

European Monitoring of Biodiversity in Agricultural Landscapes

EMBAL

Survey Manual 2023



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from

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Content

Content	3
Figures	6
Tables	7
1 Purpose of the EMBAL field survey	8
2 Definitions of elements in the agricultural landscape	9
2.1 Agricultural landscape and landscape elements.....	9
2.2 Non-agricultural land	9
3 Overview of the EMBAL field survey	11
3.1 Structure of the survey	11
3.2 Terminology	11
3.3 Elements to be surveyed.....	12
3.4 Accessing and observing parcels and landscape elements.....	12
3.5 Preparation of the survey	13
3.5.1 Survey period	13
3.5.2 Surveyor kit – what to take into the field.....	13
3.5.3 Safety	14
4 Parameters	15
4.1 All parcels and landscape elements	15
4.1.1 Parcel ID and geometry.....	15
4.1.2 Accessibility and observation	16
4.1.3 Land cover 1 (LC1)	17
4.1.4 Land cover 2 (LC2)	18
4.1.5 Coverage of LC2	20
4.2 Arable and grassland parcels	20
4.2.1 Stage of the vegetation	20
4.2.2 Irrigation	22
4.2.3 Presence of extensive field strips.....	22
4.2.4 Width of extensive field strips.....	23
4.2.5 Flower density	23
4.2.6 Colours of currently flowering forbs.....	24
4.2.7 Evaluating changes in previously surveyed parcels	28
4.2.8 Parcel images	29
4.2.9 Further remarks.....	29
4.3 Arable parcels	30
4.3.1 Non-woody crop coverage	30
4.3.2 Wild plant coverage.....	31
4.4 Grassland parcels	32
4.4.1 Vigour of vegetation	32
4.4.2 Graminoid-forb ratio	33

4.5	Complexes of land-covers	34
4.5.1	Number of land use units	35
4.5.2	Complex land cover 1 (cLC1)	36
4.5.3	LC1 coverage	36
4.5.4	Complex land cover 2 (cLC2)	36
4.5.5	LC 2 coverage	36
4.5.6	Subjective nature value (sNV) of land covers	36
4.5.7	Subjective nature value of the complex	37
4.6	Landscape elements	38
4.6.1	Type of element	38
4.6.2	Width of landscape elements < 5 m	38
4.6.3	Length of landscape elements < 20 m	38
4.6.4	Subjective nature value of landscape elements	38
4.7	Overall plot survey	45
4.7.1	Plot accessibility	45
4.7.2	Plot characterisation	45
4.7.3	Subjective plot nature value (overall estimation)	46
4.7.4	Plot remarks	49
4.7.5	Plot photos	50
5	Transect parameters	51
5.1	All transects	51
5.1.1	Transect location	52
5.1.2	Transect possible?	52
5.1.3	Transect shifted?	53
5.1.4	Parcel Land Cover	54
5.1.5	Stage of the vegetation	54
5.1.6	Recording of the transect line	54
5.1.7	Transect photos	55
5.1.8	Inclination	56
5.1.9	Site exposition	56
5.1.10	Flower density	56
5.1.11	Colours currently of flowering forbs	57
5.1.12	Number of species of currently flowering forbs	58
5.1.13	Record of currently flowering indicator species	58
5.1.14	Remarks	58
5.2	Transects on arable fields	60
5.2.1	Height of crop	60
5.2.2	Vegetation layer coverage	60
5.3	Transects on grassland	62
5.3.1	Vigour of vegetation	62
5.3.2	Height herbaceous layer	63
5.3.3	Graminoid-forb ratio	63
5.3.4	Vegetation layer coverage	64

5.3.5	Presence and cover of structural species.....	64
5.3.6	Total cover of legumes.....	65
5.3.7	EUNIS Grass habitat type	65
5.3.8	Grassland age.....	68
5.3.9	Grassland fertilisation.....	69
5.4	Evaluating changes in previously observed transects	70
6	Annexes.....	73
6.1	List of codes for types of land cover and landscape elements.....	74
6.2	Recording sheet at parcel level	80
6.3	Recording sheet for complexes of land covers	81
6.4	Summary of transect shifting rules	82
6.5	Recording sheet for grassland transects	83
6.6	Recording sheet for arable transects.....	84
6.7	Timeframing based on biogeographic region and elevation.....	85
6.8	List of indicator species	86
6.9	Picture guide for the identification of the indicator species	88
6.10	Image sources	89

Figures

Figure 3-1: Example of a 500 x 500 m EMBAL plot.	11
Figure 4-1: Renumbering of parcels when splitting and joining during the survey.	15
Figure 4-2 Geometry changes in part of a plot.	16
Figure 4-3: Example of parcels with LC1 and LC2:.....	18
Figure 4-4 Extensive pasture (eC23) with shrub coverage (eE14) of 25 -40 %.	18
Figure 4-5: Example of a complex landscape element.	19
Figure 4-6 Stage of vegetation in a grassland	21
Figure 4-7 Crops in different stages of development:	21
Figure 4-8: Irrigation in the field	22
Figure 4-9 Examples of extensive field strips.....	23
Figure 4-10: A range of flower densities	24
Figure 4-11 Development of a <i>Taraxacum officinalis</i> flower.....	24
Figure 4-12 Types of plants with inconspicuous flowers.	25
Figure 4-13 Examples of parcel pictures	29
Figure 4-14: Crop coverage.....	30
Figure 4-15 Coverage of wild plants	31
Figure 4-16: Illustration of the different vigour types in grassland.	32
Figure 4-17 Examples of different vigour	33
Figure 4-18 Examples of land cover complexes	35
Figure 4-19: Examples for grassy strips (eE21) with differing subjective nature values	40
Figure 4-20: Example for judging the nature value of landscape elements.	41
Figure 4-21 – Examples for different roads and tracks	42
Figure 4-22 – Example for a man-made structure:.....	43
Figure 4-23 Examples of man-made structures.....	43
Figure 4-24: Examples of flower areas and strips.	44
Figure 4-25: Examples for plots with differing nature values (NV).....	48
Figure 5-1 Construction of the margin transect.	51
Figure 5-2: Transect photos from the start and from the end.	55
Figure 5-3 Example of a posy picture.	55
Figure 5-4 Pictures of the vegetation structure.	56
Figure 5-5: A range of flower densities from very dense (left) to none (right).	57
Figure 5-6: Example of a flower posy.	57
Figure 5-7: Examples of ground coverage in arable transects.	61
Figure 5-8: Illustration of the different vigour types in grassland	62
Figure 5-9 Grasslands with different type of vigour.....	63
Figure 5-10 Illustration of structural species in grassland.	64
Figure 5-11 Examples of leguminous plants.....	65
Figure 5-12 Seeding rows in grassland < 5 years old.	69
Figure 5-13: Grassland fertilisation.....	70
Figure 5-14 Differences in the color of grasslands due to fertilization.	70
Figure 6-1 Time framing of the EMBAL 2022 survey as set out by the European Commission in the technical documents for the LUCAS surveys.....	85

Tables

Table 2-1 Overview of codes and definitions for land cover categories and landscape elements used in the EMBAL methodology.10

Table 4-1 Descriptors of a parcels observability17

Table 4-2 Examples of combinations of land cover 1 and land cover 2.....19

Table 4-3 Descriptors for the growth state of the vegetation in grasslands and arable fields. ..20

Table 4-4 Examples of different flower colors26

Table 5-1 Levels of grassland fertilisation.....69

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

The EMBAL 2022-2023 survey is designed to apply the EMBAL-methodology in all 27 EU-Member states, to assess its applicability in the field and establish a baseline data-set. The EMBAL survey is also harmonized with other European approaches like the Land Use/Cover Area Survey (LUCAS), 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 and arable 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 and the field survey sheets.

2 Definitions of elements in the agricultural landscape

2.1 Agricultural landscape and landscape elements

For the EMBAL survey 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 four types of land use: **arable crops**, **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 land

Land that does not form part of the *agricultural used* 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:

- Forests
- Wetlands including marshes, uncultivated or natural bogs and intertidal flats.
- Big rivers, lakes and marine waters and their banks/shores.
- Official roads and railways and adjacent landscape elements.

- 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);

A summary of the EMBAL land cover codes and their definitions is provided in the following table, the **full list of codes is provided in Annex 6.1**.

Table 2-1 Overview of codes and definitions for land cover categories and landscape elements used in the EMBAL methodology.

See Annex 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	All kinds of different arable cultures Fallow arable land, arable set aside	> 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 a secondary code	Covering > 8 % of a parcel
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 grassland (not mown / pastured) Mulched grassland Other kinds of grassland	> 25 m ²
eD	Shrubland	Grazed shrubland	eD10	Shrubland with >70% shrub and tree cover from 0-70%; intermittently used for grazing animals	> 25 m ²
eE	Landscape element	Woody elements	eE11 – eE14	Isolated trees, tree lines, groups of trees, small woodlands, hedges, field coppices etc.	Trees > 4 m tall Woodland > 25 m ²
		Grass-herb elements	eE21 eE22	Grassy strips, including field margins, embankments and buffer strips Small grassy patches with permanent grass-herb cover	1-20 m wide >25 m ² , ≤0.5 ha
		Water elements and reed or sedge beds	eE31 – eE34	Rivers, ditches, ponds and reed/sedge beds	1-20 m wide / > 25 m ² , ≤ 0.5 ha
		Stone, rock, raw soil and terrace elements	eE41 – eE45	Dry stone and natural stone walls, stone heaps, rock outcrops, earth escarpments or raw soil etc.	≥ 1 m wide
		Roads and tracks	eE51- eE53	Dirt / Grass track (permanent), Gravel track, Paved farm tracks	≥ 1 m wide
		Man-made structures, artefacts, other elements	eE61- eE65	Field barns, solar panels, pylons etc.	≥ 1 m wide
		Flower strips	eE71	Flower strips or flower areas	≥ 1 m wide
eF	Complexes of land-covers	Multiple types of land-use in one parcel	eF11- eF31	Complexes of gardens, orchards or terraced landscapes.	> 25 m ²
eN	other Non-agricultural land	Forest	eN10	Forest, both natural forests and afforestation	≥ 0.5 ha
		Wetland	eN20	Inland and coastal wetlands	≥ 0.5 ha
		Open water	eN30	Large inland or coastal running or standing water bodies	≥ 0.5 ha or >20 m wide
		Settlement area and infrastructure	eN40	Settlement areas, industrial areas, buildings, official roads, and railways	≥ 25 m ²
		Other open, non-agricultural	eN50 eN60	Other anthropogenic but not agricultural land Other natural elements	≥ 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 sample¹ (Land Cover/Use Area Frame Survey), 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 the 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 the recording of vegetation/biodiversity data takes place.

1: <https://ec.europa.eu/eurostat/web/lucas/data/lucas-grid>

3.2 Terminology

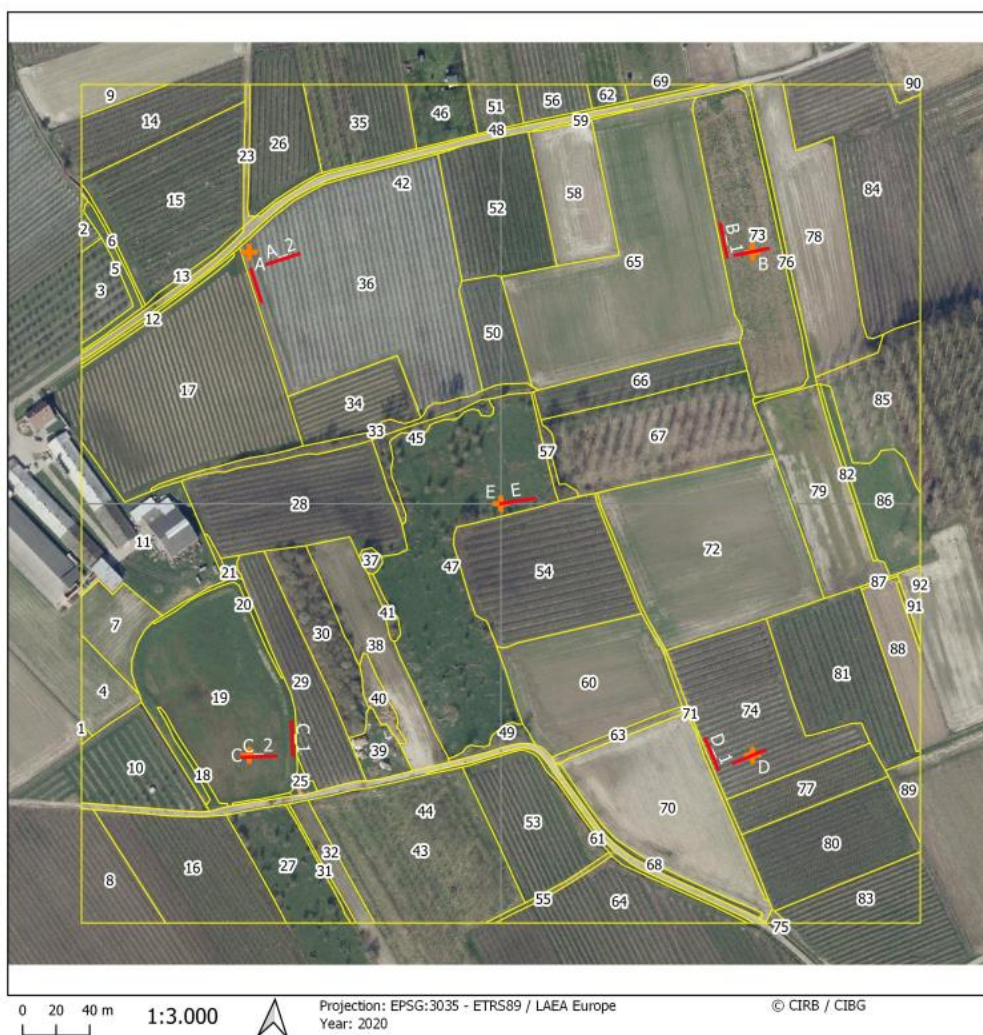


Figure 3-1: Example of a 500 x 500 m EMBAL plot.

Yellow lines define the individual (agricultural) land use parcels. 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 units of agricultural land, which exceed an area of 25 m² (Land cover classes eA – eD and eF); non-agricultural land will be classified in land cover 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 (land cover class eE). For most LE there is a minimum size of 25 m² and a maximum size of 0.50 ha, with a few exceptions (please see annex 6.1 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 an ID number. Since it is not possible to see the same detail of management via the images, **the delineation of parcels must be assessed in the field, changes must be noted, and corrected during post-processing.**

In each plot, the field survey comprises two elements:

1. **Surveying parcels:** 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.

The average time to survey an EMBAL plot is about half a workday. This depends on the complexity of the plot and the number of necessary changes.

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 walking on the 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 position of the parcel must be entered in the survey-app.

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 corresponding rules, feedback to the coordinators is essential so the manual can be adapted to specific situations. **Uncertainties should always be communicated to the coordinators or helpdesk** 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 are highly advised for route planning. However, access to plots might be difficult and require more time than planned, so a time buffer 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 peak 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 annex 6.7**.

The survey may be carried out up to 5 days before the beginning of the “optimal survey period” or up to 10 days after the end of the “optimal survey period”. This temporal leeway should be utilized to correct for differences in the stage of plant development, in case of a very warm or cold spring, which might accelerate or delay plant growth. Changes to the start of the survey must be discussed with the survey coordinators beforehand.

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 2022-2023 survey. **Note that the ODK app does not run on iPhones**. The smartphone should have at least 16 GB of free space.

Devices and materials necessary during the survey process are:

- Android (minimum version 8.1) smartphone or tablet with a camera with a resolution of at least 1600 x 1200 pixel
- Power bank or ability to charge the phone in the car
- Maps of the plots (provided by survey coordinators)
- Clipboard
- Pens/pencils (should be suitable for writing on colour prints)

- Survey manual, Vegetation guide (see Annex 6.8 and 6.9), EMBAL-leaflet to explain the mission of the survey to interested third parties
- Measuring tape and stick
- Compass with inclinometer or compass app for smartphone

In case it is not possible to work with the app, printouts of the survey sheets can be utilized (see Annex 6.2 to 6.6). It is however **very highly recommended to use the ODK-app**. Data input from paper sheets into the ODK-app is very time consuming and should only serve as an emergency back-up.

For navigating to and in a plot, it is advantageous to bring the following:

- Navigation system for the car
- Binoculars
- GPS
- Overview maps as orientation in the field (optimum scale 1:25,000)

Further attire and materials:

- Proper clothing: hiking boots, long trousers, gloves
- Rain protection: raincoat, rain hat, rain trousers, wellingtons/rubber boots, umbrella, waterproof phone-case
- Sun protection: sunscreen, wide brimmed hat, long-sleeve clothing
- Sufficient drinking water
- 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. Surveyors should additionally 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.

Surveyors should take local knowledge into account when assessing dangers. In certain regions hazards such as bears, wolves, livestock guardian dogs / shepherd dogs, snakes or ticks must be considered. When handling plant material, giant hogweed (*Heracleum mantegazzianum*) must be avoided.

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 as well as landscape elements. For reference, the paper version of the survey is given in the Annex 6.2 to 6.6.

4.1 All parcels and landscape elements

It is often the case that the boundary of the EMBAL plot runs through a continuously used parcel. For example a big wheat field of 5 ha, of which only 2 ha are located within the plot. **Only the area within the plot should be utilized to assess most EMBAL parameters.**

4.1.1 Parcel ID and geometry

Each parcel and landscape element are assigned a parcel ID. Each plot will have been digitally mapped based on orthophotos before the fieldwork. They may need to be modified in the field, because land use may have 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 which are moved every few weeks or months do not count as a parcel border: only permanent border structures are relevant here.

Geometry changes applicable to parcels are either:

- **Cutting parcels** apart into multiple parts:
Example A: The parcel identified as ID 5 is split during fieldwork into three parts with three different land cover codes: Old ID: 5 → New IDs: 5, 1005, 2005
- **Merging parcels** together to form bigger areas, deleting a parcel.
Example B: Two parcels of similar size are merged, original IDs: 8 and 10 → New ID: 10. Which ID is chosen for the remaining parcel is not relevant here.
- **Combination of the two operations**, meaning a part is cut off from one parcel and merged with another parcel, effectively moving the border between the parcels.
Example C: The border between parcel 4 and 7 needs to be moved. A part of parcel 4 is split off and merged with parcel 7, moving the border between the parcels but deleting neither of them.

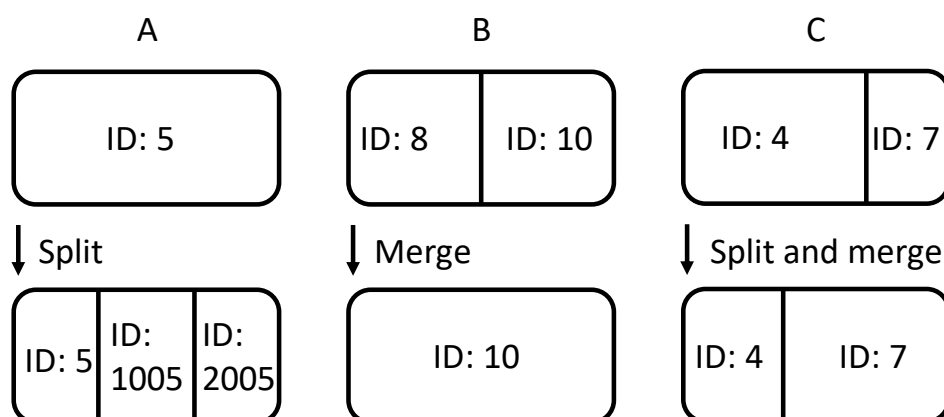
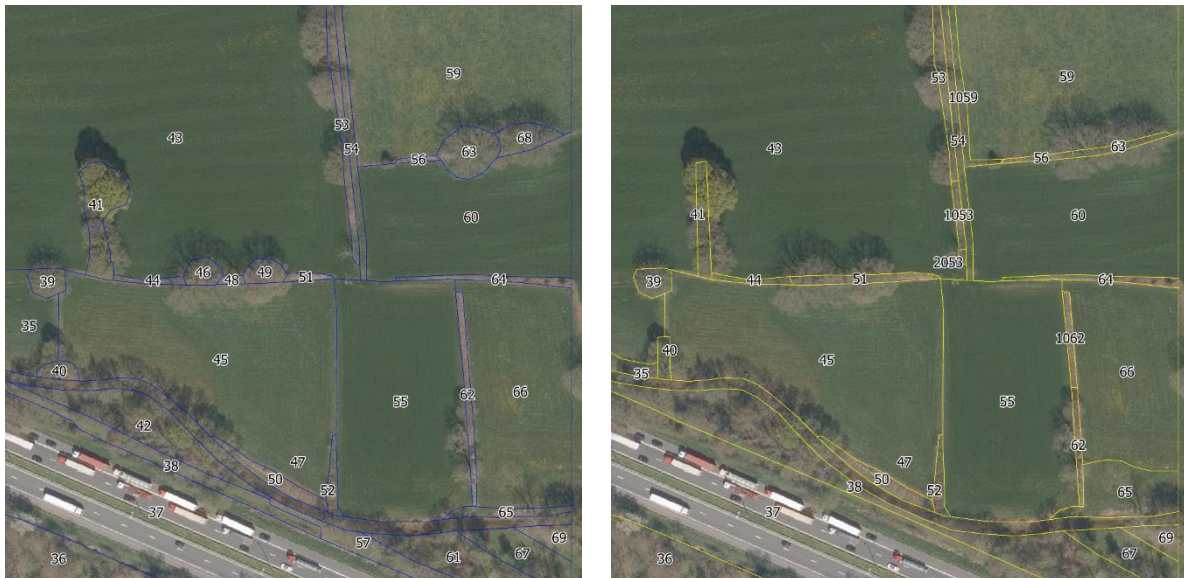


Figure 4-1: Renumbering of parcels when splitting and joining during the survey.



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Figure 4-2 Geometry changes in part of a plot.

Left image: parcel delineation via Computer Aided Photo Interpretation (CAPI).

Right image: changes to parcel delineation by surveyor.

Some individual trees and grass strips (Parcels 41, 44, 46, 48, 49 and 51) have been combined into bigger tree-line elements (eE13). Parts of Parcel 35 have been added to parcel 43. The parcels 1053, 2053, 1059 and 1062 have been newly created and split of from already existing parcels.

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

The **ODK app does not automatically check whether parcels have already been observed** nor which new ID's have been generated. There is however a list available, showing all already surveyed elements. This list can be compared with a list of all parcel ID's present in the plot, printed on the back of the ground document to check that all parcels which have been observed. Wrongly attributed parcel IDs can however be corrected during the post-processing of the data.

4.1.2 Accessibility and observation

All parcels should be surveyed from their edge. Surveyors should approach parcels on the footpaths and field tracks as well as alongside the border of parcels such as:

- Grass strips between arable fields
- Edges of grassland
- Forest margins which are adjacent to fields
- Alongside a water course or ditch

Table 4-1 Descriptors of a parcels observability

Yes	The parcel can be seen, one can walk up to it and assess it.
Partially	The parcel can be seen from a distance (up to 20m) or through an obstacle (e.g. a loose hedge)
No, but PI possible	This option should be selected if the parcel is not observable in the field but the orthophoto allows a reliable determination of the eN land cover. Since no further parameters are recorded for eN anyway, classification by photointerpretation is possible here.
No	The parcel cannot be accessed physically (dangerous terrain, land owner denying access) and/or cannot be seen because of an obstacle (thick hedge, concrete wall). The parcel can also not be adequately described using orthophotos (due to the photos being for example out of date) Issues relating to accessibility should also be communicated to the survey coordinators.

4.1.3 Land cover 1 (LC1)

LC1 describes the **first layer of vegetation** and thus often the main land-use present in each parcel. It describes mostly the layer of non-woody vegetation present in the parcel. An exception to this is the LC-Code eD10 – “Shrublands”, which should be used as LC1 despite consisting of mostly woody vegetation. In the case of landscape elements, it describes the primary attribute of a given element. This may also include some mostly woody elements such as thick hedges (eE14) or single trees (eE11).

See Annex 6.1 for the full list of land cover codes

In case of parcels which extend beyond the border of the EMBAL plot, the entire area of similar land use can be observed to assess the kind of LC1. This is most important for features which are dependent on size, such as for example “eE34-reed sedge beds” and “eN20-wetland”. As these are primarily distinguished from one another by size, with eN20 used for wetlands over 0.5 ha. In the field the entire area taken up by the land-use, even parts beyond the plot boundary, should be considered when deciding on a LC1 code. **All other parameters however must be assessed only on the parcel area within the EMBAL plot.**

If there is **mixed land cover**, an additional layer (LC2) can also be added, as explained in the next section. In case of heavily interconnected parcels with many small parcels such as terraced landscapes or small scale garden areas, specific LC-Codes for “**complexes of land covers**” can be utilized to describe such cases, this will be further explained in section 4.5.

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
- eB18 Other permanent cultures
- eC51 Other kinds of grassland

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.

4.1.4 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, vineyards, Dehesas or agroforestry systems, the land cover consists of two layers. **LC1 is the ground layer** (arable and fallow land (eA), grassland (eC)) and **LC2 is the woody layer**, consisting of woody vegetation such as (fruit) trees, wine-plants, berry bushes or shrubs.

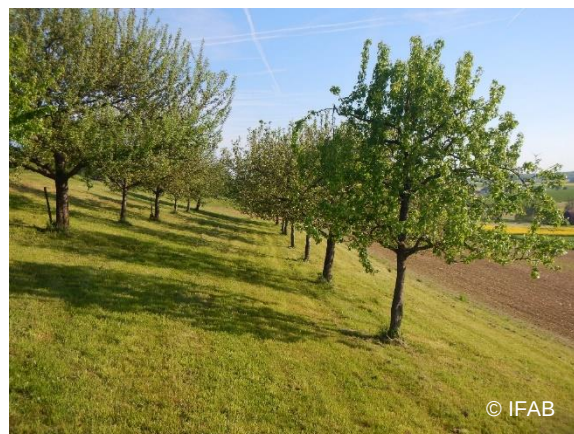


Figure 4-3: Example of parcels with LC1 and LC2:.

Left: Dehesa in Spain: Barley with holm oaks. LC1 = eA13 (barley) + LC2 = eB16 (other trees), LC2-coverage 8-15 %

Right: Fruit orchard in Germany: Fruit trees with mulched grassland. LC1 = eC41 (mulched grassland) + LC2 = eB11 (fruit orchard), LC2-coverage: 25-40 %

LC2 can also be used to indicate landscape element types, such as hedges and scrub (eE14) or patches of stones (eE42), that are so frequent that it is difficult to delineate each individual patch of scrub (see the list of examples of LC combinations below).



Figure 4-4 Extensive pasture (eC23) with shrub coverage (eE14) of 25 -40 %.

If there are **more than two applicable LC codes**, a given **parcel should be split into separate polygons** to disentangle the land cover types. This is especially common for landscape elements, which may consist of more than two features to describe. If the land cover types are

too entangled to separate them into different polygons, the most dominant features of an element should be put into the LC1 and LC2 categories.

For example, a grass strip (eE21) with a stone wall (eE41) and a hedge (eE14) overgrowing the wall in some parts. In this case, describe the wall as LC1 and the hedge as LC2, with an appropriate coverage, foregoing the grass strip.



Figure 4-5: Example of a complex landscape element.

The landscape element consists of a stone wall (eE41), and small groups of trees (eE12) 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 eE12 with coverage 8-15 %).

Note that most **codes for woody vegetation may only be entered as LC2** and cannot occur as LC1. eN codes can only be entered as LC1. For more detailed descriptions of the Land Cover codes see Annex 6.1. The following list provides some examples of LC1/2 combinations.

Table 4-2 Examples of combinations of land cover 1 and land cover 2.

Description	LC1	LC2 (coverage)
Vineyards with bare tilled soil between the rows	eA71	eB15 (40-60 %)
Vineyards with alternating bare soil and grassy vegetation between the rows	eA72	eB15 (40-60 %)
Plastic tunnels with strawberry cultivation	eA52	None (in Greenhouses or tunnels the crop must not be further assessed)
Fruit orchard with old trees with round crowns (i.e. not espalier plantations) at a low density and moderately intensive pasture underneath	eC22	eB11 (40-60 %)
Olive grove with a dense canopy and bare tilled soil underneath	eA71	eB14 (80-100 %)
Pasture with scattered oaks covering > 8 % of the parcel (if < 8 %, each tree has to be delineated individually)	eC23	eE12 (8-15 %)
Grazed vegetation with a dense canopy of hornbeam, beech and ash covering > 70 % of the parcel	eC25	eE12 (60-80 %)
Abandoned pasture with scrub encroachment	eC31	eE14 (40-60 %)
Occasionally grazed pasture with a high density of stones covering the surface	eC24	eE42 (8-15 %)
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	eE13 (25-40 %)
Mediterranean shrubland with scattered large oak trees used very seldomly for grazing	eD10	eE12 (8-15%)

Hedge consisting of bushes with individual trees (>4 m) sticking out of it and < 30 % grassy vegetation	eE14	None, because trees and < 30% grassy vegetation are included in the description
Asphalt/concrete track with a central grass strip	eE53	None (the grass strip is included in the asphalt track)
Solar farm with a large number of individual panels over mulched grassland	eC41	eE64 (80-100 %)

4.1.5 Coverage of LC2

If an LC2 is present (see previous section) then its coverage must 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 < 8 % of the parcel the trees should be mapped as individual elements (eE11 or eE12). Above 8 % they should be assigned as LC2 to the LC1 codes eA - eE.

The coverage of the LC2 layer is entered in the percentage categories seen on the right:

Coverage
0%
1-3%
>3-8%
>8-15%
>15-25%
>25-40%
>40-60%
>60-80%
>80-100%

4.2 Arable and grassland parcels

4.2.1 Stage of the vegetation

This parameter describes the **current status of the vegetation** in a parcel. The **EMBAL survey aims to assess parcels during the peak of plant growth in spring**, when a wide variety of wild plants is flowering.

The assessment of the parcel parameters thus depends on the current state of the vegetation. For grasslands this means whether the parcel has already been cut or grazed or for arable fields whether it is freshly sown or even already harvested.

Table 4-3 Descriptors for the growth state of the vegetation in grasslands and arable fields.

Grassland:	Arable Land
Not mown or pastured: The first growth of vegetation is still standing	Crop is in full development, the crop plants cover over 25 % of the parcel
Regrowth after first cut/pasturing: The first growth of vegetation has been cut, the vegetation has regrown to > 20 cm in height.	Crop plants are not yet in full development and the crop plants cover less than 25 % of the parcel
Mown/pastured recently: The vegetation is cut or grazed and < 20 cm in height	Crop has been sown or germinated only recently (plants < 5 cm tall) Crop has been harvested already

In certain biogeographic regions, grasslands tend to exhibit very low growth rates and do not grow taller than 20 cm. In such cases, try to assess whether the grassland has already been grazed or cut by comparing it with neighboring parcels or vegetation in adjacent landscape elements.

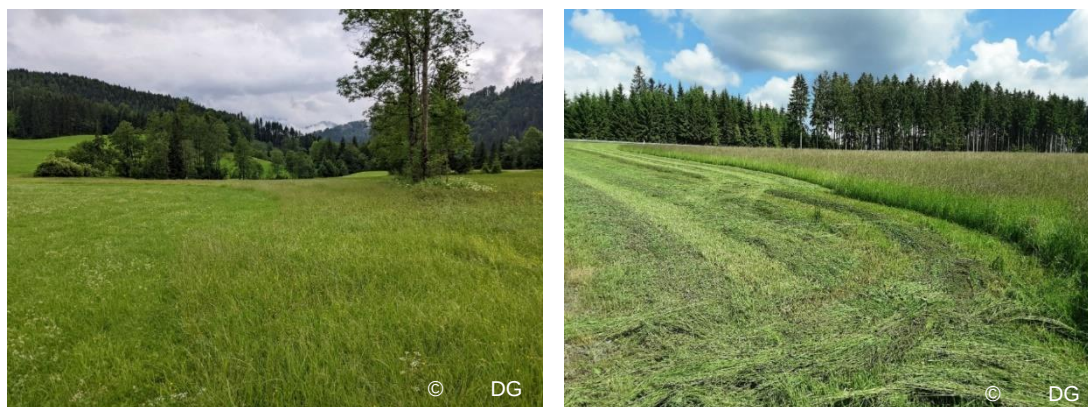


Figure 4-6 Stage of vegetation in a grassland

Left image: A meadow in first growth (right half of picture) and in regrowth after mowing (left half of picture).

Right image: A meadow in which one part has been recently mown, while the standing grass on the right hand side is still from the first growth.



Figure 4-7 Crops in different stages of development:

Upper left: Sugar beet (eA22) in full development – the plants cover more than 25% of the parcel and are in full growth.

Upper right: Sunflower (eA31) in full development – the plants cover more than 25% of the parcel and are in full growth, even though they are still somewhat small for the species in question.

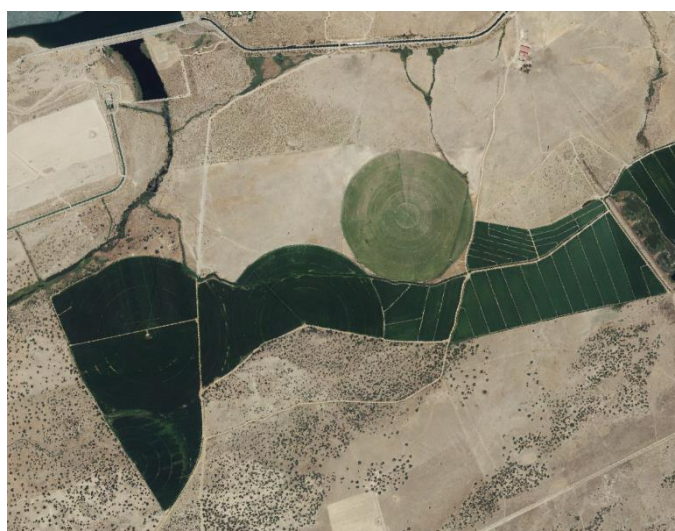
Lower left: wheat (eA11) in full development, covering the entire field evenly.

Lower right: Maize (eA15) not yet in full development. The plants are still very small after having germinated only recently and cover less than 25 % of the field.

4.2.2 Irrigation

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 see Figure 4-8) and/or through signs on the ground such as irrigation pipes. This parameter has three possible levels:

- Irrigated
 - Irrigation equipment installed on field between plants
 - Active irrigation going on at the moment
- Maybe irrigated
 - Irrigation pipes lying close to the field
 - Vegetation is considerably greener than adjacent, similar parcels – especially apparent during dry conditions
 - Wells for irrigation present close to the field but not currently used
- No obvious irrigation



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Figure 4-8: Irrigation in the field

Upper left: Examples of irrigation patterns visible in ortho-photos.

Upper right: PVC pipes in a maize field for irrigation

Bottom: Centre-pivot sprinkler for circular irrigation

4.2.3 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 4-9).

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. Strips sown with flowering plants, but no crop plants should be entered as “eE71 – Flower strips/Flower areas”.

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 4-9 Examples of extensive field strips

Left: Grassland with strip of uncut vegetation.

Right: Cereal field with strip of reduced herbicide application, exhibiting increased numbers of wild plants.

4.2.4 Width of extensive field strips

If “Yes” was selected for the previous question, the width of the extensive strip should be entered in meters. If a strip varies in width, the mean width should be measured.

4.2.5 Flower density

Estimate the **average visible flower density** according to the following scale. This ranges from no flowers to the densest possible flower coverage, see Figure 4-10 .

- 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** **very dense, continuous “flower carpet”**

Note that category 5 does not imply 100% flower coverage, as this does not occur outside of e.g. oilseed rape monocultures, but the most dense coverage that is naturally possible. Only wild

flowers in the herbaceous vegetation on the ground are considered, **not the flowers on trees and shrubs** nor **flowering annual crops** such as sunflower or oilseed rape.



No flowers	Very few	Few	Medium	Dense	Very dense
------------	----------	-----	--------	-------	------------

Figure 4-10: A range of flower densities

No flowers on the left to very dense on the right.

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.

4.2.6 Colours of currently flowering forbs

Each **type of flower colour** from **currently flowering herbaceous plants** that can be seen is selected. This includes flowers which are in the process of opening, with the petals visible, or flowers which recently finished with flowering, where the petal color can still be distinguished, see also Figure 4-11. The colours of flowering forbs are observed in an observation window of approximately 20 m along the parcel edge.

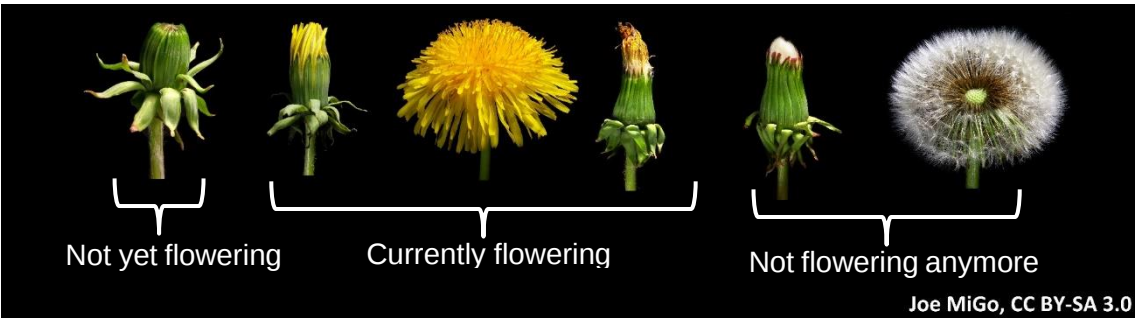


Figure 4-11 Development of a Taraxacum officinalis flower

For image source refer to annex 6.10.

Note that **only wildflowers in the herbaceous vegetation** on the ground are considered, **not the flowers on trees and shrubs** nor **flowering annual crops** such as sunflower or oilseed rape.

Plants with **inconspicuous flowers** (i.e. small, green flowers which don't get frequently visited by pollinators) **should not be considered** when assessing the number of currently flowering forbs. Examples for these are all **graminoids** (grasses, sedges and rushes) and forbs such as **docks or sorrels** (*Rumex sp.*), **stinging nettle** (*Urtica sp.*), **plantains** (*Plantago sp.*) or **goosefoots** (*Chenopodium sp.*), see Figure 4-12.



Figure 4-12 Types of plants with inconspicuous flowers.

These must **not** be taken into account for assessing the currently flowering species.

Upper row: *Rumex acetosa*, *Plantago lanceolata*, *Chenopodium album*

Lower row: *Urtica dioica*, *Carex exsiccata*

For picture credits see annex 6.10

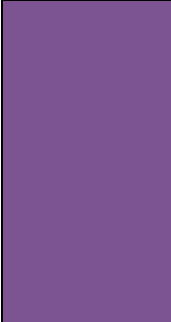
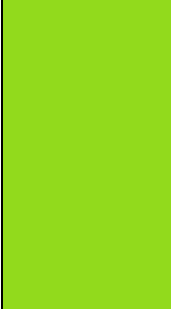
Any given colour is selected only once, even if more species of the same colour occur. There are 9 colour categories, including the category “mixed”. Mixed means that the flower has at least 2 colours and that at least 20 % of the flower is of another colour than the dominant colour (e.g. a daisy with yellow disc flowers in the centre and white ray flowers surrounding it). **When unsure whether two flowers of similar colour should be classed as the same colour or not, it is preferable to assign them to different colour categories.**

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).

Table 4-4 Examples of different flower colors

For image sources see annex 6.10.

White			
Yellow			
Orange			
Red			
Magenta			

Purple			
	 © IFAB	 © DG ENV	 © IFAB
Blue			
	 © Hermann Schachner	 © DG ENV	 © Hans Hillewaert
Green			
	 © H. Zell	 © Robert Flogaus-Faust	 © Anro0002
Mixed			
At least 2 colours. At least 20 % of the flower is of another colour than the dominant colour	 © Sepulnation1986	 © DG ENV	 © Agnieszka Kwiecień / Nova

4.2.7 Evaluating changes in previously surveyed parcels

Most parcels will already have been surveyed in the previous year. During the re-visit of a plot, changes to survey-parameters may occur. When selected parameters are changed between this and the last survey year, the probable origin of the change must be estimated.

Parameter changes can be **either due to a real change in the land-cover** or **due to issues with the assessment of the parameters** in the previous survey year.

There are **five Types of Change (ToC)**:

- **ToC1 - Phenological reasons:** Differences in survey timing leading to different assessments
- **ToC2 - Change of definitions:** Changes in parameter definitions which lead to a change in how the data is stored
- **ToC3 - Surveyor variation:** Changes due to different interpretation of the survey
- **ToC4 - Real change:** Actual, meaningful change in land-cover, land use or vegetation
- **ToC5 - Other** (Free text entry) – Choose this option, if you cannot be sure why change occurred between the two years.

The ODK app will show parameters assessed during the previous survey year. It is important to **not just copy these values** but **assess what can be seen on the field** and note any differences and the most probable reason for these to have occurred!

- **ToC1 - Phenological reasons:** Parcels may have been observed very late during the growing season in 2022. This may have lead to wrong attribution of a LC code – make sure to be aware of the date of assessment for a given parcel when checking for estimating the kind of change.
- **ToC2 - Change of definitions:** Due to updates to the survey instructions, codes have received updates, leading to differences between the codes of two years, see the list below for codes affected by changes. In such cases, the LC-code of a parcel is updated, even though the real land-cover itself did not change.

EMBAL 2023 Code	Short definition	EMBAL 2022 Code
eF11	<i>Garden complex</i>	<i>eB19</i>
eF31	<i>Terrace landscape</i>	<i>eE41</i>
eE11 and eE12	<i>Solitary tree</i>	<i>eE11</i>
eE13	<i>Tree line / avenue</i>	<i>eE12</i>
eE14	<i>Hedges / shrubs</i>	<i>eE13</i>
eE41	<i>Stone wall</i>	<i>eE42</i>
eE42	<i>Stone heap</i>	<i>eE43</i>
eE43	<i>Isolated rock</i>	<i>eE44</i>
eE44	<i>Earth escarpment</i>	<i>eE45</i>
eE45	<i>Raw soil site</i>	<i>eE46</i>
eE61	<i>Agricultural building</i>	<i>eE61 and eE62</i>
eE62	<i>Woodpile</i>	<i>eE63</i>
eE63	<i>Solar panel</i>	<i>eE64</i>
eE64	<i>Electric pylon</i>	<i>eE65</i>
eE65	<i>Other LE</i>	<i>eE66</i>
eE71	<i>Flower strip</i>	<i>eA81 and eE71</i>

- **ToC3 – Surveyor variation:** Subjective surveyor interpretation may lead to different or even wrong assessments of parameters. This can also include misattributions based on parcel size, such as a small woodland < 0.5 ha being defined as “eN10 - forest” instead of “eE14 – small woodland / shrub area”.

- **ToC4 – Real change:** describe meaningful changes to the land cover, land use and key vegetation parameters on a parcel, which are not likely due to any reason detailed above. Examples for this would be:
 - A grassland being ploughed between years, changing from eC to eA
 - Trees being felled in an orchard, reducing the coverage of LC2.
- **ToC5 – Other:** Choose this option, if you cannot be sure why change occurred between the two years. There is also the possibility to supply a free text and give an estimation for the probably origin of the apparent change.

4.2.8 Parcel images

For the purposes of Quality Control photos have to be taken of certain parcels.

During the **survey of the first two plots**, a picture has to be taken of **each surveyed parcel**. These are used in the quality control, to ensure that the work done by each surveyor is satisfactory.

During the **plots surveyed after the first two**, pictures will be required from a **random selection** of parcels. These may later also be utilized for further quality control, to give additional feedback.

Furthermore, pictures can be added to any parcel if necessary. These might help explain one's decision-making process in assigning certain values to parameters.

Make sure to take the pictures in **landscape format**, showing approximately 20 % sky and 80 % parcel area. The picture should show the vegetation present on the parcel and if possible, the extent of the parcel.



Figure 4-13 Examples of parcel pictures

Pictures show the parcel area, with the crop / grassland structure and vegetation composition. They are taken in landscape format (horizontally).

4.2.9 Further remarks

This field is for remarks concerning anything related to the observed land use, nature value and biodiversity of the parcel as well as related to the study methodology or factors inhibiting access to a parcel. There are some pre-made remark options, as well as the possibility to add a free text entry (by choosing “other” in the ODK-app).

Option in ODK	Description
Orthophoto largely outdated	The aerial images on the ground document are outdated, i.e. that the predefined parcel delineation does not match up with the situation on the ground in many cases.

Retrospective data entry of parcel data	If the entry of the data for a parcel form was forgotten in the field and done at home, select this option. Ensure that all parcels are always assessed in the field! If this option is selected too often a re-visit of the field in the same season will be necessary.
Other	Free text entry to give a remark on any not yet noted cases or noteworthy aspects of the survey on this parcel.

4.3 Arable parcels

4.3.1 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 as seen in the table to the right. (Some examples are shown in Figure 4-14.) In case of eA71 – “mostly bare soil”, 0 % should be recorded.

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 **fruit trees, olives or wine**, this information is recorded in the coverage of LC2. The non-woody crop coverage only needs to be assessed if there is an annual crop growing under the perennial crop.

Coverage
0%
1-3%
>3-8%
>8-15%
>15-25%
>25-40%
>40-60%
>60-80%
>80-100%



4.3.2 Wild plant coverage

The **coverage of non-woody, non-crop (wild) plants** is estimated **on the parcel level** in %-categories ,as seen on the right. This may be heterogeneous, so try to estimate an average value for what is visible of the parcel. Wild plants exclude crop species that are growing spontaneously from the previous crop (“volunteers”).

Coverage
0%
1-3%
>3-8%
>8-15%
>15-25%
>25-40%
>40-60%
>60-80%
>80-100%



Figure 4-15 Coverage of wild plants

Left: Sunflowers with weeds between the rows, Wild plant coverage 8-15 % - even though the wild plants are small, they are quite numerous and cover the entire field

Right: Barley field with poppies, Wild plant coverage 8 – 15 %.

4.4 Grassland parcels

4.4.1 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 4-16).

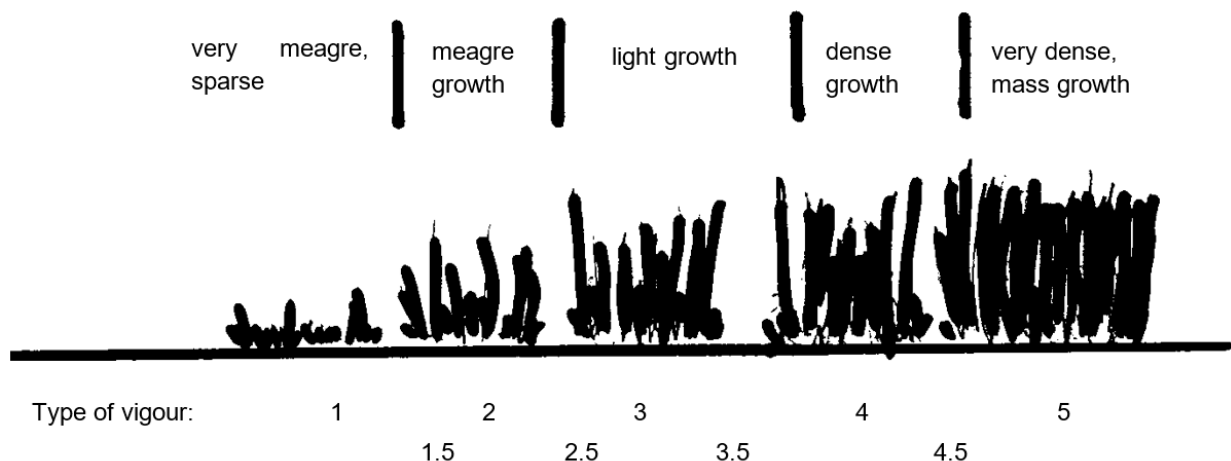


Figure 4-16: Illustration of the different vigour types in grassland.

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.

- **Vigour level 1** is a very sparse vegetation where the low-growing plant species or open soil can be seen well.
- **Vigour level 3** is light growth where the sunlight can reach almost all layers but with medium shading effects given through taller growing plants.
- **Vigour level 5** is very dense vegetation where only the tallest plants receive full sunlight.

The type of vigour is assessed when the vegetation is in full development in spring. Grazed or mown patches may be assessed with the help of ungrazed/unmown patches remaining on the grassland.. A vigour of 4 to 5 can be expected if one or few highly productive species dominate, whilst the grassland will probably have vigour 1 to 3 if there is space between the tall grasses and forbs and sunlight reaches the ground. Judging the vigour of grasslands regrown after the first cut is possible, but less accurate. If a grassland is freshly mown and the vegetation not yet regrown, vigour cannot be assessed.



Figure 4-17 Examples of different vigour

Left picture: Grassland with very low vigour (1); only sparse vegetation, small plant species dominate, light can reach the soil surface in great quantities

Right picture: Grassland with very high vigour (5): Dense growth, vegetation dominated by highly productive grasses and a lot of overlap, light can't reach the soil surface,

4.4.2 Graminoid-forb ratio

The graminoid-forb ratio characterises the rough composition of the herbaceous, non woody vegetation in a grassland. It is an estimation whether a grassland is dominated by **graminoids (grasses, sedges, rushes, reeds)** or **forbs (non-woody, broadleaved plants including ferns)**.

A grassland consisting of roughly equal amounts of graminoid plants and forbs gets assigned a graminoid-forb ratio of 50:50. An intensively managed grassland with only a few buttercups and no other forbs would then be estimated as 90:10.

The **graminoid-forb ratio is not linked to how densely the parcel is covered**. Even if only 20 % of the parcel is covered by non-woody plants, the sum of the graminoid percentage and the forb percentage must always be 100.

Graminoids to Forbs
100 : 0
90 : 10
80 : 20
70 : 30
60 : 40
50 : 50
40 : 60
30 : 70
20 : 80
10 : 90
0 : 100

4.5 Complexes of land-covers

In certain regions agricultural areas are characterized by many small, interconnected parcels with similar types of land use due to historical or geographic reasons.

To facilitate the description of such landscapes, they can be described using the category “eF – Complexes of land covers”. The different eF codes give an overall characterization of the present landscape and its most defining features.

These codes should only be used if different kinds of land covers are connected in a way that separating them into individual parcels is not possible. It is overall preferable to assess parcels individually rather than combining them into a complex element.

eF	Complexes of land covers	Gardens and small scale orchards	eF11	Complexes of many small vegetable fields, garden fields, huts, (orchard) trees and hedges including small paths and tracks (often close to settlement areas as leisure or semi-natural garden areas. Small parcels adjacent to housing with this code can be merged with eN40.).
		Polyculture	eF21	More than 2 land covers combined on one parcel, such as crops, pastures, different kinds of orchards and olive groves, vineyards, stone walls, hedges, and paths. The elements must be connected in a fashion that separating them into individual parcels is not possible.
		Terraces	eF31	Complexes of small terraces with dry stone and natural stone walls, arable fields, vineyards, olive or orchards, vegetable gardens etc., including small paths, tracks and natural bush / tree elements. A high density of ≥ 1 terraces /walls /20 m of slope mixed with other land cover must be given.
		Other	eF41	Other heavily interconnected types of land-use. Give a short description of the main characteristics of the observed land-use.

eF11 is intended for garden areas (which may also be used for leisure), such as a small number of fenced small gardens, each with vegetable and flower cultivation as well as some tree elements. Large areas of small gardens (allotment gardens), mostly close to cities, should be coded as eN40. For vegetable cultures with a larger scope, such as rows of different vegetables cultivated on a field see code eA54.

eF21 should be used for agricultural parcels, where land covers overlap such as an olive grove with wine plants between the rows of trees. Wherever possible, try to separate different land-uses in to separate parcels however!

eF31 can be used to describe multiple small parcels, which are assembled into a terraced landscape for easier cultivation. These are most commonly found in southern europe, especially Cyprus, Greece, Italy or Malta.



Figure 4-18 Examples of land cover complexes

Upper picture: Terrace landscape (eF31) with stone or earth walls (eE42) and mainly agricultural land use types (eA), but also shrub vegetation (eE14) and stone elements (eE43).

Lower left: Polyculture (eF21) with alternating strips of open soil and vegetation (eA72), vineyards (eB14) and olive trees (eB14).

Lower right: Garden element (eF11) with mulched grassland (eC41), medium intensive meadow (eC13), berry bushes (eB13) small plots for gardening (eA54), garden shed (eE61) and orchard trees (eB11).

4.5.1 Number of land use units

This parameter is only assessed in eF31 – Terrace landscapes.

When assessing a terrace landscape, give an estimate of how many different land use units are contained within the parcel. The number of land use units is estimated in steps of five, i.e. 1 – 5, 6 – 10, 11 – 15 etc.

A **land use unit** is each field or grassland which is undergoing a different cultivation scheme. For example:

In a small scale terrace landscape on a hillside one finds four fields with wheat cultivation, two olive groves and three ruderal grasslands. Each of these is its own terrace within the landscape and separated from the others by paths or walls. Thus, there are 6 – 10 land use units in the complex.

4.5.2 Complex land cover 1 (cLC1)

In a given complex element, up to 5 different LC1-types (**arable fields, grasslands and landscape elements**) can be noted. Permanent cultures such as orchard trees, vineyards and landscape elements such as tree lines or solar panels are noted in land cover 2. **Only a certain sub-set of LC1 codes should be used in complexes of land-covers**, for a full list see Annex 6.1.

4.5.3 LC1 coverage

The coverage of each type of land cover 1 within the complex shall be estimated in 5 % steps. The coverage of all LC1 present in the complex must sum up to 100 %.

4.5.4 Complex land cover 2 (cLC2)

For a given complex element, up to 5 types of LC2 such as permanent cultures (orchards, vineyards and olive groves) or landscape elements (tree lines or solar panels) can be noted. Only a certain sub-set of LC2 codes should be used in complexes of land-covers, for a full list see Annex 6.1.

4.5.5 LC 2 coverage

The coverage of the canopy of a given permanent culture or woody landscape element shall be estimated in 5 % steps. These do not have to add up to 100 %.

4.5.6 Subjective nature value (sNV) of land covers

Code / Type	Definition	Subjective nature value
eA Arable fields	Intensively used arable fields with no wild vegetation.	1
	Intensively used arable fields with very few wild plants present.	2
	Arable fields with few, common wild plant species such as poppies, thistles, or <i>Veronica</i> present.	3
	Arable fields with many different wild plant species present, but none in high numbers.	4
	Extensively used arable fields with many individuals of different wild plant species present.	5

Code / Type	Definition	Subjective nature value
eB Permanent cultures	High intensity fruit plantation on a trellis with mulched grass between the trees, vineyards without (wild) plants between the rows of wine.	1
	Vineyards with mulched, species poor vegetation between the rows, olive groves with open soil and little or no wild plants.	2
	Young orchard trees with a round canopy (not on a trellis), vineyards with moderately diverse vegetation between the rows.	3
	Orchard trees or olive trees of medium age and size with moderately diverse vegetation between the trees.	4
	Old orchard or olive trees with dead branches and nesting opportunities for wild animals. Diverse wild vegetation between the trees.	5

Code / Type	Definition	Subjective nature value
eC Grassland	High intensity grassland dominated by grass with little or no flowering plant species.	1
	Intensively used grassland with some flowering plant species present.	2
	Grassland with moderate use intensity and different flowering forbs present.	3
	Extensively used grassland with medium to high species diversity. Species diversity may however still be low on acidic/sandy soils.	4
	Very extensively used grassland, i.e. only one cut per year or sporadic grazing. Unless situated on poor soils it may exhibit a high species diversity.	5

Each type of cLC1 and cLC2 should be assessed regarding its subjective nature value. If there are multiple land use units of one kind, for example multiple wheat fields in a terrace landscape, give a mean value for all land use units.

The subjective nature value should reflect the use intensity of a given land cover type, for which the diversity and amount of flowering wild plants can serve as an indicator. Note that in some cases, species diversity may be very low on extensively used parcels due to the local soil conditions. Such areas still have a high subjective nature value despite appearing less favorable for biodiversity.

For permanent cultures the use intensity of the trees/vineyard and the resulting presence of wild species and habitat opportunities for animals are most important. The subjective nature value of landscape elements present in the complex parcel shall be assessed following the rules set out for the different kinds of landscape elements, see section 4.6.

4.5.7 Subjective nature value of the complex

After assessing the present land cover types and their subjective nature values, an overall assessment of the entire complex's subjective nature value shall be given. This should reflect the overall impact on biodiversity the area has when accounting for the present land cover types. The biggest impact on this parameter is the use intensity and biodiversity of the agriculturally used areas inside the complex element. Landscape elements present in the complex element should only serve to refine the subjective nature value assessment.

Example	Subjective nature value
Very intensively used agricultural areas with little to no wild vegetation and only few landscape elements.	1
Intensively used agricultural areas with little wild vegetation and only few landscape elements.	2
Agricultural areas with some wild vegetation and some landscape elements with medium subjective nature value.	3
Fields and grasslands with different wild plant species and different landscape elements with medium to high subjective nature value.	4
Fields and grasslands with extensive use. Species diversity may be high. High structural diversity with many different high subjective nature value landscape elements	5

4.6 Landscape elements

4.6.1 Type of element

There are 7 categories of landscape elements (eE) and 24 distinct codes. enter the code here following the description in Section 6.1.

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/eE22 (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. eE14 (hedges and woody strips).

In case of complex landscape elements consisting of more than 2 of the present categories, one should try to delineate the elements as different parcels as far as is possible. If the elements are linked in a fashion that this is not possible, the two most prominent landscape elements should be used to assess the overall character of the landscape element.

4.6.2 Width of landscape elements < 5 m

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.

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

4.6.3 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). For singular trees, record the crown diameter with this parameter.

4.6.4 Subjective nature value of landscape elements

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

Value	Description
1	Very low nature value
1.5	Very low to rather low nature value
2	Rather low nature value
2.5	Rather low to moderately high nature value
3	Moderately high nature value
3.5	Moderately high to rather high nature value
4	Rather high nature value
4.5	Rather high to very high nature value
5	Very high nature value

Many landscape elements have a specific minimum degree of biodiversity due to their habitat structure, for these types only the values 3, 4 and 5 are recordable. This includes all landscape elements mostly comprising vegetation and woody plants.

Some anthropogenic landscape elements can only be assigned a very low subjective nature value (1 or 2) due to their low benefit for biodiversity, for example eE51-paved roads.

In the following, a description of the estimation of the subjective 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 6.1).

For combinations of landscape elements, e.g., eE21 grassy strips with eE13 tree avenues, both LC1 and LC2 should be considered in the evaluation of the subjective nature value.

4.6.4.1 Wood/ Tree/ Bush elements (eE11–14)

Wood/tree/bush elements include **isolated trees, tree lines and avenues and hedges, woody strips, small woodlands and 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	Subjective nature value
eE11-14 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

4.6.4.2 Grass-herb elements (eE21, eE22)

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 consider the management practice – if visible – when assigning the subjective nature value for grass-herb elements (Figure 4-19, left picture).

Code / Type	Definition	Subjective nature value
eE21-22 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 4-19: Examples for grassy strips (eE21) with differing subjective nature values

- Left - Mulched buffer strip along grass track, subjective nature value 3,
 Middle - Moderately species-rich field margin, subjective nature value 4.
 Right - Species-rich buffer strip along farm track, subjective nature value 5

4.6.4.3 Water elements and reed/sedge beds (eE31–34)

Water bodies (including the vegetation directly surrounding them) are evaluated according to their structural diversity of the watercourse, structure of the ditch, structure of the bank and riverine vegetation.

The accompanying woody vegetation (e.g. trees, hedges) should be delineated as separate Landscape Elements if it is clearly separated from the water body and not heavily interconnected with it.

Code / Type	Definition	Subjective 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 / soil 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

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 subjective nature value as far as it is not “disturbed” by the growth of nitrophytic plants such as *Urtica* sp. (stinging nettles). The subjective nature value of such elements is the following:

Code / Type	Definition	Subjective nature value
eE34 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

4.6.4.4 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 subjective nature value for most elements will be between 3 and 5, only pure cement walls are judged with 1 or 2. The subjective 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 subjective nature value (Figure 4-20).

Vegetation growing on a wall or terrace might also be judged with a subjective high nature value, because it can be a habitat for plants, refuge for animals and insects.

The elements have a minimum width of 1 m.

Code / Type	Definition	Subjective 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

Please note: In case of complexes of small terraces with dry stone and natural stone walls in which combinations of the following land uses are included:

- Arable fields, vineyards, olive groves or orchards, vegetable gardens etc.
- Small paths, tracks
- Natural bush or tree elements

If a high density of ≥ 1 terraces/walls over 20 m of slope is mixed with different land covers and landscape elements (occurring for example in many Mediterranean countries) the code **eF31** should be entered **as LC1**, with corresponding cLC1 and cLC2 assessments. See also section 4.5.



Figure 4-20: Example for judging the nature value of landscape elements.

A stone wall (LC1 = eE41) with trees (LC2 = eE12)). 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.

4.6.4.5 Roads and tracks (eE51–53)

Paths are only assessed if they are more than 1 m wide (Figure 4-21). 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 (eN40), whose main purpose is not agricultural traffic, on

the other. Small paths in-between permanent cultures such as vineyards, orchards or nurseries are part of the arable land use and need not be mapped individually.

Code / Type	Definition	Subjective 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



Figure 4-21 – Examples for different roads and tracks

Upper row:

Left - paved farm track with bordering grass/gravel strip, NV (nature value) 1, middle - paved farm track with grass/gravel strip in the paths middle, NV 2, right - dirt/gravel track, NV 2-3;

Lower row:

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

4.6.4.6 Other man-made structures and other elements (eE61–65)

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 or channels – though man-made – are defined as “water elements” (codes eE31-33).

Other elements (eE65) may occur, which are not described in this manual yet and which do not fit into the categories eE11 – 64. These should be described briefly (and will serve for the further development of the list of land cover codes).

Code / Type	Definition	Subjective nature value
eE61-65 Other man-made structures, artefacts, other elements	Man-made structure without or with very low subjective nature value (e.g. electric transformer tower with hardly any buffer strip).	1
	Man-made structure with low subjective nature value (e.g. electric transformer tower with a small grass-herb buffer strip).	2
	Man-made structure with medium subjective nature value (e.g. electric transformer tower with a broad and partly species rich grass-herb buffer strip).	3
	Man-made structure with high subjective 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 subjective 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 4-22 – Example for a man-made structure:

eE61-Agricultural building in the field (Animal shed), offering different habitats for many wild animals through the open structure and different materials as well as the direct edges not being cut or grazed, subjective nature value 4



Figure 4-23 Examples of man-made structures

Left: Low subjective nature value: Small shacks with tools and firewood (eE61), still in common use, only short vegetation: subjective nature value 2

Right: High subjective nature value: Woodpile (eE63) with some decomposing wood, small shrubs, and vegetation: subjective nature value 4

4.6.4.7 Flower areas and strips (eE71)

In many agricultural landscapes, flower areas and strips are sown on arable land. The structure and species composition of such strips can vary quite a lot. They might cover just a strip of a few meters' width or a whole parcel.

Code / Type	Definition	Subjective nature value
eE71 Flower areas and strips	Flower area or strip with medium subjective 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 subjective 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 subjective 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 4-24: 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.

4.7 Overall plot survey

After having surveyed an entire 500 x 500 m plot, a short summary of the survey area must be given according to the following parameters.

4.7.1 Plot accessibility

Give a short summary whether the plot could be reached, how easy it was to reach, if there are roads leading to it or other factors influencing the access to the overall plot.

If the **entire plot is not physically reachable** and **no parcel could be observed**, select the option “**Not reachable**” in this question, and **notify the survey coordinators about this circumstance**.

4.7.2 Plot characterisation

For each plot, some main characteristics of the present landscape shall be described. The assessment is mostly based on the **agricultural areas** within the plot, **non-agricultural areas** such as forests, wetlands or settlements **should only be noted**. There are 4 categories to characterize different aspects of the plot.

4.7.2.1 Landscape structure

This parameter relates to the size of the **agricultural parcels** within the plot.

- **Large scale:** dominated by few, big fields, with fields commonly exceeding 5 ha in size.
- **Medium scale:** mostly medium sized fields ranging in size from 5 ha – 1 ha
- **Small scale:** many fields, most under 1 ha.
- **Terraces** indicate a small-scale landscape with many stone/earth walls forming terraces.

4.7.2.2 Use intensity

The use intensity describes the overall **level of inputs and outputs of a landscape**, such as **fertilizer and pesticides**, to increase agricultural productivity. For grasslands the **frequency of mowing or grazing** is an important factor for use intensity. In permanent cultures such as orchards or vineyards, cultivation methods such as utilizing a trellis and facilitating access of harvesting machines indicate a higher use intensity.

Agriculturally used areas on slopes or mountainsides are often used less intensively, as accessing them with heavy machinery is often impossible. This is however not a fixed rule and care should be taken when assessing the use intensity of a landscape.

There are four levels to describe the use intensity:

- **Intensive use:** Probably regular fertilizer inputs and pesticide use, grassland which gets grazed/mown frequently, few forb species present in grassland, fruit plantations (heavily pruned trees) and vineyards with intense use, greenhouse culture
- **Medium use intensity:** Reduced fertilizer and pesticide inputs, less frequent mowing/grazing, more wild plant species may be visible in parcels
- **Extensive use:** low fertilizer inputs/manure, no pesticide use, rough grazing or low cutting frequency in grassland, orchards with old trees with round crowns and high stems, high species diversity possible in parcels
- **Mixed use intensity:** Combination of 2 or 3 levels of use intensity within a plot.

4.7.2.3 Land uses

Select the main land-uses visible within the agriculturally used area of the plot. In most cases, a plot has 1 or 2 defining types of land-use.

- **Arable fields**
- **Horticulture** (including vegetables on fields, asparagus, plastic tunnels, and greenhouse culture)
- **Grassland** (including fodder production on arable fields)
- **Grazed shrubland**
- **Orchards** (Both fruit plantations on a trellis (LC2 code eB12) and 'regular' orchards (LC2 code eB11))
- **Vineyards**
- **Olive groves**

A given **land-use category** should **cover more than 10% of the agriculturally used area**, for example: A landscape with 20 ha of agricultural area has 15 ha of arable fields, 4 ha of grassland and 1 ha of orchards. One should then select "arable fields" and "grassland", but not "orchards" as they only cover 5% of the agricultural area.

Additionally, some **non-agricultural areas** can be remarked here, if they cover more than 25% of the plot area.

- **Forests**
- **Wetland areas**
- **Settlement and industrial areas**

4.7.2.4 Structural diversity

Note the abundance of landscape elements (LE) in the plot, accounting for their number and diversity.

- **Many:** Large number of different LE, such as woody elements, water features and stone walls, forming an interlinked pattern in the plot and connecting habitats.
- **Some:** LE are found within the landscape, but are less connected to one another. There is also less diversity in the types of elements present.
- **Few or none:** Low number (<10) of isolated LE which have no connections to one another

4.7.3 Subjective plot nature value (overall estimation)

The overall estimation of the subjective plot nature value serves as a **rough and subjective estimation** to compare the sum of the detail records with the overall impression.

The subjective plot nature value comprises the following categories 1 to 5 and their intermediate stages:

Value	Description
1	Very low nature value
1.5	Very low to rather low nature value
2	Rather low nature value
2.5	Rather low to moderately high nature value
3	Moderately high nature value
3.5	Moderately high to rather high nature value
4	Rather high nature value
4.5	Rather high to very high nature value
5	Very high nature value

Overall, the subjective plot nature value depends mostly on the **use intensity** and **species richness** of the **agriculturally used parcels –excluding all areas coded as “eN – non agricultural”**. If the agricultural areas are mostly extensively used with many indicator species, the plot has a higher subjective nature value. **Landscape elements** with high individual subjective nature values (3 to 5) might further **enhance the overall subjective plot nature value** by 0.5 to 1. This depends on their size and how well distributed they are in the plot.

A low subjective plot nature value (1) is given when the whole plot comprises arable fields or grassland with highly intensive use, few landscape elements and very few indicator species (Figure 4-25).

The subjective nature value of an intensive arable plot might be higher (2) if there are some landscape elements with medium to high subjective nature value (3 to 4) are present.

A subjective plot nature value of 2 is also given if most of the arable land and grassland has at least a few indicator species. If most parcels have no or very few indicator species but one or two have many this can also result in a subjective nature value of about 2. Combined with the subjective nature value of any present landscape elements of medium to high subjective nature value (3 to 5) the subjective plot nature value may rise to a value of 2.5 or 3.



Figure 4-25: 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 – **subjective plot NV 4**

Upper right: no landscape elements and only intensive arable fields are present – **subjective plot NV 1**

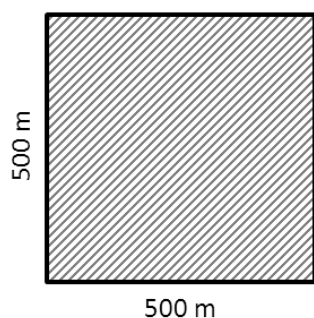
Lower left: mix of arable land and grassland of differing use intensities, individual trees and bushes – **subjective plot NV 3.5**

Lower right: mix of grassland and arable land, grass-herb strips between agricultural fields, but arable fields and grasslands are intensively managed – **subjective plot NV 2.5**

Note: a plot as a whole can have a high subjective nature value even if not every single parcel has a high nature value. Most parcels do however need to be species rich in order to qualify for a high nature value plot.

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 subjective nature value. The assessment always depends on the individual situation on the plot.

This is indicated in the following examples:

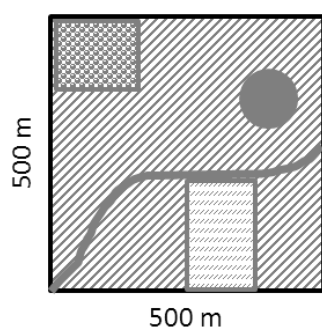


Example 1a) the whole plot is extensively-used species-rich grassland. There are no structural elements. Because of the species richness and the typical grassland vegetation, the plot can be given sNV 4 or 5.

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

Example 1c) the plot is intensively used = sNV 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 sNV of 5 despite the intensively used parcel, as it is “compensated” by a higher structural diversity.

4.7.4 Plot remarks

This field is for remarks concerning anything related to the observed land use, landscape structure, nature value and biodiversity of the plot as well as the study methodology. There are some pre-made remark options, as well as the possibility to add a free text entry (by choosing “other” in the ODK-app).

Option in ODK	Description
Orthophoto largely outdated	The aerial images on the ground document are outdated, i.e. that the predefined parcel delineation does not match up with the situation on the ground in many cases.
Problems with local residents or landowners	Locals might sometimes be apprehensive about surveys being performed on their land. If you encounter resistance or get told to stop surveying, select this option.
Challenging terrain	Terrain which impedes progressing through the plot, such as steep inclines, very rocky terrain with crevices, swampy terrain.
Many parcels completely not observable (does not replace a form for each parcel)	Select this option if a majority of the agricultural area of the plot cannot be directly observed due to fences, thick hedges, walls or resistance from land-owners.
Less than 10% agricultural land	Due to changes in land-cover, the agricultural area of a plot might be diminished so far that it covers less than 10 % of the plot area (e.g. a new housing development being built on the only fields within a plot already consisting of 85 % “non-agricultural land”).
Retrospective data entry of Overall Plot	If the entry of the overall plot form was forgotten in the field and done at home, select this option.
Other	Free text entry to give a remark on any not yet noted cases or noteworthy aspects of the survey in this plot.

4.7.5 Plot photos

During the survey, **take care to take pictures of the overall plot area**. Five of the taken photos should be supplied during the overall plot survey, to give an impression of the surveyed area. The photos should show the main land use types present in the plot, common landscape elements and points of interest in view of biodiversity or agricultural practices.

5 Transect parameters

5.1 All transects

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

Transects are only recorded in grassland and arable land. The transect positions are pre-defined in the app and ground documents. There are **four possible transect pairs** (A – D) per plot (field margin and field interior) and **one transect in the plot centre** (E), in case that this point is located on grassland.

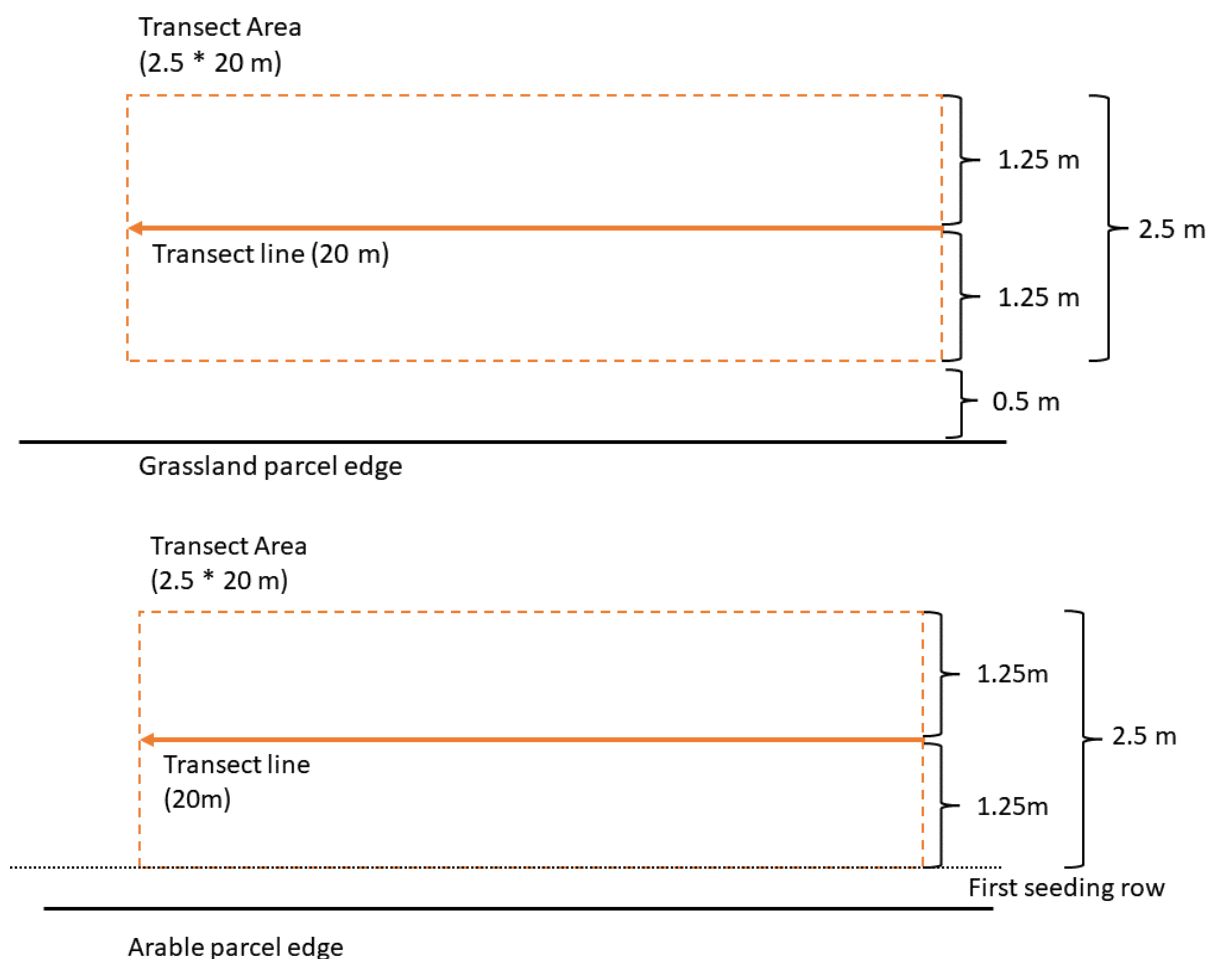


Figure 5-1 Construction of the margin transect.

The margin transects (A_1 - D_1) are positioned along the edge of the parcel, see Figure 5-1. For arable fields this 1.25 m into the parcel from the first seeding row. In grassland this is 0.5 m into the grassland parcel from the edge. The line of the transect is then a further 1.25 m into the parcel in relation to the first seeding row or the 0.5 m in the grassland parcel).

The field interior transects (A_2 - D_2) start 10 m into the field from one end of the margin transect at a 90° angle. In the case of arable fields they should follow the seeding rows, if possible at a 90° angle. In narrow parcels they might be running at a < 90° angle. In arable fields, the margin transect should also, where possible, be located in the headland of the field. This is a part of the field, where the farmer ploughs in another direction than in the overall field area. It is often located on the short borders of arable fields.

In case of **vineyards, fruit tree plantations with a trellis or asparagus fields only an interior transect has to be performed**, following the rows of the culture.

5.1.1 Transect location

The location of the transect needs to be recorded in the ODK-app. It might sometimes take a moment, until the device used for recording the transect is located with sufficient accuracy by the GPS.

When assessing a transect observed during the previous year, care must be taken to select a suitable location for the transect based on various factors:

Transect pairs which were observed in the previous year should be observed at the same location again.

- For **transects on grassland (eC)**, try to re-observe the transects at the same location as last year. This is shown in the ground document.
- In the case of **transects on arable fields (eA)**, this should be checked with the cultivation of the field. The transects should run along the seeding rows, with the margin transect located in the “headland” of the field. This is mostly situated on the short edge of a field, with the cultivation direction being perpendicular to the main cultivation direction.
- In case the previously observed transects in an arable field are not located in the seedings rows and headland, they should be shifted accordingly to fit along the cultivation.

Transects which were not observed in the previous year and weren't shifted should again be attempted at the location given in the ground-document. If the transect is not possible there, it should be tried to be shifted according to the rules described in section 5.1.3.

5.1.2 Transect possible?

There might be some situations in which it will not be possible to walk a transect in the intended position. Possible reasons for this might be:

Option in ODK	Description
No grassland for the E transect	The E-transect should only be performed on
Landowner does not allow to enter the parcel	If possible, try to approach land-owners to ask for permission to enter a parcel for observing transects. This can often help to avoid conflicts. In some cases land-owners might however be reluctant to have the survey be performed on their land, in such cases tick this option.
Margin not possible due to vegetation (vineyard, asparagus, fruit tree plantation)	In case of permanent cultures such as asparagus, vineyards and fruit tree plantations, only the interior transect has to be observed. Choose this option for transects in this type of landcover, when assessing the transect Defining a true margin in such parcels is quite difficult and will thus not be performed in the EMBAL survey The margin transect does not need to be shifted to another position in such cases, observing the interior transect is sufficient.
Interior not possible due to high crops	Mostly the case for Canola fields, which can be very tall and impossible to enter during the survey. In such cases the interior transect can be skipped to avoid excessive damage to the crops. The interior transect does not need to be shifted to another position in such cases, observing the margin transect is sufficient.

Other	Free text entry to give a remark on any not yet noted cases which necessitate a transect to be skipped.
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- Access to land is denied or not possible, e.g. due to a fence, bulls 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 or an arable field

In these cases, the transect should be shifted inside the parcel or to another parcel, see the next section 5.1.3. If the transect cannot be shifted to an alternative parcel, this question should be answered with “No”. If the answer “No” is given, a reason is required (free text).

5.1.3 Transect shifted?

If the pre-defined transect cannot be done, but a transect is possible in the same parcel or another suitable parcel, answer “Yes” here and give a reason.

Possible reasons for shifting a transect are:

Option in ODK	Description
No homogenous vegetation	The predefined transect is not in an area of homogenous vegetation (e.g. there are deep wheel ruts running through the transect; the part of the parcel where the transect is located has been mown recently while there still is standing vegetation in another part of the same parcel – this does not apply if the entire parcel is mown.) This rule does not apply if the transect was already observed in the previous year – it should then still be observed at the same location, even with heterogenous vegetation.
Field borders shifted	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 pre-processing was carried out
Physical access to the field is blocked	There is a blockage on the area of the transect (e.g. bales of silage have been placed at the field edge)
Arable transect shifted to the headland or along seeding rows	Transects in arable fields should follow the seeding rows. Furthermore, the margin transect should be located in the headland of a field.
Other	Free text entry to give a remark on any not yet noted cases or noteworthy aspects of the survey on this transect.

A summary of these rules and conditions for transect shifts are available in Annex 6.4.

A transect should **NOT be shifted** if the **entire parcel** has been freshly grazed or cut or if an arable field has no vegetation cover. The transects should then be performed at the intended location if possible. Furthermore, **the E-transect at the centre of a plot may not be shifted at all**. The E-transect is done to achieve data-parity with the LUCAS survey. In the LUCAS survey, a grassland transect is observed on the E-point, with a direction facing East. To ensure that LUCAS and EMBAL data are comparable, the E-transect may thus only be performed on grassland and not be shifted.

The transect should be shifted to the closest possible patch 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).

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. To choose a new parcel, the parcel closest to the seeding point (A – D) of a given transect should be selected.

The alternative parcel should have the same type of land-cover as the original, i.e. an arable field should be substituted with another arable field and a grassland with a grassland. If this is not possible, an arable field can also be substituted with a grassland and vice versa. If there is no parcel with agricultural land use in the quadrant of a given seeding point, the transect can be skipped.

A shifted transect 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.

5.1.4 Parcel Land Cover

Give the land cover of the parcel in which the transects are located. Be aware, that coverages of woody elements may differ between the parcel and transect area.

5.1.5 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). Refer to section 4.2.1 for more information on this parameter.

Category	Grassland:	Arable Land
1	Not mown or pastured: The first growth of vegetation is still standing	Crop is in full development, the crop plants cover over 25% of the parcel
2	Regrowth after first cut/pasturing: The first growth of vegetation has been cut, the vegetation has regrown to > 20 cm in height.	Crop plants are not yet in full development and the crop plants cover less than 25 % of the parcel
3	Mown/pastured recently: The vegetation is cut or grazed and < 20 cm in height	Crop has been sown or germinated only recently (plants < 5 cm tall) Crop has been harvested already

5.1.6 Recording of the transect line

The position of all transects must be recorded with a “transect point” and “transect line”. The point, recorded in section 5.1.1, stores all data relating to the transect. The transect line records the path of the transect, to see if it aligns with the pre-defined transects or if changes had to be made during the survey. The transect path is recorded using the “GeoTrace” feature of the ODK-app.

While walking the transect line also pick one individual of each flowering species present in the transect area (**except for protected species such as Orchids**). This collection of flowers (flower posy) will be relevant for the following parameter assessments.

5.1.7 Transect photos

Three to four photos should be taken while walking and recording the transect line. **The photos must be taken in landscape format (horizontal)**. For photographs of the transect start and end, they should show about 20 % sky and 80 % landscape:

- **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 currently flowering plants of the transect against the posy background. While walking the transect line, pick a flower of each species you see. Take care to pick no protected species (e.g. Orchids), but rather put the posy background next to the plant and take a photo.
If there are no plants currently flowering, no photo has to be taken.
- **Vegetation structure** – photo taken from above into the plant stand to show the present vegetation, see Figure 5-4.



Figure 5-2: Transect photos from the start and from the end.

The measuring tape in the centre of the pictures marks the 20 m transect line.



Figure 5-3 Example of a posy picture.



Figure 5-4 Pictures of the vegetation structure.

Pictured are a grassland (left) and an arable field (right). They are taken at an angle, looking into the plant stand and showing the different layers of vegetation present in the transect.

5.1.8 Inclination

The inclination of the transect area should be classified in the following %-categories, which can be seen on the right.

The inclination can be measured using an inclinometer (some compasses include this) or smartphone-app. It is important to ensure that one measures the inclination **in percent (%)** of slope, not in degrees (°)! For reference, the percentage values are also shown in degrees in the table on the right.

1 % of slope equals to a vertical difference of 10 m over a 100 m long stretch.

Percent of slope	equals	Degree of slope
0 % (flat)	=	0°
> 0-3 %	=	> 0-1.7°
> 3-8 %	=	> 1.7-4.5°
> 8-15 %	=	> 4.5-8.5°
> 15-25 %	=	> 8.5-14°
> 25-40 %	=	> 14-22°
≥ 40 %	=	≥ 22°

5.1.9 Site exposition

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 on the ground (N, NE, E, SE etc.)?

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

5.1.10 Flower density

Indicate the flower density **on the transect** according to the scale previously seen in section 4.2.5:

- 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 very dense, continuous “flower carpet”

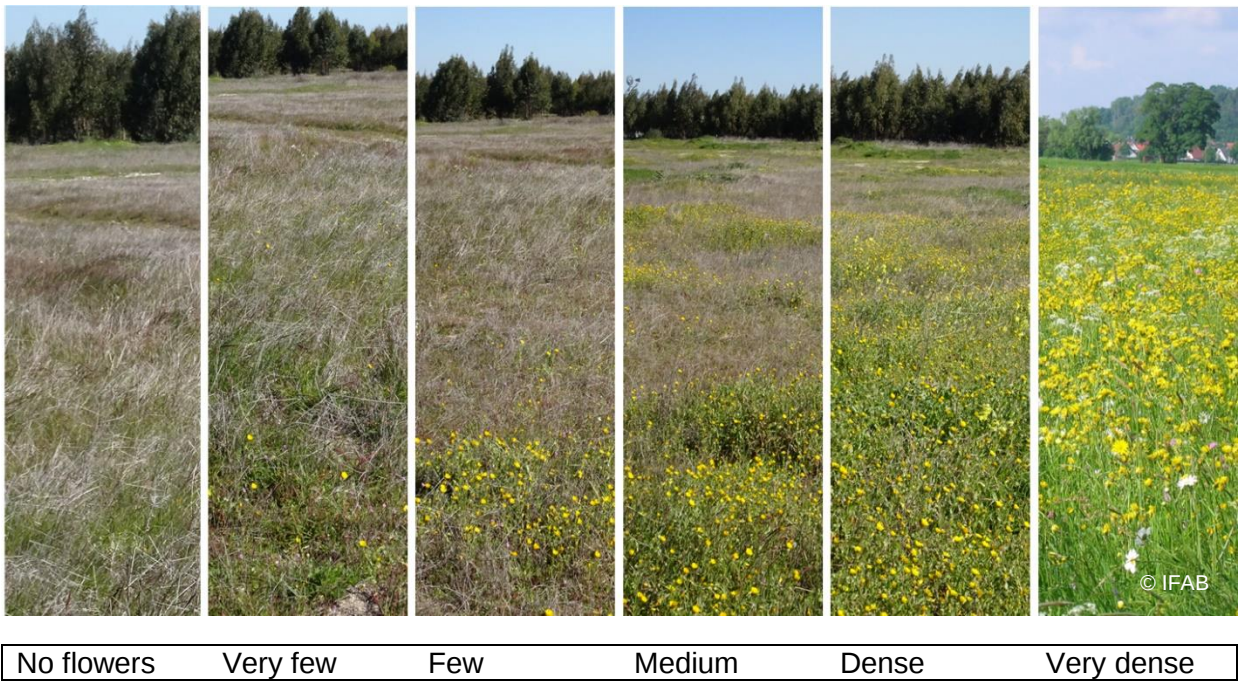


Figure 5-5: A range of flower densities from very dense (left) to none (right).

5.1.11 Colours currently of flowering forbs

Each type of flower colour that is visible **on the transect area** (and thus present in the flower posy) 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 4.2.6 for a more detailed description.

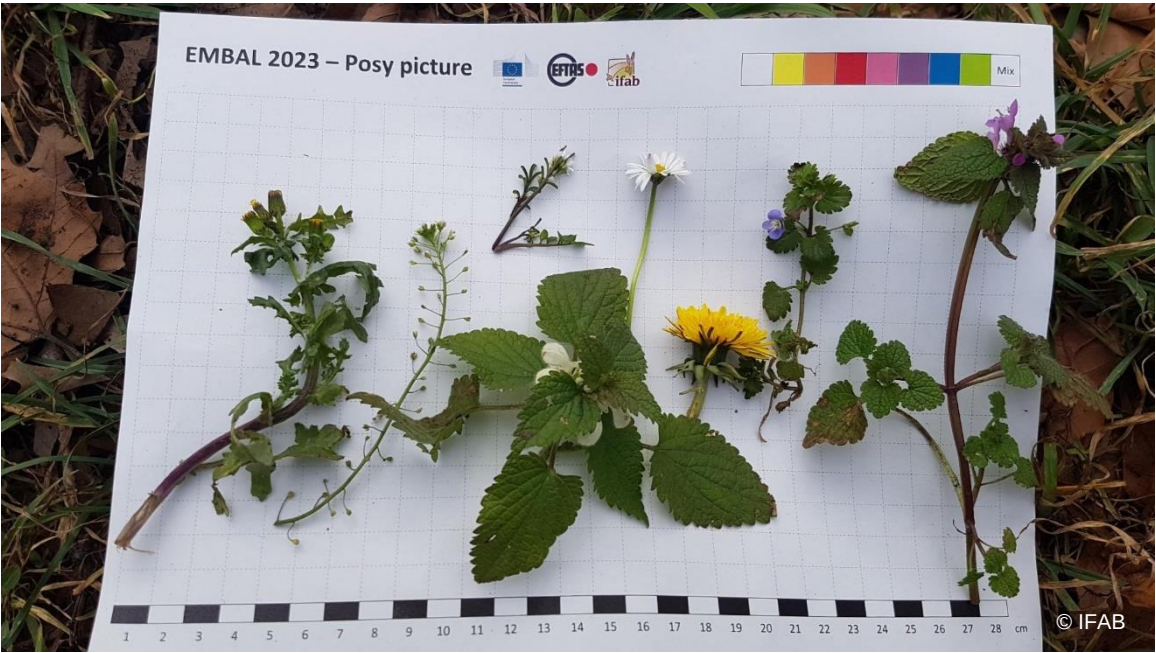


Figure 5-6: Example of a flower posy.

Here the colours yellow, white, mixed, blue and violet are visible.
There are overall 8 species of flowering forbs, of which three have white flowers, two have yellow flowers and one mixed, blue and purple flower.

5.1.12 Number of species of currently flowering forbs

Count the **total number of currently flowering forb species** present on the transect are, i.e. count how many flowers are visible in the posy picture. This includes species which have well developed flower buds almost ready to flower, and species which have just finished flowering and the colour of the petals can still be distinguished. For a more in-depth description of the “flowering state” of a plant, refer to chapter 4.2.6.

This applies to **all insect-pollinated plant species**, i.e. species with mostly colourful flowers. No grasses/sedges or plants with inconspicuous flowers like *Urtica* sp. (Stinging nettles), *Chenopodium* sp. (Goosefoot), *Rumex* sp. (Docks) or *Plantago* sp. (Plantain) should be considered, see also section 4.2.6.

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).

5.1.13 Record of currently flowering indicator species

Lists with plant indicator species (or species groups) can serve as surrogates for biodiversity. For both grassland and arable land there is an indicator species list covering all biogeographic regions. The indicator species are easily identifiable in the field, and neither very common nor very rare.

See **Annex 6.8** and **Annex 6.9** for the full list of the indicator species groups and pictures of example species. **Not all species belonging to an indicator species group are listed in the annex**, just a selection of species typical for a given group!

While slowly walking along the transect line, the **indicator species groups of which one or more species are present and currently flowering should be recorded**.

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**.

It might be beneficial to utilize smartphone apps for plant identification to quickly assess whether a given flowering plant is part of a certain key species group. “iNaturalist”, “FloralIncognita”, “Seek” and “Plantnet” all offer a rapid estimation of which family, genus or even species a plant belongs to.

5.1.14 Remarks

In the remarks section for transects, any comments that concern the vegetation survey or survey procedure are welcome. There are some pre-made remark options, as well as the possibility to add a free text entry (by choosing “other” in the ODK-app).

It's also possible to attach images in this section, to show problems like thick crops inhibiting access to the transect.

Option in ODK	Description
Orthophoto largely outdated	The aerial images on the ground document are outdated, i.e. that the predefined parcel delineation does not match up with the situation on the ground in many cases.
Retrospective data entry of parcel data	If the entry of the data for a transect form was forgotten in the field and done at home, select this option.

	Ensure that all transects are always assessed in the field! If this option is selected too often a re-visit of the field in the same season will be necessary.
Other	Free text entry to give a remark on any not yet noted cases or noteworthy aspects of the survey on this transect.

5.2 Transects on arable fields

5.2.1 Height of crop

The height of the crop is measured in cm. It refers to the average height of the crop, not the highest stalk. In case of fallow fields with open soil and no crop present, 0 cm should be put in in this question. The same applies for vineyards, orchards or olive groves with open soil between the trees or wine plants.

5.2.2 Vegetation layer coverage

The coverage is divided into the ground layer (< 1.5 m) and the canopy layer (> 1.5 m). Coverage values are recorded in % - categories as seen on the right:

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 the following components, but the coverage of these must sum up to 100%.

Coverage
0%
1-3%
>3-8%
>8-15%
>15-25%
>25-40%
>40-60%
>60-80%
>80-100%

- **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 – 3 % should be selected.
- **Wild plants:** The coverage of non-crop (wild) plants is estimated in % on the transect area, excluding crop plants that are growing spontaneously from the previous crop.
- **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). Dead plant matter which is not rooted (mulch, litter from last season) counts toward this layer.

The **woody canopy** layer is all woody plant material recorded as seen from the bird's eye perspective. It is recorded in the same %-categories as the ground layer, shown above. This layer does not need to add up to 100 %.

- **Orchard:** Fruit and nut trees
- **Olive groves:** Olive production can be mixed with arable crops
- **Vineyards:** Wine plants
- **Others:** All other types of woody vegetation/perennial vegetation like cacti



Figure 5-7: Examples of ground coverage in arable transects.

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

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

Bottom left – Crop 60-80 %, Wild plants 3-8%, Underseed 40-60%, Bare 0%,

Bottom right – Crop 25-40 %, Wild plants 25-40 %, Underseed 0%, Bare 3-8%,

5.3 Transects on grassland

These parameters relate to transects observed on parcels with LC1 from the category “eC – grassland” as well as transects on parcels assigned one of the codes eA41 – eA45 (Sown grass on arable fields).

5.3.1 Vigour of vegetation

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.

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. The type of vigour is indicated when **the vegetation is in full development** in spring; grazed patches may be judged with the help of ungrazed patches remaining on the pasture.

Vigour is not assessed in recently mown grassland or pastures which have been recently grazed very short.

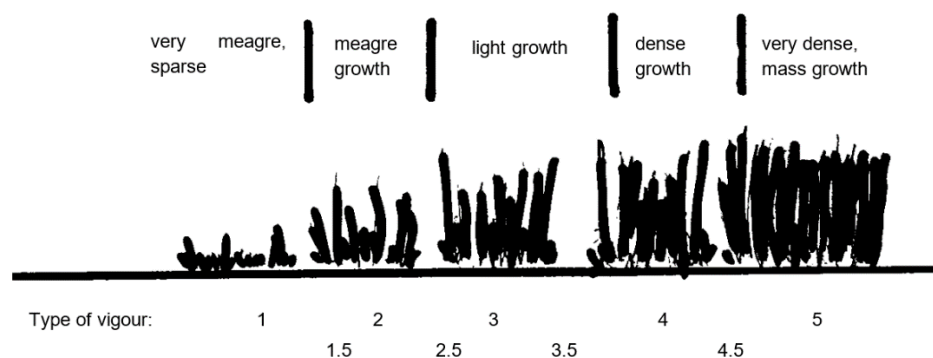


Figure 5-8: Illustration of the different vigour types in grassland

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.



Figure 5-9 Grasslands with different type of vigour

Left: Low vigour (1-2): Open soil and small plants can be seen between the grasses

Middle: Medium vigour (3): Forbs and grasses coexisting, overlapping with each other, shading each other.

Right: High vigour (5): Grass dominated grassland, with nearly no sunlight reaching the soil surface.

5.3.2 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.

5.3.3 Graminoid-forb ratio

The graminoid-forb ratio characterises the rough composition of the herbaceous, non woody vegetation in a grassland. It is an estimation whether a grassland is dominated by **graminoids (grasses, sedges, rushes, reeds)** or **forbs (non-woody, broadleaved plants including ferns)**.

A grassland consisting of roughly equal amounts of graminoid plants and forbs gets assigned a graminoid-forb ratio of 50:50. An intensively managed grassland with only a few buttercups and no other forbs would then be estimated as 90:10.

The **graminoid-forb ratio is not linked to how densely the transect is covered**. Even if only 40-60 % of the transect is covered by non-woody plants, the sum of the graminoid percentage and the forb percentage must always be 100.

Graminoids to Forbs
100 : 0
90 : 10
80 : 20
70 : 30
60 : 40
50 : 50
40 : 60
30 : 70
20 : 80
10 : 90
0 : 100

5.3.4 Vegetation layer coverage

The plant coverage of the transect area is divided into the ground layer (< 1.5 m) and the canopy layer (> 1.5 m). Coverage values are recorded in %-categories, which can be seen in the table on the right.

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

- **Herbaceous layer:** all graminoid, forb, fern and moss species, i.e. non-woody plants.
- **Bare layer:** Open soil and stones which can be seen from above by looking down at the ground from approximately 1.0 m height (a standing position).
- **Woody layer (on the ground): all woody plants** (small shrubs, dwarf shrubs) <1.5 m in height

Coverage
0%
1-3%
>3-8%
>8-15%
>15-25%
>25-40%
>40-60%
>60-80%
>80-100%

The **woody canopy** layer is all woody plant material as seen from the bird's eye perspective, recorded in %-categories, same as the ground layer.

- **Shrubs:** all woody plants between 1.5 and 5 m in height
- **Dwarf shrub:** woody plants < 1.5 m in height
- **Orchard:** fruit and nut trees
- **Old trees:** Trees older than 20 years or over 5 m in height. Trees producing fruits or nuts are considered as orchards.
- **Vineyards:** Wine plants
- **Others:** all other types of woody or perennial species (e.g. Brambles, Cacti)

5.3.5 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). To assess the structural species plants should be observed, regardless of whether they are currently flowering or not.

If the species on the list (see Section 6.6, and some examples in Figure 5-10) are present on the transect they should be selected and their coverage in %-categories recorded, which can be seen in the table to the right:

Coverage
0%
1-3%
>3-8%
>8-15%
>15-25%
>25-40%
>40-60%
>60-80%
>80-100%



Figure 5-10 Illustration of structural species in grassland.

Left: Rushes (*Juncus acutiflorus*) in a wet grassland, 60 – 80 % coverage on the transect area
 Right: Grassland overgrown with *Calamagrostis epigejos*, 80 – 100 % coverage on the transect area
 For image sources see annex 6.10.

5.3.6 Total cover of legumes

Legumes are plants in the Fabaceae (pea and bean) family that are agronomically useful because due to their ability to 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.). They are characterized by their pinnate leaves (leaves made up of smaller leaflets) and distinct flower shape. Examples of species belonging to Fabaceae family can be found in the “Indicator species guide” document in Annex 6.9.

Record the total coverage of these species, **regardless of whether they are currently flowering or not**, on the transect area in in %-categories as can be seen on the right:



Figure 5-11 Examples of leguminous plants.

Left: Red clover (*Trifolium pratense*), a common Fabaceae.

Center: a leaf of common vetch (*Vicia sativa*), showing small leaflets which form a bigger leaf.

Right: bird's foot trefoil (*Lotus corniculatus*) showing the flower shape common to Fabaceae plants.

For image sources see annex 6.10

5.3.7 EUNIS Grass habitat type

EUNIS is a European system for classifying habitats. Select one from the reduced list of potential EUNIS habitat types to describe the **habitat present in the transect area** (and if necessary consider the direct surrounding for judging the type). The interior and margin transect may have different EUNIS habitat types.

Grassland habitat types:

- 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
- D1 = Raised and blanket bogs
- I1 = Arable land and market gardens

Habitat complexes with trees:

- X06 = Crops, meadows or pastures developed under orchards or other cultivated tree plantations
- X09 = Pasture woods

Other habitats:

- Other: please give a note on the type of habitat

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

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).

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.

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.

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 (**over 1000 m altitude**) 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%.

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.

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

I1 Arable land and market gardens

To be used when classified as eA41 – eA45 or if applicable on eC31 (fallow land regenerating into a grassland on its own)

Croplands planted for annually or regularly harvested crops other than those that carry trees or shrubs. They include fields of cereals, of sunflowers and other oil seed plants, of beets, legumes, fodder, potatoes and other forbs. Croplands comprise intensively cultivated fields as well as traditionally and extensively cultivated crops with little or no chemical fertilisation or pesticide application. Faunal and floral quality and diversity depend on the intensity of agricultural use and on the presence of borders of natural vegetation between fields

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.

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.

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.

5.3.8 Grassland age

It can prove challenging 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)
- no seeding rows from a seeding drill visible
- the sward is rather dense
- composition / distribution of the grass and herb species on the ground is balanced.

Very intensively managed meadows, with high slurry inputs after each of the several cuts per year and showing less than 10 plant species, are still considered "old" in the sense of being utilized in the same way and not being ploughed for many years.

Grassland less than 5 years old ($\leq$ 5 years):

- seeding rows of grassland are visible
- only few grass and forb species occur (normally less than 10 species)
- patches of open ground
- signs of ploughing or other types of soil disturbance

This option should only be chosen, if one can be certain that the soil of the given parcel is worked with a plough in a regular manner. Grasslands on arable fields (LC1 Codes eA41 to eA45) fall into this category as well.

Unclear

If there are no clear signs of how old the grassland is, choose this option.



Figure 5-12 Seeding rows in grassland < 5 years old.

5.3.9 Grassland fertilisation

This parameter covers the addition of nutrients to grassland, and has the following possible responses (see also Figure 5-13):

Table 5-1 Levels of grassland fertilisation.

Option	Meadow	Pasture
Sure – recent fertiliser application	Slurry, manure, or mineral fertiliser visible on the parcel	High density of dung on the parcel after grazing by animals
Probably – currently no fertiliser visible, but signs that it gets applied regularly	Dark green color of the grass Dense plant growth Grass species dominate	Dark green color of the vegetation Patches of denser vegetation, where dung facilitated plant growth
Unclear	No clear signs if the parcel gets fertilized or not (Not dark green in color, plant growth not meagre)	No clear signs if the parcel gets fertilized or not (Not dark green in color, plant growth not meagre)
No – no input of additional fertiliser	Meagre plant growth Forbs and grasses coexist Grass has a light green color	Only rough grazing, very little dung on the pasture

- **Sure:** direct signs of fertilisation (e.g. slurry, manure or mineral fertiliser on the surface; many evenly spread patches of dung on the parcel)
- **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, high density of productive grass species
- **Unclear:** there are neither positive signs nor negative signs of grassland fertilisation
- **No:** no additional fertiliser has been applied, i.e. there are no signs of manure, slurry or mineral fertilizer 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 or sheep), whereas

a large amount of dung (due to intensive grazing) does count as a sign of “sure” fertilisation.



Figure 5-13: Grassland fertilisation.

Left: Sure (slurry is visible on the surface).

Middle: Probably fertilised (grass is lush green but there are no visible signs),

Right: No additional fertiliser (only rough grazing, high species diversity)



Figure 5-14 Differences in the color of grasslands due to fertilization.

Left image: Two grassland parcels with different levels of fertilization. The light green parcel in the background could be classified as “unclear”, the grassland on the right half of the photo as “probably fertilized”.

Right image: Signs of fertilization via animal droppings. The dark green spots on the grassland show where cow dung led to increased plant growth. The grassland can be qualified as “probably fertilized”. If the quantity of dung patches was higher and more evenly distributed with fresh dung present, it could be classified as “sure”.

5.4 Evaluating changes in previously observed transects

Most transects will already have been surveyed in the previous year. During the re-visit of a plot, changes to survey-parameters may occur. When selected parameters are changed between this and the last survey year, the probable origin of the change must be estimated.

Parameter changes can be either due to a real change in the land-cover or due to issues with the assessment of the parameters in the previous survey year.

There are **five Types of Change (ToC)**:

- **ToC1 - Phenological reasons:** Differences in survey timing leading to different assessments

- **ToC2 - Change of definitions:** Changes in parameter definitions which lead to a change in how the data is stored.
- **ToC3 - Surveyor variation:** Errors due to different interpretation of the survey
- **ToC4 - Real change:** Actual, meaningful change in land-cover, land use or vegetation
- **ToC5 - Other** (Free text entry) – Choose this option, if you cannot be sure why change occurred between the two years.

The ODK app will show parameters assessed during the previous survey year. It is important to **not just copy these values** but **assess what can be seen on the field** and note any differences and the most probable reason for these to have occurred!

- **ToC1 - Phenological reasons:** Transects may have been observed very late during the growing season in 2022. This may have led to very different evaluations of parameters – make sure to be aware of the date of assessment (which is printed on the ground document) for a given transect when checking for estimating the kind of change.
- **ToC2 - Change of definitions:** Due to updates to the survey instructions, codes and parameters have received updates, leading to differences between the codes of two years, see the list below for LC-codes affected by changes. In such cases, the LC-code of a parcel is updated, even though the real land-cover itself did not change..

EMBAL 2023 Code	Short definition	EMBAL 2022 Code
eF11	<i>Garden complex</i>	eB19
eF31	<i>Terrace landscape</i>	eE41
eE11 and eE12	<i>Solitary tree</i>	eE11
eE13	<i>Tree line / avenue</i>	eE12
eE14	<i>Hedges / shrubs</i>	eE13
eE41	<i>Stone wall</i>	eE42
eE42	<i>Stone heap</i>	eE43
eE43	<i>Isolated rock</i>	eE44
eE44	<i>Earth escarpment</i>	eE45
eE45	<i>Raw soil site</i>	eE46
eE61	<i>Agricultural building</i>	eE61 and eE62
eE62	<i>Woodpile</i>	eE63
eE63	<i>Solar panel</i>	eE64
eE64	<i>Electric pylon</i>	eE65
eE65	<i>Other LE</i>	eE66
eE71	<i>Flower strip</i>	eA81 and eE71

- **ToC3 – Surveyor variation:** Subjective surveyor interpretation may lead to different or even wrong assessments of parameters. Please use the photographs supplied on the ground document, to get an idea of the state of the vegetation in the previous year and see, whether a meaningful change has occurred or the previously assessed data is inconsistent with the parameter definitions.
- **ToC4 – Real change:** describe meaningful changes to the land cover, land use and key vegetation parameters on a parcel and transect, which are not likely due to any reason detailed above.

Examples for this would be:

- A grassland being ploughed between years, changing from eC to eA
- Trees being felled in an orchard, reducing the coverage of LC2.
- A grassland being harrowed, and the coverage of grass/herb plants thus being significantly reduced.

For transects, the pictures from last year's assessment can be utilized to see whether a change is a "real change" or another type of change. They are printed on the ground document for reference.

- **ToC5 – Other:** Choose this option, if you cannot be sure why change occurred between the two years. There is also the possibility to supply a free text and give an estimation for the probably origin of the apparent change.

6 Annexes

Content

- 6.1 List of codes for types of land cover and landscape elements
- 6.2 Recording sheet at parcel level
- 6.3 Recording sheet for complex
- 6.4 Summary of transect shifting rules
- 6.5 Recording sheet for grassland transects
- 6.6 Recording sheet for arable transects
- 6.7 Timeframing based on biogeographic region and elevation
- 6.8 List of indicator species
- 6.9 Picture guide for the identification of the indicator species (separate document)
- 6.10 Image sources

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

LC code	Landcover	Category	Code	Specification	Code	Specification	Extent min
eA	Arable land	Non permanent crops <i>Areas smaller than 25 m² are ignored/integrated into the surrounding parcel</i>	Cereals		Horticulture		> 25 m²
			eA11	Wheat (winter and spring, also incl. Triticale, Durum, Spelt)	eA51	Vegetables (also asparagus, strawberries, etc.)	
			eA12	Barley	eA52	Plastic tunnel	
			eA13	Rye	eA53	Greenhouse culture	
			eA14	Oats	eA54	Market garden: Cultivation of different kinds of vegetables on one agricultural field, combination of small vegetable fields, garden fields and/or plastic tunnels / greenhouse cultures, including small paths and tracks	
			eA15	Maize			
			eA16	Rice			
			eA17	Other cereals (including mixed cereals for fodder)	Other crops		
			Root crops		eA61	Other non-permanent crops	
			eA21	Potatoes	Open soil and fallow		
			eA22	Sugar beet	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., in olive groves, orchards or vineyards, or in the case of a fire break).	
			eA23	Other root crops			
			Oil and special crops				
			eA31	Sunflower	eA72	Alternating ploughing in permanent cultures: To be used as LC1 in permanent cultures such as vineyards, berry plantations or orchards, where every other row gets ploughed regularly, while the rest of the rows is sown with a mixture of different grass and forb species.	
			eA32	Rape and turnip seeds			
			eA33	Soya			
			eA34	Cotton			
			eA35	Tobacco			
			eA36	Floriculture and ornamental plants			
			Fodder production		eA80	Fallow / set-aside arable land 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 such as weeds or tall herbs.	
			eA41	Clovers			
			eA42	Lucerne			
			eA43	Grass-Clover-Mixture			
			eA44	Sown grass on arable land (includes signs of use as an arable field such as wheel ruts, clear seeding rows, marks of ploughing)			
			eA45	Other legumes and mixtures for fodder			

eB	Permanent cultures and trees	Permanent cultures and trees <i>If tree cover <8% 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	> 8 % coverage on the parcel If coverage is < 8 % define the trees as Landscape Elements (eE11 or eE12)
			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 with agricultural use (e.g. Dehesas with cork-oaks)	
			eB17	Nurseries (including Christmas trees)	
			eB18	Other permanent cultures (including permanent energy wood plantations)	
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, no small woody plants appear on the grassland. 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 4-8 times per year.	> 25 m ²
			eC12	Intensive meadow Vegetation mostly consisting of grasses, some forbs, cut 3-4 times per year, less intensive green than C11.	
			eC13	Medium intensive to extensive meadow Vegetation with both grasses and forbs, cut 2-3 times per year, usually paler green colour than C11/C12.	
			eC14	Extensive meadow Vegetation with both grasses and forbs, low fertiliser inputs, cut 2 times a year.	
			eC15	Very extensive meadow No signs of fertiliser application, cut only 1-2 times per year with low levels of plant growth. High species diversity possible on sites with non-poor soils. Might also have large amounts of sedges or reeds, in wet biomes.	
		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</i>	eC21	Intensive pasture Vegetation dominated by grasses (few forbs), intensive green colour, grazed very short and/or with areas of trampled bare earth. May be grazed in a rotational system, with animals only on part of the overall pasture and heavy grazing in the compartment.	

		<i>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>	eC22	Medium intensive pasture Vegetation with both grasses and forbs, vegetation of uneven height due to grazing. May be grazed in a rotational system.	> 25 m ²
			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. Use LC2 code eE14 to indicate the coverage of a woody layer (bushes, shrub, trees).	
			eC24	Only occasionally grazed (very extensive), up to 70% shrub or tree cover may occur (if shrub coverage is >70% see eD10, when tree coverage is >70% see eC25), dead plant material may occur, few signs of animals (e.g. dung). Please use LC2 code eE14 to indicate the coverage of a woody layer (bushes, shrub, trees).	
			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.	
		Other grassland	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 without being sown.	
			eC41	Mulched grassland (i.e. cut but not harvested) Found 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	Occasionally grazed shrublands (Mediterranean shrublands such as Garrigue and Maquis) Areas with 70 – 90 % coverage by shrubs or other woody vegetation under 4 m tall. If shrub coverage is less than 70%, apply a suitable eC code. If shrub coverage exceeds 90 % and there are no signs of agricultural use (animal paths, dung), classify as eN60. Coverage by trees (woody plants > 4 m in height) can be up to 70 %. Define trees in LC2 with an appropriate code (eB or eE12). If tree cover exceeds 70 %, classify as eN10 if there is no agricultural use, or as eC25 if there is agricultural use.	> 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. Use this code as LC1 to mark lone trees in the landscape. The ground coverage around the tree trunk does not need to be recorded in case it is an agricultural area (eA or eC). In case the ground cover around the tree is a landscape element (such as eE21, eE22, eE45) use the code eE12 to assess the tree. Measure the crown radius in meter.	≥4 m height or ≥3 m radius
			eE12	Small groups of trees or scattered trees For groups of trees or solitary trees, please specify an appropriate LC1 for the ground coverage under the trees and use this code as LC2. If there are solitary trees (which are not used for agriculture) dispersed on an agricultural parcel (eA, eC, eD, eF) use this code as LC2. The canopy of the trees should cover more than 8 % of the parcel. If they cover less than 8% of the surrounding parcel, assess the trees as individual elements. If dispersed trees have an agricultural use, see eB11/12 for fruit trees, eB14 for olive trees and eB16 for other trees such as cork-oak.	For scattered trees: More than 8 % of parcel covered by tree canopy

			eE13	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
			eE14	Hedges, small woodland areas, woody strips, field coppices and riverine scrub (including trees and bushes). If the woody canopy covers a distinct area of ≤ 0.50 ha with >70%, eE14 should be entered as LC1 . If the woody canopy is scattered on a parcel covering > 8 %, eE14 should be entered as LC2 , with the appropriate ground cover land use as LC1. If the woody canopy covers a distinct area of >0.50 ha with >70% and there are no signs of agricultural use, the parcel should be coded as non-agricultural (LC1 = eN10). When unsure about the size of the area, use eE14 instead of eN10. In extraordinary cases of very long hedges covering an area of > 0.50 ha (e.g. 500 m length and 15 m width = 0.75 ha) they shall also be mapped as eE14 (applies only for hedges < 20 m width).	> 25 m ² + ≤ 0.5 ha
		Grass-herb elements	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 eE14). Strips <1 m in width are integrated into the adjacent parcel. Areas >20 m wide see eC codes.	1-20 m
			eE22	Small grassy patches with permanent grass-herb cover, not wider than 20 m, smaller than 0.5 ha in size and without regular recent agricultural use (with recent agricultural use this would be eC31). If >0.5 ha then select an appropriate eC-code	>25m ² ≤0.5 ha
		Water elements and reed-sedge beds <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	Ditches with flowing or standing water, or temporarily dry. Ditches are man-made structures for drainage or irrigation, running usually in straight lines.	1-20 m
			eE33	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.	>25m ² ≤0.5 ha
			eE34	Reed or sedge beds <0.5 ha in size without signs of regular or irregular / former agricultural use. If >0.5 ha then eN20. When unsure about the size of an area, use eE34 instead of eN20.	>25m ² ≤0.5 ha
		Stone, rock, raw soil and terrace elements <i>If >1 linear element per 20 m distance, or in the case of rocks /stones ></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 subjective nature value of 1-2.	≥1 m width as LC1 Up to 1 per 20 m, or ≥ 1 /100 m ² for stones as LC2
			eE42	Field stone heaps and cairns.	
			eE43	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.	
			eE44	Sand, clay and loess escarpments. Not formed through human activities, but e.g. glacial or alluvial processes.	

		1/100 m ² , then these codes can be selected as LC2 for the whole parcel	eE45	Raw soil sites (stone, sand, dirt surfaces with little or no vegetation) larger than 1 m diameter. If obviously anthropogenic (gravel extraction site, open cast mine, building site) then see eN50.	
		Roads and track (including grass margins <1m)s	eE51	Dirt / Grass track. This excludes paths that are hard to distinguish from the adjacent area (these paths should not be mapped). Tracks inside vineyards or tree nurseries need not to be assessed individually.	≥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	Agricultural buildings in the field such as field barns, machinery sheds, garden/tool sheds, animal sheds, silos or dung pits. If the buildings are adjacent to a farm or settlement, they are part of the settlement/farm area (eN40). For greenhouses see eA53	≥1 m width
			eE62	Woodpiles	
			eE63	Solar panels (must be recorded as LC2 with the appropriate ground level land cover)	
			eE64	Antenna/electric pylon/wind turbine. Use as LC2 if LC1 would be eE14, eE21, eE22, eE45 or eE65. Else define as LC1.	
			eE65	Other elements	
		Flower strips and flower areas	eE71	Flower strips and flower areas. Strips of flowering plants such as <i>Phacelia sp.</i> sown along the edge of a field or grassland to serve as food for pollinators.	≥1 m width
eF	Complexes of land covers	Gardens and small scale orchards	eF11	Complexes of many small vegetable fields, garden fields, huts, (orchard) trees and hedges including small paths and tracks (often close to settlement areas as leisure or semi-natural garden areas. Small parcels adjacent to housing with this code can be merged with eN40.). Use this code as LC1. If trees are present, define the type in LC2, along the coverage of the plot.	> 25 m ²
				Suitable cLC1-codes for eF11: eA52 / A53 / eA54 (Vegetables, Tunnels, Greenhouses) eA71 / eA80 (Open soil / fallow) eC31 / eC41 (Ruderal or mulched grassland) eE11 / eE14 (Tree, shrub LE) eE33 / eE41 / eE61 eE66 (Pond /stone-wall / building LE) Suitable cLC2-codes for eF11: All eB (permanent cultures) eE12 / eE14 (Groups of trees / shrubs LE) eE66 (other LE)	
		Polyculture	eF21	More than 2 land uses combined on one parcel, such as crops, pastures, different kinds of orchards and olive groves, vineyards, stone walls, hedges, and paths. The elements must be connected in a fashion that separating them into individual parcels is not possible.	

				Suitable cLC1 -codes for eF21 : All eA codes (agricultural fields) All eC Codes (grassland) eD10 (grazed shrubland) eE11 / eE14 (Single tree, shrub LE) eE41 (stone wall LE)	Suitable cLC2 -codes for eF21 : All eB (permanent cultures) eE12 / eE14 (Groups of trees / shrubs LE) eE66 (other LE)	
		Terraces	eF31	Complexes of small terraces with dry stone and natural stone walls, arable fields, vineyards, olive or orchards, vegetable gardens etc., including small paths, tracks and natural bush / tree elements. A high density of ≥ 1 terraces / walls / 20 m of slope mixed with other land cover must be given. The LC-code eE41 MUST be used in cLC1.		>0.1 ha < 5 ha
				Suitable cLC1 -codes for eF31 : eE41 – stone / terrace walls (must be used) All eA codes (agricultural fields) All eC Codes (grassland) eD10 (grazed shrubland) eE11 / eE14 (Single tree, shrub LE) eE21 / eE22 (grass LE) eE42 / eE43 / eE44 / eE45 (stone elements) eE51 / eE52 / eE53 (paths) eE61 / eE66 (Buildings and other)	Suitable cLC2 -codes for eF31 : All eB (permanent cultures) eE12 / eE14 (Groups of trees / shrubs LE) eE66 (other LE)	
		Other	eF41	Other heavily interconnected types of land-use. Give a short description of the main characteristics of the observed land-use. For this code, any LC-code can be used for cLC1 or cLC2. Please explain the selection under “further remarks”.		
eN	other Non-agri-cultural land <i>If these are connected with each other in a parcel (e.g. houses inside a forest), they do not need to be separated into different parcels. Assign a code reflecting the dominant land-cover.</i>	Forest	eN10	Forest, both natural forests and plantations. At least 0.5 ha with 70% canopy cover of trees >3 m in height. For woodland areas < 0.5 ha see eE14.		>0.5 ha
		Wetland	eN20	Inland and coastal wetlands, including marshes, bogs and fens ≥ 0.5 ha in size and with <70% canopy cover of trees. For wetland areas < 0.5 ha see eE34.		>0.5 ha
		Open water	eN30	Large inland or coastal running or standing water bodies. For water bodies <0.5 ha or < 20 m width see eE31-eE33.		>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), wild shrublands without anthropogenic use, scree fields and large stone outcrops		≥ 25 m ²

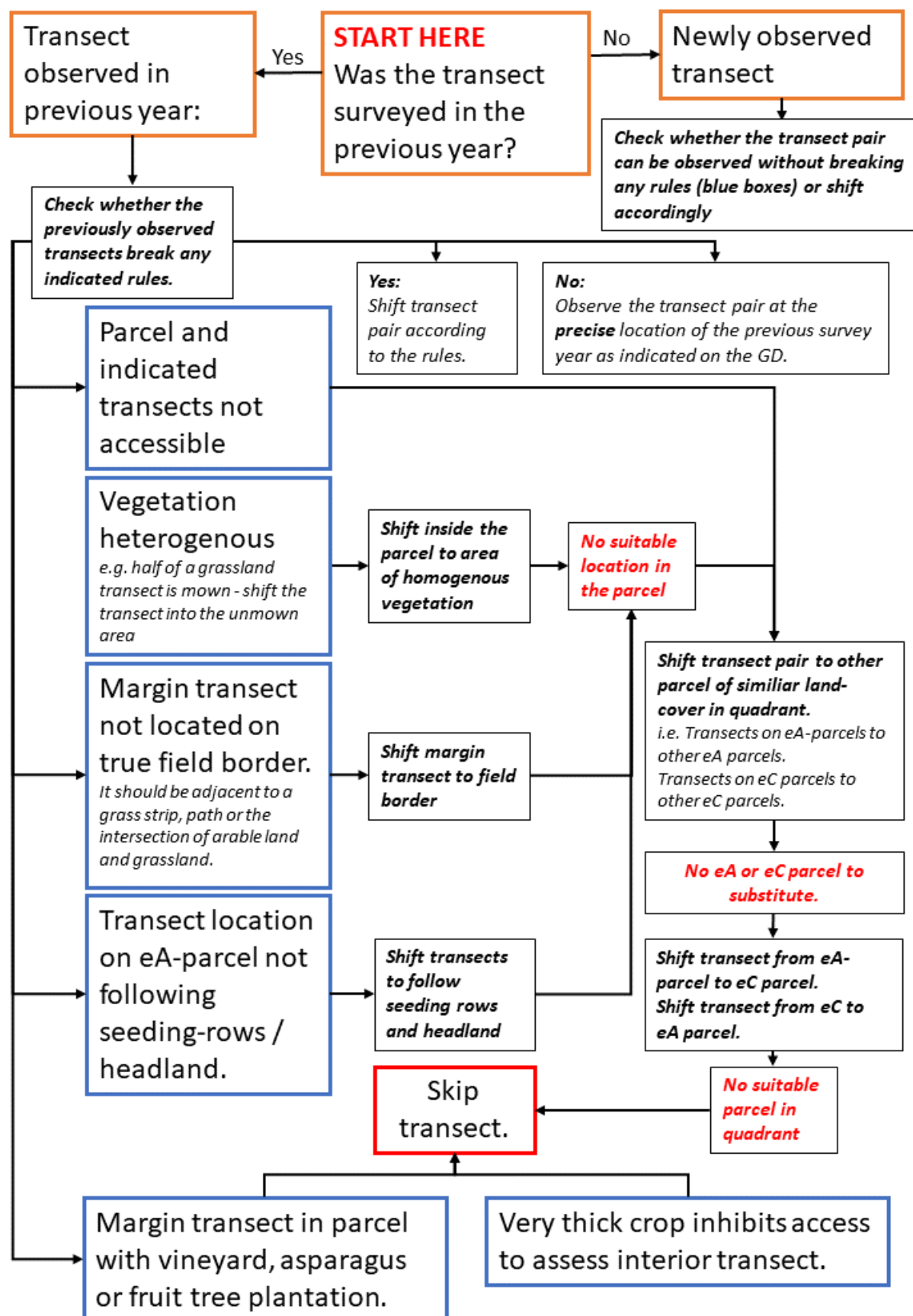
6.2 Recording sheet at parcel level

Main Sheet Parcel level					Surveyor ID:			EMBAL-ID:										Date: ____/____/____									
ID	4.1.2 Can be observed?	4.1 Land cover			4.1.3 Stage of vegetation			4.1.7 Irrigation			4.1.8 Width of extensive strip (if present)	4.1.10 Flower density	4.1.11 Flower colours (tick each flower colour only once per parcel if present)										4.2 Arable parcels		4.3 Grassland parcels		4.1.12 Further remarks
	Y = Yes N = No P = Partially	4.1.4 LC1	4.1.5 LC2	4.1.6 Coverage LC 2 Fill in one of these categories: 1: 0% 2: >0-3% 3: >3-8% 4: >8-15% 5: >15-25% 6: >25-40% 7: >40-60% 8: >60-80% 9: >80-100%	1: Full record possible (crop visible/not mown or pastured) 2: Record difficult but possible (crop partially developed / partially mown/pastured / regrowth after mowing/grazing (vegetation >20cm) 3: No full record possible (crop harvested/mown or pastured recently with vegetation <20 cm)	irrigated	maybe irrigated	not irrigated		Fill in one of the following categories: 0: none 1: Very few 1.5 2: Few 2.5 3: Medium 3.5 4: Dense 4.5 5: Very dense	White	Yellow	Orange	Red	Magenta	Violet	Blue	Green	Mixed	Number of flower colours: (Possible inputs 0 – 9)	4.2.1 Crop coverage Fill in one of these categories: 1: 0% 2: >0-3% 3: >3-8% 4: >8-15% 5: >15-25% 6: >25-40% 7: >40-60% 8: >60-80% 9: >80-100%	4.2.2 Wild plant coverage Fill in one of these categories: 1: 0% 2: >0-3% 3: >3-8% 4: >8-15% 5: >15-25% 6: >25-40% 7: >40-60% 8: >60-80% 9: >80-100%	4.3.1 Vigour Fill in one of these categories: 1: Very meagre 1.5 2: Meagre 2.5 3: Light 3.5 4: Dense 4.5 5: Very dense	4.3.2 Graminoid forb ratio Fill in one of these categories: 100:0 90:10 80:20 70:30 60:40 50:50 40:60 30:70 20:80 10:90 0:100			
	☐ Y ☐ N ☐ P				☐	☐	☐		m		☐	☐	☐	☐	☐	☐	☐	☐	☐								
	☐ Y ☐ N ☐ P				☐	☐	☐		m		☐	☐	☐	☐	☐	☐	☐	☐	☐								
	☐ Y ☐ N ☐ P				☐	☐	☐		m		☐	☐	☐	☐	☐	☐	☐	☐	☐								
	☐ Y ☐ N ☐ P				☐	☐	☐		m		☐	☐	☐	☐	☐	☐	☐	☐	☐								
	☐ Y ☐ N ☐ P				☐	☐	☐		m		☐	☐	☐	☐	☐	☐	☐	☐	☐								
	☐ Y ☐ N ☐ P				☐	☐	☐		m		☐	☐	☐	☐	☐	☐	☐	☐	☐								
Landscape Elements					4.4.2 Width (if < 5 m wide)			4.4.2 Length (if < 20 m long)		4.4.2 Subjective nature Value Fill in one of the following categories: 1: Very low 1.5 2: Rather low 2.5 3: Moderately high 3.5 4: Rather high 4.5 5: Very high		Further remarks		4.5 Plot description: Plot photos taken? _____													
ID	4.1.2 Can be observed?	4.1.4 LC1	4.1.5 LC2	4.1.6 Coverage LC 2 (%)																							
	☐ Y ☐ N ☐ P				_____ m			_____ m																			
	☐ Y ☐ N ☐ P				_____ m			_____ m																			
	☐ Y ☐ N ☐ P				_____ m			_____ m																			
	☐ Y ☐ N ☐ P				_____ m			_____ m																			

6.3 Recording sheet for complexes of land covers

[illegible]

6.4 Summary of transect shifting rules



6.5 Recording sheet for grassland transects

Parcel ID: _____		Grassland transect ID: _____		Surveyor ID: _____		EMBAL ID: _____					
5.1	Transect location on Ground Document:		Latitude: _____		Longitude: _____		Altitude: _____				
5.1.4	Parcel Landcover:		LC2 Coverage: _____%	5.1.5	Stage of vegetation		☐ not mown/pastured (record is possible) ☐ Partially mown/pastured or regrowth after mowing/grazing (vegetation >20 cm in height) ☐ recently mown/pastured vegetation < 20 cm (full record not possible)				
	LC1: _____	LC2: _____									
5.1.2	Transect possible? ☐ Yes ☐ No		If 5.1.1 is "No" or 5.1.3 is "Yes", give a reason why:								
5.1.3	Transect shifted? ☐ Yes ☐ No										
5.1.6	Transect location:		Start-point:	Latitude: _____		Longitude: _____					
			End-point:	Latitude: _____		Longitude: _____					
5.1.7	Photographs:	From start ☐	From End ☐	Flower Posy ☐		Vegetation structure ☐					
	Photo-ID: _____										
5.1.8	Inclination (%)		5.1.9	Exposition		5.3.8	Grassland Age				
	1 ☐ 0 5 ☐ >15-25 2 ☐ >0-3 6 ☐ >25-40 3 ☐ >3-8 7 ☐ >40 4 ☐ >8-15			1 ☐ Flat 5 ☐ SE 9 ☐ NW 2 ☐ N 6 ☐ S 3 ☐ NE 7 ☐ SW 4 ☐ E 8 ☐ W			1 ☐ < 5 years 2 ☐ > 5 years 3 ☐ Unclear				
							1 ☐ No 2 ☐ Probably 3 ☐ For Sure 4 ☐ Unclear				
5.3.1	Vigour of Vegetation (Intensity of growth)		☐ 1 ☐ 1.5 ☐ 2 ☐ 2.5 ☐ 3 ☐ 3.5 ☐ 4 ☐ 4.5 ☐ 5 Very meagre Meagre Light Dense Very Dense		5.3.2	Height of herbaceous layer: _____ cm					
					5.1.11	Flower colours	☐ White ☐ Yellow ☐ Orange ☐ Red ☐ Magenta ☐ Violet ☐ Blue ☐ Green ☐ Mixed				
5.1.10	Flower density		☐ None ☐ Very Few ☐ Few ☐ Medium ☐ Dense ☐ Very dense		5.1.10	Number of Flowering forb species					
						(Possible values 0 – 33)					
5.3.7	EUNIS Habitat Type										
	☐ E1	Dry grasslands		☐ F3	Temperate and Mediterranean montane scrub						
	☐ E2	Mesic grasslands		☐ F6	Garrigue						
	☐ E3	Seasonally wet and wet grasslands		☐ D1	Raised and blanket bogs						
	☐ E4	Alpine and subalpine grasslands		☐ I1	Arable land and market gardens						
	☐ E5	Woodland fringes and clearings, tall forb stands		☐ X09	Pasture woods						
	☐ E6	Inland salt steppes		☐ X06	Crops, meadows or pastures developed under orchards or other cultivated trees						
	☐ E7	Sparely wooded grasslands		☐ Other:	Define:						
5.1.13	Key species (groups) (tick boxes if one species of a group occurs in the transect)					5.3.6	Graminoid forb ratio				
	☐ Apiaceae ☐ Campanula sp. ☐ Centaurea sp., Serratula tinctoria ☐ Cirsium sp., Carduus sp., Carlina sp., Eryngium planus, Echinops sp. ☐ Juncus sp. ☐ Myosotis sp.		☐ Orchidaceae ☐ Scabiosa sp. Knautia sp. / Succisa sp. ☐ Silene sp. - red flowering, Lychnis flos-cuculi., Dianthus sp. ☐ Trifolium sp. - red flowering ☐ Trifolium sp., Medicago sp. Lotus sp., Coronilla sp. - yellow flowering ☐ Vicia sp., Lathyrus sp., Astragalus sp. (blue + violet flowers)			☐ 100:0 ☐ 40:60 ☐ 90:10 ☐ 30:70 ☐ 80:20 ☐ 50:50 ☐ 70:30 ☐ 10:90 ☐ 60:40 ☐ 0:100 ☐ 50:50 (Sum must be 10)					
5.3.4	Vegetation layers		0%	>0-3%	>3-8%	>8-15%	>15-25%	>25-40%	>40-60%	>60-80%	>80-100%
	Herb layer		☐	☐	☐	☐	☐	☐	☐	☐	☐
	Bare layer		☐	☐	☐	☐	☐	☐	☐	☐	☐
	Woody layer (all woody plants < 1m)		☐	☐	☐	☐	☐	☐	☐	☐	☐
	Woody canopy layer (coverage of the transect by the canopy of woody species from the birds eye view)										
	Shrubs (> 1 to 5 m)		☐	☐	☐	☐	☐	☐	☐	☐	☐
	Dwarf shrubs (< 1 m)		☐	☐	☐	☐	☐	☐	☐	☐	☐
	Orchard		☐	☐	☐	☐	☐	☐	☐	☐	☐
	Vineyard		☐	☐	☐	☐	☐	☐	☐	☐	☐
	Old trees (> 5 m or > 20 years old)		☐	☐	☐	☐	☐	☐	☐	☐	☐
	Others		☐	☐	☐	☐	☐	☐	☐	☐	☐
5.3.5	Structural species										
	Shrub / brushwood / bramble		☐	☐	☐	☐	☐	☐	☐	☐	☐
	Thistles (Carduus sp. etc.)		☐	☐	☐	☐	☐	☐	☐	☐	☐
	Docks (Rumex sp.)		☐	☐	☐	☐	☐	☐	☐	☐	☐
	Rushes (Juncus sp.)		☐	☐	☐	☐	☐	☐	☐	☐	☐
	Sedges (Carex sp.)		☐	☐	☐	☐	☐	☐	☐	☐	☐
	Small-reed (Calamagrostis sp.)		☐	☐	☐	☐	☐	☐	☐	☐	☐
5.3.6	Total legume cover		☐	☐	☐	☐	☐	☐	☐	☐	☐
5.1.12	Further remarks										

6.6 Recording sheet for arable transects

Parcel ID: _____			Arable transect ID: _____			Surveyor ID: _____			EMBAL ID: _____					
5.1	Transect location on Ground Document:		Latitude: _____			Longitude: _____			Altitude: _____					
5.1.4	Parcel Landcover:		LC2 Coverage: _____%		5.1.5	Stage of vegetation		☐ crop developed/visible (record is possible)		☐ crop partially developed (record partially possible)		☐ crop not yet germinated or already harvested (full record not possible)		
	LC1: _____	LC2: _____												
5.1.2	Transect possible? ☐ Yes ☐ No				If 5.1.2 is “No” or 5.1.3. is “Yes”, give a reason why:									
5.1.3	Transect shifted? ☐ Yes ☐ No													
5.1.6	Transect location:		Start-point: _____		Latitude: _____			Longitude: _____						
			End-point: _____		Latitude: _____			Longitude: _____						
5.1.7	Photographs:		From start ☐		From End ☐		Flower Posy ☐		Vegetation structure ☐					
	Photo-ID: _____													
5.1.8	Inclination (%)			5.1.9	Exposition			5.2.1	Height of crop: _____ cm					
	1 ☐ 0 5 ☐ >15-25 2 ☐ >0-3 6 ☐ >25-40 3 ☐ >3-8 7 ☐ >40 4 ☐ >8-15				1 ☐ Flat 5 ☐ SE 9 ☐ NW 2 ☐ N 6 ☐ S 3 ☐ NE 7 ☐ SW 4 ☐ E 8 ☐ W			5.1.11	Flower colours		☐ Brown ☐ White ☐ Yellow ☐ Orange ☐ Red		☐ Magenta ☐ Violet ☐ Blue ☐ Green ☐ Mixed	
5.1.10	Flower density		☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐		None Very Few Few Medium Dense Very dense		5.1.12	Number of Flowering forb species		(Possible values 0 – 33)				
5.2.2	Vegetation layers		0%	>0-3%	>3-8%	>8-15%	>15–25%	>25-40%	>40-60%	>60-80%	>80-100%			
	Crop layer		☐	☐	☐	☐	☐	☐	☐	☐	☐			
	Wild plants		☐	☐	☐	☐	☐	☐	☐	☐	☐			
	Underseed		☐	☐	☐	☐	☐	☐	☐	☐	☐			
	Bare layer		☐	☐	☐	☐	☐	☐	☐	☐	☐			
	Woody canopy layer (coverage of the transect by the canopy of woody species from the birds eye view)													
	Orchards		☐	☐	☐	☐	☐	☐	☐	☐	☐			
	Olive groves		☐	☐	☐	☐	☐	☐	☐	☐	☐			
	Vineyard		☐	☐	☐	☐	☐	☐	☐	☐	☐			
	Others		☐	☐	☐	☐	☐	☐	☐	☐	☐			
5.1.13	Key species (groups) (tick boxes if one species of a group occurs in the transect)													
	Anagallis sp. (Syn: <i>Lysimachia</i>)		☐	Erodium sp., Geranium sp.			☐	Myosotis sp.			☐			
	Apiaceae white or yellow flowering		☐	Euphorbia sp.			☐	Papaver sp.			☐			
	Asteraceae yellow or orange flowering		☐	Fabaceae (blue/magenta/purple/red flowering)			☐	Ranunculus sp.			☐			
	Asteraceae with mixed white-yellow flowers (Chamomiles)		☐	Fabaceae (yellow flowering)			☐	Silene sp.			☐			
	Carduus sp., Cirsium sp.		☐	Fumaria sp.			☐	Thlaspi arvense			☐			
	Centaurea cyanus		☐	Galeopsis sp.			☐	Veronica sp.			☐			
	Consolida sp. (Syn: Delphinium)		☐	Lamium sp.			☐	Viola sp.			☐			
5.1.14	Further remarks:													

6.7 Timeframing based on biogeographic region and elevation

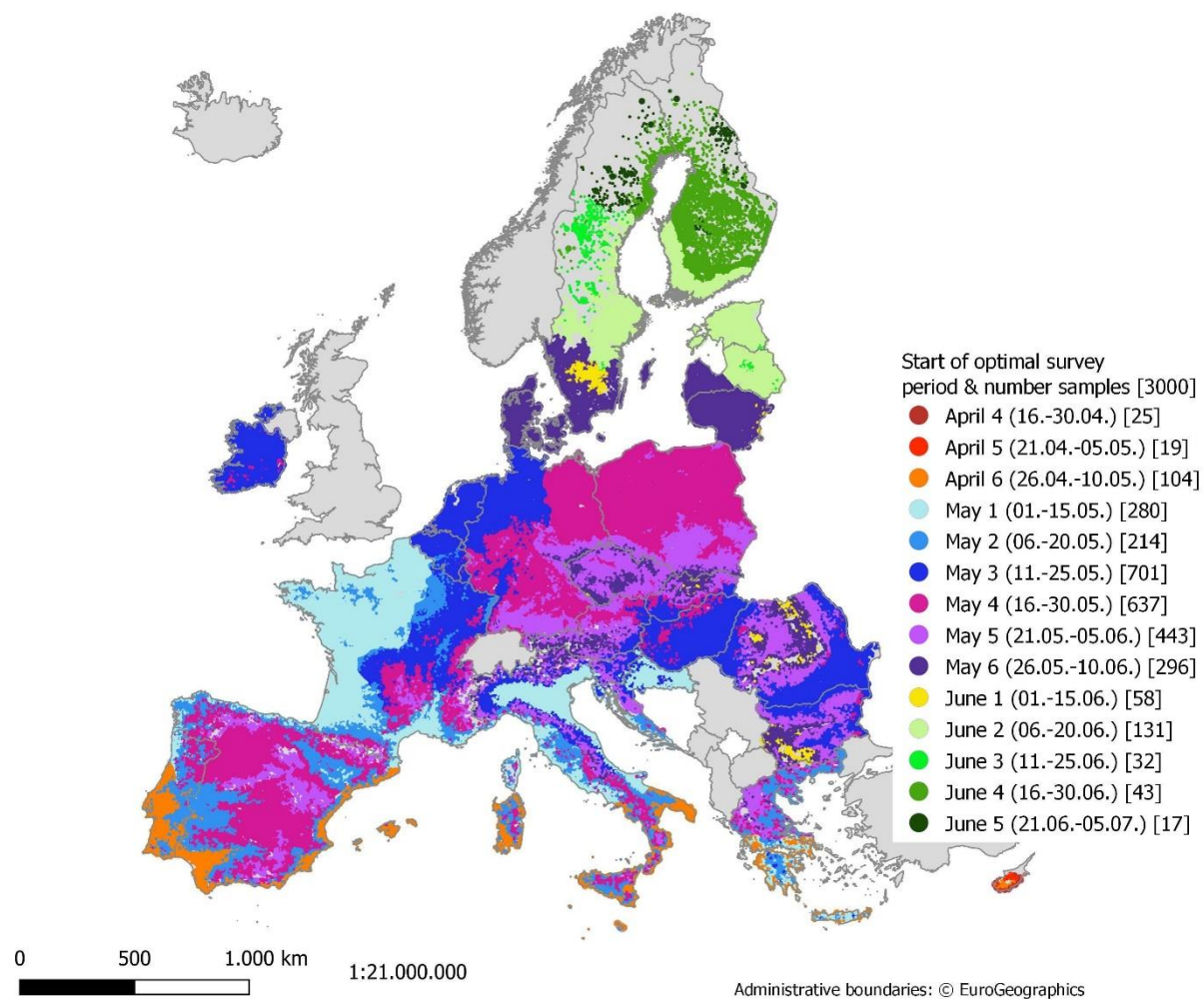


Figure 6-1 Time framing of the EMBAL 2022 survey as set out by the European Commission in the technical documents for the LUCAS surveys

6.8 List of indicator species

Part I – Arable land

<i>Species group</i>	<i>Species group</i>
<i>Anagallis</i> sp. (Syn: <i>Lysimachia</i>)	<i>Fumaria</i> sp.
Apiaceae white or yellow flowering	<i>Galeopsis</i> sp.
Asteraceae yellow or orange flowering	<i>Lamium</i> sp.
Asteraceae with mixed white-yellow flowers (Chamomiles)	<i>Myosotis</i> sp.
<i>Carduus</i> sp., <i>Cirsium</i> sp.	<i>Papaver</i> sp.
<i>Centaurea cyanus</i>	<i>Ranunculus</i> sp.
<i>Consolida</i> sp. (Syn: <i>Delphinium</i>)	<i>Silene</i> sp.
<i>Erodium</i> sp., <i>Geranium</i> sp.	<i>Thlaspi arvense</i>
<i>Euphorbia</i> sp.	<i>Veronica</i> sp.
Fabaceae (blue/magenta/purple/red flowering)	<i>Viola</i> sp.
Fabaceae (yellow flowering)	

Part II – Grassland

Key species group
Apiaceae
<i>Campanula</i> sp.
<i>Centaurea</i> sp., <i>Serratula tinctoria</i>
<i>Cirsium</i> sp., <i>Carduus</i> sp., <i>Carlina</i> sp., <i>Eryngium planus</i> , <i>Echinops</i> sp.
<i>Juncus</i> sp.
<i>Myosotis</i> sp.
Orchidaceae
<i>Scabiosa</i> sp., <i>Knautia</i> sp., <i>Succisa</i> sp.
<i>Silene</i> sp. <i>Dianthus</i> sp. - magenta flowering,
<i>Trifolium</i> sp. – magenta/red flowering
<i>Coronilla</i> sp., <i>Lotus</i> sp., <i>Medicago</i> sp., <i>Trifolium</i> . sp. - yellow flowering
<i>Vicia</i> sp., <i>Lathyrus</i> sp., <i>Astragalus</i> sp. (blue/magenta/purple/red flowering)

Part III – Structural species grassland

Shrub/ Brushwood/ Bramble
Thistles (<i>Carduus</i> sp., etc.)
Docks (<i>Rumex</i> sp., but not <i>R. acetosa</i>)
Rushes (<i>Juncus</i> sp.)
Sedges (<i>Carex</i> sp.)
Small-reed (<i>Calamagrostis</i> sp.)

6.9 Picture guide for the identification of the indicator species

(→ please see separate document)

6.10 Image sources

Sources for images used in the EMBAL 2023 manual, from authors not affiliated with the EMBAL project.

Image name	Author	Page	Download date	License and link
20140522Rumex_acetosa3	AnRo00002	25	17.01.2023	CC0, https://commons.wikimedia.org/w/index.php?curid=32918414
20130507Plantago_lanceolata3	AnRo00002	25	17.01.2023	CC0, https://commons.wikimedia.org/w/index.php?curid=26138712
20140823Chenopodium_album	AnRo00002	25	17.01.2023	CC0, https://commons.wikimedia.org/w/index.php?curid=34925751
Brennesler	KEBman	25	17.01.2023	Public Domain, https://commons.wikimedia.org/w/index.php?curid=946567
Carex_exsiccata	Randal	25	17.01.2023	CC0, https://commons.wikimedia.org/w/index.php?curid=122833265
Loewenzahn_Taraxacum_officinale	Joe MiGo	24	23.01.2023	CC BY-SA 3.0, https://commons.wikimedia.org/w/index.php?curid=12504009
Achillea_millefolium_101924471	watcherwoman	26	23.01.2023	CC0, https://commons.wikimedia.org/w/index.php?curid=96675140
Lilium_bulbiferum_var._bulbiferum_01	Uoaei1	26	23.01.2023	CC BY-SA 3.0, https://commons.wikimedia.org/w/index.php?curid=33870208
Adonis_flammea_M1	Adrian198cm	26	23.01.2023	CC0, https://commons.wikimedia.org/w/index.php?curid=15474229
Lotus_corniculatus_1614	Walter Siegmund	26	23.01.2022	CC BY-SA 3.0, https://commons.wikimedia.org/w/index.php?curid=7726249
Veronica_praecox_(Früh-Ehrenpreis)_IMG_36614	HermannScha chner	26	24.01.2022	CC0, https://commons.wikimedia.org/w/index.php?curid=24722164
Anagallis_foemina_(habitus)	Hans Hillewaert	26	24.01.2022	CC BY-SA 3.0, https://commons.wikimedia.org/w/index.php?curid=3880422
Matricaria_discoidea_003	H. Zell	26	23.01.2023	CC BY-SA 3.0, https://commons.wikimedia.org/w/index.php?curid=10667723

Eryngium_campestre_RF	Robert Flogaus-Faust	26	23.01.2023	CC BY 4.0, https://commons.wikimedia.org/w/index.php?curid=81969238
20160421Euphorbia_helioscopia2	AnRo0002	26	23.01.2023	CC0 https://commons.wikimedia.org/w/index.php?curid=48330070
Gelber_Frauenschuh_(Blüte)	Sepulnation1986	26	23.01.2023	BY-SA 3.0, https://commons.wikimedia.org/w/index.php?curid=9514088
Viola_tricolor_Fiolek_trójbarwny_2020-06-29_02	Agnieszka Kwiecień / Nova	26	23.01.2023	CC BY-SA 4.0, https://commons.wikimedia.org/w/index.php?curid=99455092
20150428Juncus_acutiflorus1	AnRo0002	64	23.01.2023	CC0, https://commons.wikimedia.org/w/index.php?curid=39842369
Trifolium_pratense_-_Keila2	Ivar Leidus	65	23.01.2023	CC BY-SA 4.0, https://commons.wikimedia.org/w/index.php?curid=50438310
Vicia_sativa_leaf3_(15661955447)	Harry Rose	65	23.01.2023	CC BY 2.0, https://commons.wikimedia.org/w/index.php?curid=40353632
Lotus_corniculatus_RF	Robert Flogaus-Faust	65	23.01.2023	CC BY 4.0, https://commons.wikimedia.org/w/index.php?curid=82027831