land



Figure 5-4: Examples of coverages in arable transects.

Top left - Crop 8-15 %, Wild plants 0%, Underseed 0%, Bare 80-100%, Woody 0%

Top right – Crop 0 %, Wild plants 0%, Underseed 0%, Bare 80-100%, Woody 0%

Bottom left – Crop 40-60 %, Wild plants 3-8%, Underseed 40-60%, Bare 0%, Woody 0%

Bottom right – Crop 25-40 %, Wild plants 60-80%, Underseed 0%, Bare 3-8%, Woody 0% (as the hedge next to the transect is not overhanging it).

5.3 Grassland transects only

5.3.1 EUNIS Grass habitat type

EUNIS is a European system for classifying habitats. Select one from the reduced list of potential EUNIS habitat types (and if necessary consider the direct surrounding for judging the type):

- X06 = Crops, meadows or pastures developed under orchards or other cultivated tree plantations
- X09 = Pasture woods
- D1 = Raised and blanket bogs
- E1 = Dry grasslands
- E2 = Mesic grasslands
- E3 = Seasonally wet and wet grasslands
- E4 = Alpine and subalpine grasslands
- E5 = Woodland fringes and clearings and tall forb stands
- E6 = Inland salt steppes
- E7 = Sparsely wooded grasslands
- F3 = Temperate and Mediterranean-montane scrub
- F6 = Garrigue
- I1 = Arable land and market gardens (ONLY the sub-type “Bare tilled, fallow or recently abandoned arable land”, which has regenerated into grassland)
- Other: please give a note on the type of habitat

The detailed descriptions of the EUNIS grassland categories are given in the following:

X06 Crops shaded by trees

Crops, meadows or pastures developed under orchards or other cultivated tree plantations if there is more than 10 % coverage of the tree canopy.

NB. The key distinguishing feature of X06 is that the trees are used for fruit or nut production and cultivated (i.e. generally found in neat rows), compared to X09, where they tend to have grown spontaneously and are mostly used for shelter for animals or wood production.

X09 Pasture woods

Typically this structure consists of large, open-grown or high forest trees (often pollards) at various densities, in a matrix of grazed grassland, heathland and/or woodland floras. A range of native species usually predominates amongst the old trees but there may be non-native species which have been planted or regenerated naturally.

D1 = Raised and blanket bogs

Peatlands formed by ombrotrophic acid peat, which is (or was while actively growing) capable of growth fed by rainfall rather than by the inflow of water from higher ground in the vicinity.

NB. Bogs have very dark soils and the surface is usually quite spongy to walk on.

E1 Dry grasslands

Well-drained or dry lands dominated by grass or herbs, mostly not fertilized and with low productivity. Included are *Artemisia* steppes. Excluded are dry Mediterranean lands with shrubs of other genera where the shrub cover exceeds 10%; these are listed as garrigue (F6).

NB. Dry grasslands often have sparse vegetation, and in regions with higher rainfall can be found on slopes with thin and/or stony soils where the water drains away quickly.

E2 Mesic grasslands

Lowland and montane mesotrophic and eutrophic pastures and hay meadows of the boreal, nemoral, warm-temperate humid and mediterranean zones. They are generally more fertile than dry grasslands (E1), and include sports fields and agriculturally improved and reseeded pastures.

NB. These are grasslands with moderate to high nutrient levels, water and productivity. They are the typical agricultural grassland.

E3 Seasonally wet and wet grasslands

Unimproved or lightly improved wet meadows and tall herb communities of the boreal, nemoral, warm temperate humid, steppic and mediterranean zones.

NB. The vegetation in wet grasslands tends to have rushes, sedges and reeds amongst the vegetation.

E4 Alpine and subalpine grasslands

Primary and secondary grass- or sedge- dominated formations of the alpine and subalpine levels of boreal, nemoral, mediterranean, warm-temperate humid and Anatolian mountains.

E5 Woodland fringes and clearings and tall forb stands

Stands of tall herbs or ferns, occurring on disused urban or agricultural land, by watercourses, at the edge of woods, or invading pastures. Stands of shorter herbs forming a distinct zone (seam) at the edge of woods.

E6 Inland salt steppes

Saline land with dominant salt-tolerant grasses and herbs. Excludes saline scrubland, listed under F6.8 xero-halophile scrubs.

E7 Sparsely wooded grasslands

Grasslands with a wooded overstorey that normally has less than 10% cover. This category E7 is restricted to three subcategories:

E 7.1: Atlantic parkland: Extensive surfaces of Atlantic regions of nemoral Europe occupied by grassland dotted with widely planted trees, characteristic of the British Isles, where they are usually enclosed, used for cattle or deer grazing.

E7.2: Sub-continental parkland: Grassland dotted with widely planted trees, to the east of the Atlantic zone of nemoral Europe.

E7.3: Dehesa: A characteristic landscape of the southwestern quadrant of the Iberian peninsula in which crops, pasture land or Mediterranean scrub, in juxtaposition or rotation, are shaded by a fairly closed to very open canopy of native oaks, *Quercus suber*, *Quercus rotundifolia*, *Quercus pyrenaica*, *Quercus faginea*.

F3 Temperate and mediterranean-montane scrub

Shrub communities of nemoral affinities. They include deciduous and evergreen scrubs of the nemoral zone, and deciduous scrubs of the submediterranean and supramediterranean zones. Excluded are heathlands with dominant [Ericaceae] F4, and the typically mediterranean maquis F5, garrigue F6 and phrygana F7.

F6 Garrigue

Evergreen sclerophyllous or lauriphyllous shrub vegetation, with an open canopy structure and some bare ground, usually with many winter annuals and vernal geophytes. Low shrubs of [Cistus], [Lavandula], [Rosmarinus] and [Stoechas] are usually present, and there may be some larger shrubs and scattered trees. Garrigue is found mostly in the Mediterranean, Macaronesian and Pontic regions, where it typically derives from degradation or regrowth of broad-leaved evergreen forests (G2), but it extends into deciduous forest areas in the supra-Mediterranean zone and sub-Mediterranean zones and into steppe areas in Anatolia. Includes scrubby land with mainly herbaceous vegetation and a large component of unpalatable non-vernal monocots ([Asphodelus], [Urginea]) and thistles, provided that shrub cover exceeds 10%.

I1 Arable land and market gardens

NB. For the purposes of EMBAL, this code is restricted to the subtype I1.5 Bare tilled, fallow or recently abandoned arable land: Fields abandoned or left to rest, and other interstitial spaces on disturbed ground. Set-aside or abandoned arable land with forbs planted for purposes of soil protection, stabilization, fertilisation or reclamation. Abandoned fields are colonised by numerous pioneering, introduced or nitrophilous plants. They sometimes provide habitats that can be used by animals of open spaces.

Other

If the vegetation doesn't fall in one of the categories described before please give a note and a short description of the habitat type.

5.3.2 Grassland age

It is not easy to judge grassland age (i.e. the length of time that the current vegetation has been growing without interruption by ploughing etc.). However, there are several signs that indicate if a grassland is more than or less than 5 years old:

Grassland older than 5 years (> 5 years):

- species-rich composition (normally more than 10 herb and grass species present), and
- no seeding rows from a seeding drill visible, the sward is rather dense and the composition / distribution of the grass and herb species on the ground is balanced.

Please note: very intensively managed meadows, with high slurry inputs after each of several cuts per year show less than 10 plant species and still are old in the sense of same use and no ploughing for many years.

Grassland 5 years old or younger (≤ 5 years):

- seeding rows of grassland are visible and / or
- only few grass and forb species occur (< 10 species)
- patches of open ground

Unclear

If there are no clear signs, choose this option.

5.3.3 Grassland fertilisation

This parameter covers the addition of nutrients to grassland, and has the following possible responses (see also Fig. 5-4):

- No: no additional fertiliser has been applied, i.e. there are no signs of manure or slurry application, and it is unlikely that this has happened at other times of the year (e.g. as is mostly the case with rough grazing). Occasional patches of dung do not count as signs of fertilisation (e.g. from occasionally pasturing goats), whereas a large amount of dung (e.g. >2% of the parcel covered by dung) due to intensive grazing does.
- Probably: the grass is lush and dark green and seems to be fertilised regularly but there are no direct signs of fertilisation; sward consists only of few species
- Sure: direct signs of fertilisation (e.g. slurry, manure or mineral fertiliser on the surface)
- Unclear: there are neither positive signs nor negative signs of grassland fertilisation



Figure 5-5: Grassland fertilisation.

From left to right: left: No additional fertiliser, middle: probably fertilised (grass is lush green but there are no visible signs), right: sure (slurry is visible on the surface).

5.3.4 Height herbaceous layer

The average height of the herbaceous layer (i.e. not the height of the highest stalks, but the average height of the main mass of the vegetation) is determined (in cm) by looking against the horizon.

5.3.5 Vigour of vegetation

Grassland types are often characterized by their often quite different types of vegetation height and density (vigour), ranging from very meagre (nutrient-poor and/or dry sites) to very dense vigour (naturally or artificially fertilized sites). The type of vigour in the parcel is indicated on a scale of 1-5 (see Figure 5-6).

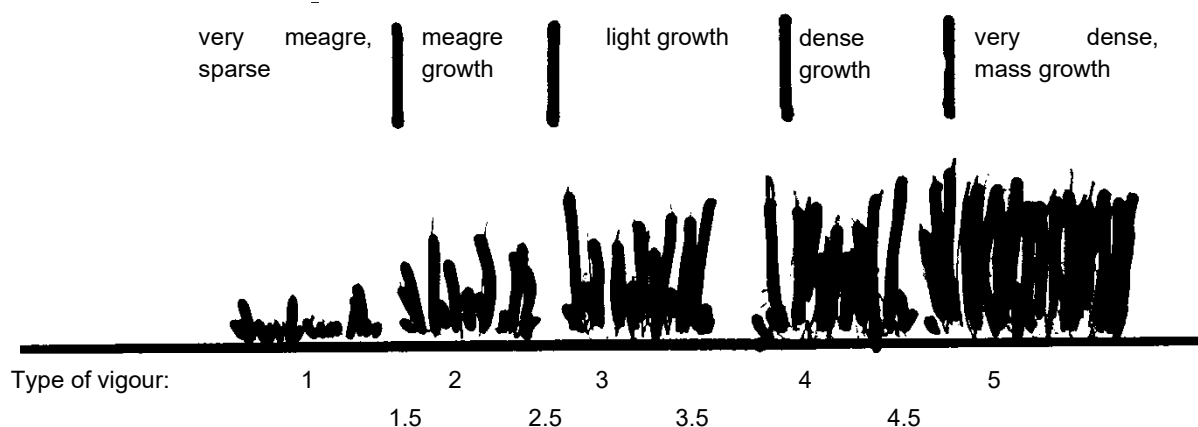


Figure 5-6: Illustration of the different vigour types in grassland

The height is not relevant for the type of vigour as the height depends mainly on the dominant species. The main characteristic for the type of vigour is the density, which limits the extent of sunlight that can reach the low plant species near the ground. Look vertically down at the ground and consider how easy it is to see the ground. Type 1 is a very sparse vegetation where the low-growing plant species or open soil can be seen fully; type 3 is light growth where the sunlight can reach almost all layers but with medium shading effects given through higher plants; type 5 is very dense vegetation where only the highest plants receive sunlight.

Evaluating vigour may be difficult when the grassland is grazed or has already been mown. The type of vigour is indicated when the vegetation is in full development in spring; thus grazed patches may be judged with the help of ungrazed patches remaining on the pasture. Meadows before the first cut should be judged according to the density that will be reached when the most of the grass species are flowering. For example, a score of 4 or 5 can be expected if one or few highly productive species dominate, whilst the grassland will probably be 1, 2 or 3 if there is space between the tall grasses and forbs and sunlight reaches the ground.

Please note: Although the vigour of vegetation as well as the graminoid-forb ratio are already covered in the general observation of the parcel, the situation in the two vegetation transects might be different.

5.3.6 Graminoid-forb ratio

Enter values for the ratio of cover of graminoids (grasses, sedges, rushes, reeds) to forbs (i.e. non-woody, broadleaved plants including fern species). The sum is always 100, also if the total coverage of this layer is only 50 % (and 50 % of bare layer or 50 % of bushes and dwarf shrub). Thus the values can be indicated as follows:

100:0, 90:10, 80:20, 70:30, 60:40, 50:50, 40:60, 30:70, 20:80, 10:90, or 0:100.

5.3.7 Coverage

The coverage is divided into the ground layer (<1.5 m) and the canopy layer (>1.5 m). Coverage values are recorded in % (0 %, 1-3 %; 4-8 %; 9-15 %; 16-25 %, 26-40 %, 41-60 %, 61-80 %; 81-100 %).

The **ground layer** may consist of the following components, but the coverage of these must sum up to 100%.

- **Herbaceous layer:** all graminoid, forb and fern species, i.e. non-woody plants.
- **Bare layer:** Open soil which can be seen from above by looking down at the ground from approximately 1.5 m height (a standing position).
- **Woody layer (on the ground): all woody plants** (small shrubs, dwarf shrubs) as well as **bracken**, <1.5 m in height

The **woody canopy** layer is all woody plant material >1.5 m in height and recorded in % in addition to the ground layer.

- **Shrubs:** all woody plants between 1.5 and 4 m in height
- **Orchard:** fruit trees
- **Others:** all other types of trees

5.3.8 Presence and cover of structural species

Certain species tend to dominate under certain conditions. These may indicate positive conditions for grassland nature value (signs of extensive use) or negative conditions (e.g. abandonment).

If the species on the list (see Section 7.4, and some examples in Figure 5-7) are present on the transect they should be selected and their coverage in % recorded (0 %, 1-3 %; 4-8 %; 9-15 %; 16-25 %, 26-40 %, 41-60 %, 61-80 %; 81-100 %).



Figure 5-7: Illustration of structural species in grassland: left: dark green rushes in the wet grassland (in the middle of the picture, partly dominating), middle grey sedges in the grassland dominating with about 40 % coverage, right docks with the big leaves dominating with about 30 % in this vegetation.

5.3.9 Total cover of legumes

Legumes are plants in the Fabaceae (pea and bean) family that are agronomically useful because they fix nitrogen in the soil. They include many species of clover (*Trifolium* spp.) and vetch (*Vicia* spp.) as well as alfalfa/lucerne (*Medicago* spp.) and lupin (*Lupinus* spp.). Record the total coverage of these species on the transect area in in % (0 %, 1-3 %; 4-8 %; 9-15 %; 16-25 %, 26-40 %, 41-60 %, 61-80 %; 81-100 %).

6 FAQs

- What should I do if I am not allowed to/can't access the land to walk a transect on the parcel?
Please select the option "parcel not fully observable" and give an explanation.
- Should I walk a transect on mown/mulched grassland?
It is difficult to judge several of the parameters (such as vigour and presence of indicator species) on recently cut grassland. Select the option "Stage of grassland"= "partly mown/pastured" or "already mown or heavily pastured" and try and record as many parameters as you can. The information from the "Stage of grassland" parameter will be used to flag certain parameters as unreliable and to be interpreted with caution.
- I can't find an appropriate code for the land cover/landscape element I see in the field, what should I do?
Please take a photo of the land cover/landscape element and send it to the survey coordinator, describing your difficulties and indicate the Plot ID as well as the ID of the element. The coordinator will provide help or can discuss jointly what is the best solution.
- What should I do if there are obstacles on the transect?
In case you are not able to walk 20 m into the parcel without encountering an obstacle such as bushes, trees, boulders or other elements, shift the direction or the starting point of the transect so that you have a homogenous area to survey, following the rules for shifting in Section 3.4.
- Should I record a species-rich grass-herb strip alongside a path though it is below 1 m width?
In general, strips or buffers below the threshold of 1 m are not recorded.

7 Annexes

Content

- 7.1 List of codes for types of land cover and landscape elements
- 7.2 Parcel parameters
- 7.3 Recording sheet for grassland transects
- 7.4 Recording sheet for arable transects
- 7.5 Time framing
- 7.6 List of indicator species
- 7.7 Photo guidance indicator species (separate document)

7.1 List of codes for types of land cover and landscape elements

LC code	Landcover	Category	Code	Specification		Extent min/max	
eA	Arable land	Non permanent crops <i>Areas smaller than 25 m² (only observing the area within the plot) are ignored/integrated into the surrounding parcel</i>	eA11	Wheat (winter and spring, also incl. Triticale, Durum)	eA41	Clovers	>25 m ²
			eA12	Barley	eA42	Lucerne	
			eA13	Rye	eA43	Grass-Clover-Mixture	
			eA14	Oats	eA44	Sown grass on arable land	
			eA15	Maize	eA45	Other legumes and mixtures for fodder	
			eA16	Rice	eA51	Vegetables (also asparagus, strawberries, etc.)	
			eA17	Other cereals (including mixed cereals for fodder)	eA52	Plastic tunnel	
			eA21	Potatoes	eA53	Greenhouse culture	
			eA22	Sugar beet	eA61	Other non permanent crops	
			eA23	Other root crops	eA71	Mostly bare soil, for example: - recently ploughed grassland - recently sown arable land - Regularly ploughed soil that is not used for production, but to keep the ground layer free of vegetation (e.g. underneath a woody crop, or in the case of a fire break).	
			eA31	Sunflower			
			eA32	Rape and turnip seeds			
			eA33	Soya	eA80	Fallow / set-aside arable land	
			eA34	Cotton	eA81	Flower strips and flower areas	
eA35	Tobacco						
eA36	Floriculture and ornamental plants						
eB	Permanent cultures and tree	Permanent cultures and trees <i>If tree cover <5% of the parcel, trees are mapped as individual trees (eE11). eB-codes must be assigned as LC2 to the LC1 codes eA-eE)</i>	eB11	Fruit orchard: Orchard with fruit trees of all kinds, mostly with stems > 1.5 m and grassland between the stems		>25 m ²	
			eB12	Fruit tree plantations: in contrast to fruit orchards dense plantations, trees in rows and the lowest branches are in a height mostly of < 1.5 m. mostly the grass is mulched and the plantations are often fenced.			
			eB13	Berry plantations: in case of mixed fruit tree and berry plantations indicate the most dominant type.			
			eB14	Olive groves			
			eB15	Vineyards			
			eB16	Other trees (e.g. Dehesas)			
			eB17	Nurseries (including Christmas trees)			
			eB18	Other permanent cultures (including permanent energy wood plantations)			
eB	Fallow	Fallow land	eA80	Arable fallow with no active use this year, but signs of agricultural use in the last 1-2 years (ruderal vegetation, no woody species). The vegetation is dominated by spontaneous vegetation and/or tall herbs or weeds.		>25 m ²	

eC	Grassland	Meadows <i>Meadows are only or predominantly cut (i.e. not grazed, or only to a small degree). Signs of mowing are that the vegetation is very even in height, often it is not fenced and there are no signs of animals.</i>	eC11	Very intensive meadow. Vegetation dominated by grasses (few forbs), intensive green colour, cut up to 5 times a year	>25 m ²
			eC12	Intensive meadow. Vegetation with both grasses and forbs, less intensive green than C11	
			eC13	Medium intensive to extensive meadow. Vegetation with both grasses and forbs, usually paler green colour than C11/C12	
			eC14	Extensive meadow	
			eC15	Very extensive meadow, no signs of fertiliser application	
		Meadow or pasture	eC16	Meadow or pasture (or both uses) of moderate intensity. This category may only be chosen if there are signs of both mowing and grazing (e.g. it has very evenly cut vegetation but there is a water trough in the field and it is fenced).	
		Pastures <i>Pastures are only or predominantly grazed. They usually have vegetation that is uneven in height (e.g. with thistles), fences, animals on the pasture, animal tracks, dung, and/or a water supply/salt lick or shelters for animals.</i>	eC21	Intensive pasture. Vegetation dominated by grasses (few forbs), intensive green colour, grazed very short and/or with areas of trampled bare earth.	
			eC22	Medium intensive pasture. vegetation with both grasses and forbs, some woody plants may occur, sometimes some dead stems of plants from last year. Please use LC2 code eE13 to indicate the coverage of a woody layer (bushes, shrub, trees).	
			eC23	Extensive pasture. Vegetation with both grasses and forbs, some woody plants may occur, usually paler green vegetation with some dead and yellowing plants, patches of taller vegetation. Please use LC2 code eE13 to indicate the coverage of a woody layer (bushes, shrub, trees).	
			eC24	Only occasionally grazed (very extensive), up to 70% shrub or tree cover (see eD10 or eC25), dead plant material may occur, few signs of animals (e.g. dung). Please use LC2 code eE13 to indicate the coverage of a woody layer (bushes, shrub, trees).	
		Other grassland	eC25	Pastured woodland with >70% tree canopy cover (average over the area of the parcel) and obvious signs of grazing by domestic animals (dung, etc.). Please use LC2 code eN10 (forest) to indicate the coverage of the tree canopy.	
			eC31	Ruderal / fallow grassland (not mown, not pastured). The vegetation is uneven, with old leaves (yellow/brown colour) from last year and often some woody stems. Ruderal grassland has developed from bare earth without being seeded.	
			eC41	Mulched grassland (i.e. cut but not harvested) e.g. in fruit orchards or amenity grassland such as parks and golf courses if outside of settlements. (Areas inside settlements should not be mapped separately - amenity grassland inside settlements = eN40)	
			eC51	Other kinds of grassland, including natural grassland (e.g. alpine grassland, mostly at altitudes > 1500 m)	
eD	Shrubland	Shrubland with sparse tree cover	eD10	Shrubland with >70% shrub cover and tree canopy cover from 0-70% (above 70% is eN10 or eC25). Shrubs are defined as woody plants up to 4 m in height, trees are above 4 m in height. Bracken is also included in this category.	>25 m ²
eE	Landscape element	Woody elements	eE11	Isolated trees with a crown radius of minimum 3 meters or a height of minimum 4 m or small groups of trees. If the tree canopy cover makes up >5% of the surrounding parcel area, this code can be used as LC2. If ≥4 trees are in an obvious line, see eE12.	≥4 m height or ≥3 m radius

		eE12	Tree lines and avenues. Trees with minimum height of 4 m in a line of at least 4 trees, space between trees maximum 20 m (if not see eE11). This code can only be used as LC2.	≥4 trees
		eE13	Hedges, woody strips, field coppices and riverine scrub (including trees and bushes). If the woody canopy covers a distinct area of ≤ 0.25 ha with >70%, eE13 should be entered as LC1 . If the woody canopy is scattered on a parcel covering > 5 %, eE13 should be entered as LC2 , with the appropriate ground cover land use as LC1. If the woody canopy covers a distinct area of >0.25 ha with >70% and there are no signs of agricultural use, the parcel should be coded as non-agricultural (LC1 = eN10).	> 25 m ² + ≤ 0.5 ha
	Grass-herb elements and reed-sedge beds	eE21	Grassy strips, including field margins, embankments and buffer strips around linear elements such as watercourses or hedges. Width of strips is 1 to 20 m. Wider areas should be classified as eC (e.g. eC31). Grassy strips >1 m wide along tracks and roads do not belong to the road but should be mapped separately under this code. Trees and bushes up to 70% coverage are allowed (>70% see eE13). Strips <1 m in width are integrated into the adjacent parcel. Areas >20 m wide see eC codes.	1-20 m
		eE22	Reed or sedge beds up to 1 ha in size without regular agricultural use. If >0.5 ha then eN20	>25m ² ≤0.5 ha
	Water elements <i>Including banks and riparian vegetation up to 5 m on either side - for linear elements up to a total width of 20 m</i>	eE31	Rivers and streams, including their riverbanks (define the vegetation in LC2), up to 20 m in width. Larger areas of open water see eN30.	1-20 m
		eE32	Standing small water bodies such as natural or man-made ponds or oxbow lakes, including their banks, up to 0.5 ha in area. Larger areas of open water see eN30.	≤0.5 ha
		eE33	Ditches with flowing or standing water, or dry. Ditches are man-made structures for drainage or irrigation, running usually in straight lines.	1-20 m
	Stone, rock, raw soil and terrace elements <i>If >1 linear element per 20 m distance, or in the case of rocks/stones > 1/100 m², then these codes can be selected as LC2 for the whole parcel. If selected as LC 2 then automatic nature value for parcel of 4 or 5</i>	eE41	Terrace elements, dry stone and natural stone walls, at least 1 m wide including the adjacent vegetation. Also brick and cement walls can be included here, but should be assigned a nature value of 1-2. If at a high density of ≥ 1 wall /20 m of slope mixed with other land cover, eE41 should be entered as LC2 , with the appropriate ground cover land use as LC1 (or in case of presence of woody structures as LC2 (e.g. vineyards) the small terraces then need to be split into new parcels and coded as eE41.	≥1 m width as LC1
		eE42	Field stone heaps and cairns.	Up to 1 per 20 m, or ≥ 1 /100 m ² for stones as LC2
		eE43	Sand, clay and loess escarpments. Not formed through human activities, but e.g. glacier or alluvial processes.	
		eE44	Isolated rock outcrops larger than 1 m diameter. If at a high density of ≥ 1 /100 m ² mixed with other land cover, eE44 should be entered as LC2 , with the appropriate ground cover land use as LC1.	
		eE45	Raw soil sites (stone, sand, dirt surfaces with little or no veg.) larger than 1 m diameter. If obviously anthropogenic (gravel extraction site, open cast mine, building site) then see eN50.	
	Roads and tracks	eE51	Dirt / Grass track. This excludes paths that are hard to distinguish from the adjacent area on the (these should not be mapped)	≥1 m width
		eE52	Gravel track	

			eE53	Paved farm tracks (including asphalt with grass strip). Public roads and highways whose main purpose is not agricultural traffic should be coded as eN40	
		Man-made structures, artefacts and other elements	eE61	Field barn (for greenhouses see eA53)	≥1 m width
			eE62	(Machinery/animal) shed	
			eE63	Woodpiles	
			eE64	Solar panels (must be recorded as LC2 with the appropriate ground level land cover)	
			eE65	Antenna/electric pylon/wind turbine	
			eE66	Other elements	
eN	Non-agricultural elements		Forest	eN10	
		Wetland	eN20	Inland and coastal wetlands, including marshes, bogs and fens ≥ 0.5 ha in size and with <70% canopy cover of trees.	>0.5 ha
		Open water	eN30	Large inland or coastal running or standing water bodies	>0.5 ha or > 20 m width
		Settlement area and asphalt roads and railways	eN40	Settlement areas, industrial areas, buildings, villages and garden areas, official roads and railways including adjacent landscape elements	≥25 m ²
		Other open, non-agricultural	eN50	Other anthropogenic but not agricultural or forestry land use/land cover	≥25 m ²
			eN60	Other natural elements, such as natural grassland (e.g. not regularly grazed alpine grassland, mostly very steep) scree fields and large stone outcrops	≥25 m ²
eZ	Pre-classification unclear	Pre-classification unclear	eZ	Classification during pre-processing (CAPI) unclear. Code cannot be selected during field work.	≥25 m ²

Landscape Elements

ID	Can be observed?	Element type LC 1	Type LC2	Coverage LC2 (%)	Width ≤ 5 m	Length if ≤ 20 m	Nature value	Remarks

Plot description

Plot photos taken? _____

Nature value	Plot description	Remarks

7.4 Recording sheet for arable transects

Arable land transect Surveyor: _____ Date: ___/___/___ Point-ID: _____

LC1: _____ LC2: _____ coverage LC2 : _____ % Transect ID : _____

1 Transect information: direct shifted no transect possible If shifted or no, why?: _____
If shifted, new start coordinates: _____

Stage of the arable land developed /visible crop (record is possible) culture not visible yet (freshly sown or fallow) (record is partly possible) already harvested (full record is **not** possible)

2 Photos:

photo type	from start	from end	flower posy	vegetation structure
photo ID				

3 Site exposition: 3a Flat direction of slope 3b Inclination: 0 1 2 3 4 5 6
Inclin. classes 0 1 2 3 4 5 6
Percent classes 0% >0-3% 4-8% 9-15% 16-25% 26-40% 0%

4a Coverage: 4a Crop _____ % 4b Height of crop: _____ cm
 Wild plants _____ % Woody canopy layer (trees above):
 Orchard: _____ %
 Underseed _____ % Olive groves _____ %
 Bare soil, stones _____ % Others: _____ %
 Woody layer _____ % (woody layer on ground = seldom in arable)
 (Sum of coverage = 100 %)

5 Number of flowering forbs: 5a _____ 5b Flower: no very few me- dense very
(Possible values: 0 – 33) density flowers few medium dense dense

6 Flowering colours: Brown White Yellow Orange Red Magenta Purple Blue Green Mixed

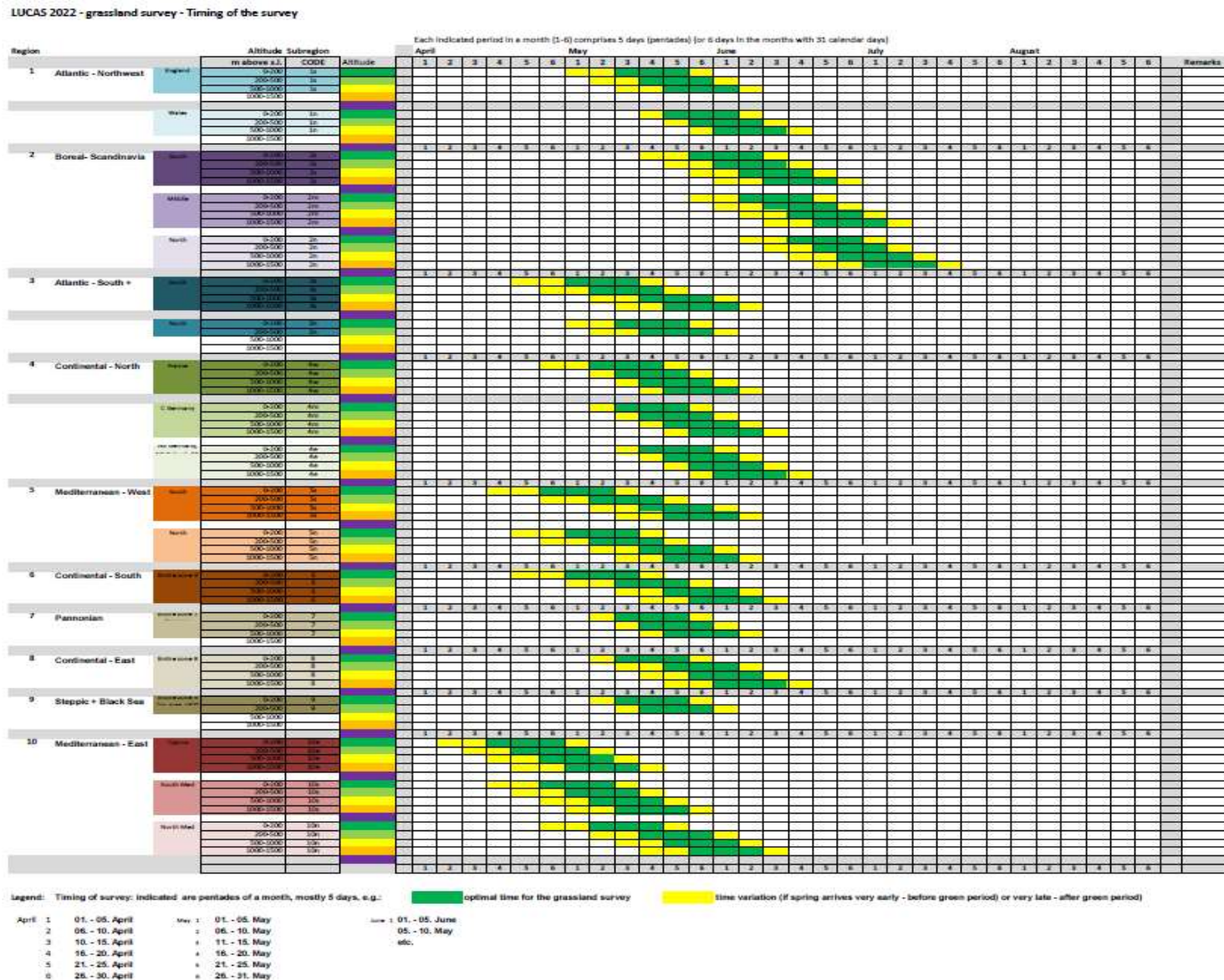
7 Key species for species richness:

Anagallis spec.	<input type="checkbox"/>	Galeopsis spec.	<input type="checkbox"/>	Rumex spec.	<input type="checkbox"/>
Anthemis spec.	<input type="checkbox"/>	Juncus spec.	<input type="checkbox"/>	Silene spec.	<input type="checkbox"/>
Apiaceae white/yellow flowering	<input type="checkbox"/>	Lamium spec.	<input type="checkbox"/>	Spergula arvensis	<input type="checkbox"/>
Asteraceae yellow flowering	<input type="checkbox"/>	Lapsana communis	<input type="checkbox"/>	Stachys spec.	<input type="checkbox"/>
Calendula spec.	<input type="checkbox"/>	Lathyrus spec.	<input type="checkbox"/>	Thlaspi arvense	<input type="checkbox"/>
Centaurea spec.	<input type="checkbox"/>	Legousia spec.	<input type="checkbox"/>	Trifolium spec.	<input type="checkbox"/>
Chrysanthemum spec.	<input type="checkbox"/>	Linaria spec.	<input type="checkbox"/>	Valerianella spec.	<input type="checkbox"/>
Cirsium spec., Carduus spec.	<input type="checkbox"/>	Lithospermum arvense	<input type="checkbox"/>	Veronica spec.	<input type="checkbox"/>
Consolida spec.	<input type="checkbox"/>	Lythrum spec.	<input type="checkbox"/>	Vicia spec.	<input type="checkbox"/>
Epilobium spec.	<input type="checkbox"/>	Matricaria spec.	<input type="checkbox"/>		
Erodium spec.+ Geranium spec.	<input type="checkbox"/>	Medicago spec.	<input type="checkbox"/>		
Eryngium campestre	<input type="checkbox"/>	Mentha spec.	<input type="checkbox"/>		
Euphorbia spec.	<input type="checkbox"/>	Myosotis spec.	<input type="checkbox"/>	Remarks:	
Fabaceae red/bleu	<input type="checkbox"/>	Ornithogalum spec.	<input type="checkbox"/>		
Filago spec.	<input type="checkbox"/>	Papaver spec.	<input type="checkbox"/>		
Fumaria spec.	<input type="checkbox"/>	Ranunculus spec.	<input type="checkbox"/>		
Remarks / further species:					

8 Remarks: _____

7.5 Timeframing based on biogeographic region and elevation

Time framing of the grassland surveys as set out by the European Commission in the technical documents for the LUCAS surveys



7.6 List of indicator species

Part I – Arable land

Indicator species for species richness:			
<i>Anagallis</i> spec.	<input type="checkbox"/> __	<i>Lapsana communis</i>	<input type="checkbox"/> __
<i>Anthemis</i> spec.	<input type="checkbox"/> __	<i>Legousia</i> spec.	<input type="checkbox"/> __
Apiaceae white/yellow flowering	<input type="checkbox"/> __	<i>Linaria</i> spec.	<input type="checkbox"/> __
Asteraceae yellow flowering	<input type="checkbox"/> __	<i>Lithospermum arvense</i>	<input type="checkbox"/> __
<i>Calendula</i> spec.	<input type="checkbox"/> __	<i>Lythrum</i> spec.	<input type="checkbox"/> __
<i>Centaurea</i> spec.	<input type="checkbox"/> __	<i>Matricaria</i> spec.	<input type="checkbox"/> __
<i>Chrysanthemum</i> spec.	<input type="checkbox"/> __	<i>Mentha</i> spec.	<input type="checkbox"/> __
<i>Cirsium</i> spec., <i>Carduus</i> spec.	<input type="checkbox"/> __	<i>Myosotis</i> spec.	<input type="checkbox"/> __
<i>Consolida</i> spec.	<input type="checkbox"/> __	<i>Ornithogalum</i> spec.	<input type="checkbox"/> __
<i>Epilobium</i> spec.	<input type="checkbox"/> __	<i>Papaver</i> spec.	<input type="checkbox"/> __
<i>Erodium</i> spec. + <i>Geranium</i> spec.	<input type="checkbox"/> __	<i>Ranunculus</i> spec.	<input type="checkbox"/> __
<i>Eryngium campestre</i>	<input type="checkbox"/> __	<i>Rumex</i> spec.	<input type="checkbox"/> __
<i>Euphorbia</i> spec.	<input type="checkbox"/> __	<i>Silene</i> spec.	<input type="checkbox"/> __
Fabaceae red/blue flowering	<input type="checkbox"/> __	<i>Spergula arvensis</i>	<input type="checkbox"/> __
Fabaceae yellow flowering	<input type="checkbox"/> __	<i>Stachys</i> spec.	<input type="checkbox"/> __
<i>Filago</i> spec.	<input type="checkbox"/> __	<i>Thlaspi arvense</i>	<input type="checkbox"/> __
<i>Fumaria</i> spec.	<input type="checkbox"/> __	<i>Valerianella</i> spec.	<input type="checkbox"/> __
<i>Galeopsis</i> spec.	<input type="checkbox"/> __	<i>Veronica</i> spec.	<input type="checkbox"/> __
<i>Juncus</i> spec.	<input type="checkbox"/> __	<i>Vicia</i> spec.	<input type="checkbox"/> __
<i>Lamium</i> spec.	<input type="checkbox"/> __		

Part II – Grassland

Indicator species / species groups			
Apiaceae	<input type="checkbox"/> ___	Orchidaceae	<input type="checkbox"/> ___
<i>Campanula</i> sp.	<input type="checkbox"/> ___	<i>Scabiosa</i> sp., <i>Knautia</i> sp., <i>Succisa</i> sp.	<input type="checkbox"/> ___
<i>Centaurea</i> sp., <i>Serr. tinctoria</i>	<input type="checkbox"/> ___	<i>Silene</i> sp. - red flowering, <i>Lychnis flos-cuc.</i> , <i>Dianthus</i> sp.	<input type="checkbox"/> ___
<i>Cirsium</i> sp., <i>Carduus</i> sp., <i>Carlina</i> sp., <i>Eryngium planus</i> , <i>Echinops</i> sp.	<input type="checkbox"/> ___	<i>Trifolium</i> sp. - red flowering	<input type="checkbox"/> ___
<i>Juncus</i> sp.	<input type="checkbox"/> ___	<i>Trifol.</i> sp., <i>Medicago</i> sp. <i>Lotus</i> sp., <i>Coronilla</i> sp. - yellow flowering	<input type="checkbox"/> ___
<i>Myosotis</i> sp.	<input type="checkbox"/> ___	<i>Vicia</i> sp., <i>Lathyrus</i> sp., <i>Astragalus</i> sp. (blue+purple flowering)	<input type="checkbox"/> ___

Part III – Structural species grassland

for structural characterisation:	
Shrub/ Brushwood/ Bramble	<input type="checkbox"/> ___ %
Thistles (<i>Carduus</i> sp., etc.)	<input type="checkbox"/> ___ %
Docks (<i>Rumex</i> sp., but not <i>R. acetosa</i>)	<input type="checkbox"/> ___ %
Rushes (<i>Juncus</i> sp.)	<input type="checkbox"/> ___ %
Sedges (<i>Carex</i> sp.)	<input type="checkbox"/> ___ %
Small-reed (<i>Calamagrostis</i> sp.)	<input type="checkbox"/> ___ %

7.7 Picture guide for the identification of the indicator species

(→ please see separate document)