biodiversa+
European Biodiversity Partnership

EUROPEAN PARTNERSHIP

Designing representative, scalable & policy-useful biodiversity monitoring programmes

Outcomes from the BioMonWeek 2026 workshop “How to design Biodiversity Monitoring Programmes”

Co-funded by the European Union

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Authors	Mona Naeslund (SEPA), Guillermo Aguilera Núñez (SEPA), Andrea Hagyo (JRC), Henrik Hedenås (SLU), Rozália Kapás (SEPA), Dirk Lindemann (EFTAS), Laura Sutcliffe (IFAB)
Contributors	Participants at the BioMonWeek 2026 workshop "How to design monitoring programmes" (7 May 2026, Montpellier, France); Mathieu Basille (OFB).
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What is Biodiversa+

The European Biodiversity Partnership, Biodiversa+, supports excellent research on biodiversity with an impact for policy and society. Connecting science, policy and practice for transformative change, Biodiversa+ is part of the European Biodiversity Strategy for 2030 that aims to put Europe's biodiversity on a path to recovery by 2030. Co-funded by the European Commission, Biodiversa+ gathers partners from research funding, programming and environmental policy actors in European and associated countries to work on 5 main objectives:

1. Plan and support research and innovation on biodiversity through a shared strategy, annual joint calls for research projects and capacity building activities
2. Set up a network of harmonised schemes to improve monitoring of biodiversity and ecosystem services across Europe
3. Contribute to high-end knowledge for deploying Nature-based Solutions and valuation of biodiversity in the private sector
4. Ensure efficient science-based support for policy-making and implementation in Europe
5. Strengthen the relevance and impact of pan-European research on biodiversity in a global context.

More information at: https://www.biodiversa.eu/

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Executive summary

This report summarises the BioMonWeek 2026 interactive workshop on how to design biodiversity monitoring programmes that are representative, scalable and useful for policy across regions and countries. The workshop combined expert inputs and live participant polling to identify design trade-offs and practical bottlenecks. Three messages recurred throughout: (i) inference depends on sampling design, i.e. good variables and protocols are not enough if the sample is biased or ill-defined; (ii) Europe's monitoring landscape remains fragmented, with governance fragmentation and lack of harmonised standards as major constraints on integration and long-term sustainability; and (iii) policy usefulness requires an explicit pathway to convert observations to indicators that are easily communicated and translated into parameters used in policy questions without compromising scientific robustness.

Participants represented multiple countries and biogeographic regions and brought research, monitoring, policy and data management perspectives. Polling outcomes highlighted that limitations in representativeness most often stem from data scarcity, uneven spatial coverage, short time series and unstable funding. When asked about barriers to coordinated European data sharing, participants ranked governance fragmentation and lack of standards higher than technical infrastructure, aligning with broader European assessments that identify interoperability, coordination and sustained resourcing as core bottlenecks.

The workshop used concrete examples, from scalable national monitoring programmes in Sweden to EU-scale schemes such as EMBAL to illustrate how stratification, spatial balance, phenology windows, and data governance choices shape what a monitoring programme can credibly claim. The report closes with design principles and near-term steps that policy makers and programme leaders can apply when building or reforming monitoring systems, including recommendations for harmonisation through 'minimum common requirements' rather than full standardisation.

1. Background: European context and monitoring design challenges

Across Europe, biodiversity monitoring is expected to support legally binding targets and policy performance monitoring frameworks (e.g., restoration and sectoral policies), while being scientifically robust and feasible within constrained budgets at the same time. A central challenge, however, is not only what variables are measured or which field protocols are used, but how the monitoring programme itself is designed. As emphasised by Ranlund et al. [1], the design of a monitoring system must begin with clear questions and objectives, an explicit definition of the target population, an appropriate time horizon, and consideration of the main sources of bias and error. In this sense, protocols are necessary but not sufficient: programmes may collect the same variables with the same protocol, yet still differ fundamentally in what they can represent and what inferences they support, depending on how sites, times, and units are selected. Designing for inference and representativeness is therefore a foundational requirement, not a later technical adjustment.

This design challenge is especially important in Europe, where multiple syntheses highlight persistent structural barriers: monitoring systems are often fragmented across agencies and projects; coverage is uneven across taxa, habitats and regions; and data are frequently difficult to integrate because standards, governance arrangements and funding horizons differ among countries [2–5]. A recent European gap analysis quantified shortfalls against stakeholder-prioritised Essential Biodiversity Variables (EBVs), finding that roughly one-fifth of EBVs lacked transnational data integration and that existing initiatives often cover fewer than 70% of countries, with remaining deficiencies in sampling and representativeness [4-5]. From the perspective of Ranlund et al. [1], these are not only coordination problems but also design problems: if the sampling frame, allocation, or inclusion probabilities are unclear or inconsistent, then even extensive data collection may fail to support robust inference across regions or over time

The EBV concept was developed to bridge the gap between raw observations and policy-relevant indicators by defining a set of standardised variables that can be aggregated and scaled across space and time [6-7]. In practice, EBVs only become usable if monitoring programmes specify how observations are sampled and measured, and if data pipelines make results accessible and interoperable. Here, the Biodiversa+ harmonisation guidance by Silva del Pozo et al. [3] provides an important complement to the design perspective in Ranlund et al. [1]: harmonisation should not be understood as imposing identical protocols everywhere, but rather as agreeing minimum common requirements while allowing flexibility in protocols according to context, existing schemes, and available resources. The same guidance also recommends a parallel workflow in which both raw data and EBV-level products are maintained, thereby preserving analytical flexibility while improving comparability across scales.

EuropaBON and Biodiversa+ both emphasise that technical harmonisation alone is not sufficient: governance, coordination capacity, and sustained funding are prerequisites for long-term, policy-fit monitoring [2–4]. But these enabling conditions are most effective when tied to an explicit monitoring design logic, one that states what the programme is intended to represent, how the sample supports that representation, and how observations will be translated into indicators.

These challenges are particularly noticeable in supporting European legislation explicitly requiring representativeness and comparability. For example, the EU's pollinator monitoring method requires monitoring at an adequate number of sites to ensure representativeness across Member State territories

[8]. EU-wide monitoring surveys such as the LUCAS Landscape Features module were developed to provide consistent and unbiased estimates that can support the Common Agricultural Policy (CAP) impact indicators [9]. In other words, 'design for inference' is increasingly becoming a policy requirement, not just a scientific ideal. The key issue is therefore not only to harmonise measurements, but to design monitoring programmes whose sampling and data workflows make the resulting evidence genuinely representative, scalable and policy-useful.

2. Workshop overview and outcomes

The workshop 'How to design monitoring programmes' was held at BioMonWeek 2026 and combined short expert presentations with interactive Mentimeter questions. The aims were to: (i) clarify core design principles for representative monitoring; (ii) discuss harmonisation and governance options for cross-border monitoring; (iii) explore how monitoring data can be translated into policy indicators; and (iv) how Biodiversa+ can further contribute. Presentations drew on Swedish national monitoring practice (National Inventories of Landscapes in Sweden (NILS) and related programmes) [10], on the European monitoring of biodiversity in agricultural landscapes (EMBAL survey) [11, 12], and the EU-wide monitoring scheme LUCAS and policy indicator examples [9, 13].

The workshop was attended by around 30 active participants that represented a broad mix of organisations and professional backgrounds, spanning multiple European countries and biogeographic regions. Polling indicated a predominance of researchers and monitoring professionals, with smaller numbers of policy makers and data managers (Fig. 1 and 2).

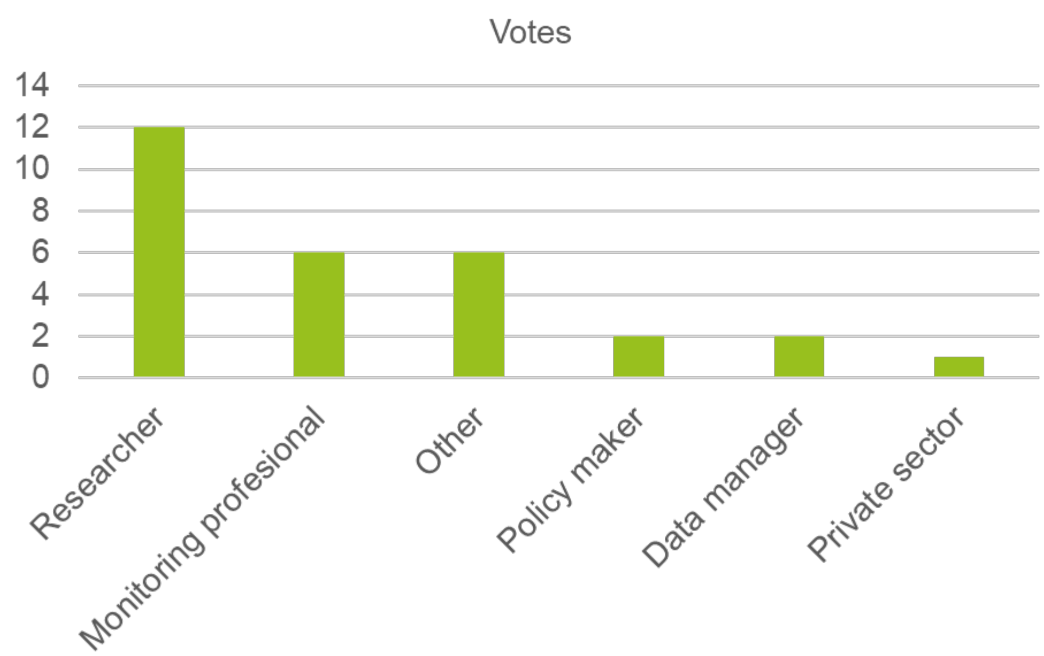

Figure 1. Participant professional backgrounds, multiple choices. Source: BioMonWeek 2026 workshop (Mentimeter) [14].

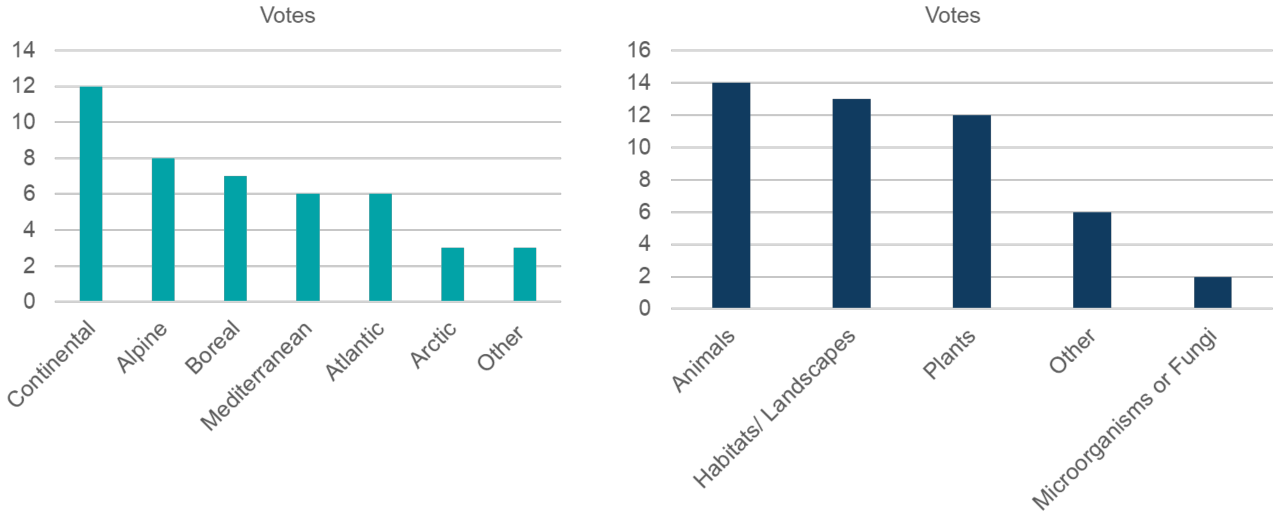

Figure 2. Biogeographic regions and target organism groups from participants´ work in multiple choice responses. Source: BioMonWeek 2026 workshop (Mentimeter) [14].

2.1. Designing representative and scalable monitoring

A central point from the opening presentation was that monitoring design often fails not because questions or field protocols are weak, but because the sampling design is under-specified. Without a probability-based or otherwise defensible sampling framework, it becomes unclear what the data represent and whether results can be generalised beyond sampled locations [10]. The presentation contrasted probability-based national designs (e.g., grid-based, stratified and spatially balanced approaches used in Sweden's National Monitoring of Landscapes in Sweden (NILS)) with self-selected sampling typical of some citizen science programmes, where observer site choice can introduce strong biases even when protocols are standardised [10]. A key message was that randomness is essential because it gives all locations a known probability of inclusion and reduces bias arising from accessibility-driven or subjective site selection. However, purely random designs may fail to capture rare habitats or species, motivating the use of stratification and disproportionate allocation within probability-based, design-based sampling approaches [10].

The workshop explored the classic trade-off between achieving broad representativeness and adequately capturing 'rare phenomena' (rare habitats, species, or pressures). Stratification and disproportionate allocation, i.e. higher sampling intensity in rare landscapes, were discussed as ways to improve inference for rare components without abandoning probability principles [10]. Participants' own experience mirrored this tension: responses split between systems that are strongly representative but weak for rare phenomena and systems attempting to balance representativeness and targeted coverage (Fig. 3).

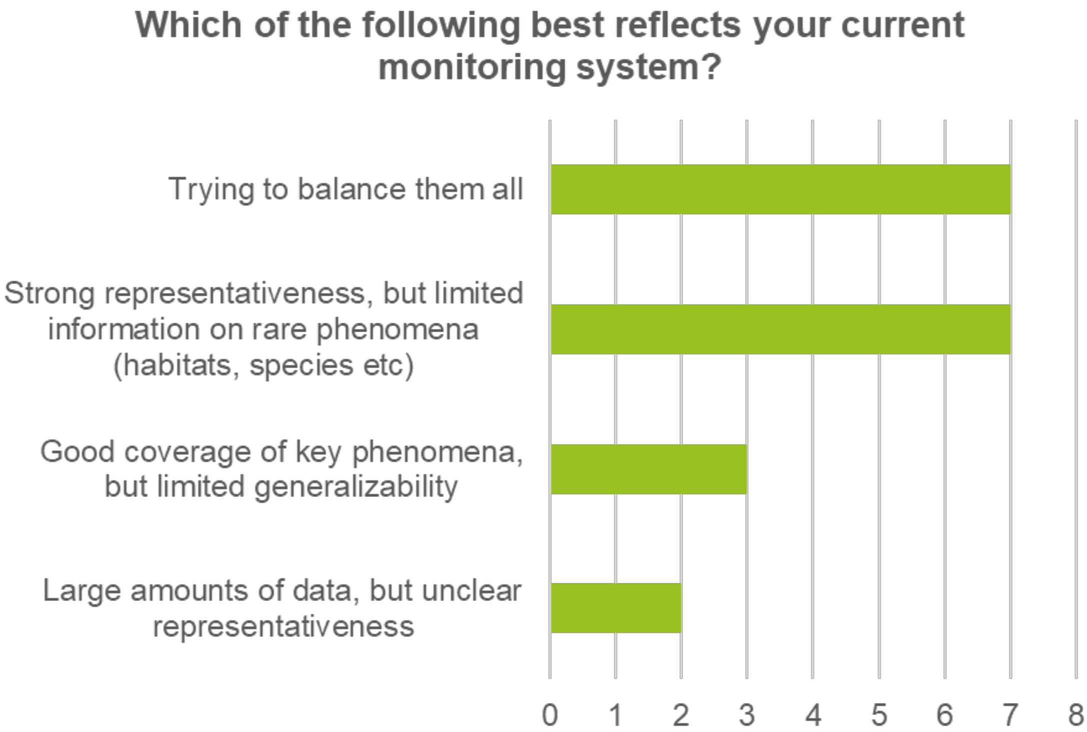

Figure 3. Participant view of current system balance between representativeness and targeted coverage. Source: BioMonWeek 2026 workshop (Mentimeter) [14].

2.2. Harmonising monitoring and governing data across borders

The second theme focused on why it remains difficult to combine monitoring results across countries even when many national schemes exist. Both European syntheses and workshop participants identify fragmentation as structural: different mandates, reporting cycles, and institutional arrangements create misalignment in priorities and methods, while standards and metadata practices differ across communities [2–5]. Biodiversa+ newly published Phase III report argues for a multi-level governance approach that links European coordination with national coordination centres and thematic expert networks, aiming to connect existing schemes while preserving national specificity [2].

Interactive ranking confirmed that practitioners perceive governance and standardisation as the dominant barriers to coordinated data sharing (Fig. 4). Participants ranked ‘governance fragmentation’ as the largest barrier, followed by ‘lack of standards’ and ‘funding continuity’; technical infrastructure and data ownership concerns were placed lower [14]. This closely aligns with recommendations in the Biodiversa+ harmonisation guide, which emphasises minimum shared requirements, flexible protocol alignment, and parallel workflows that support both raw data sharing and EBV-level products [3].

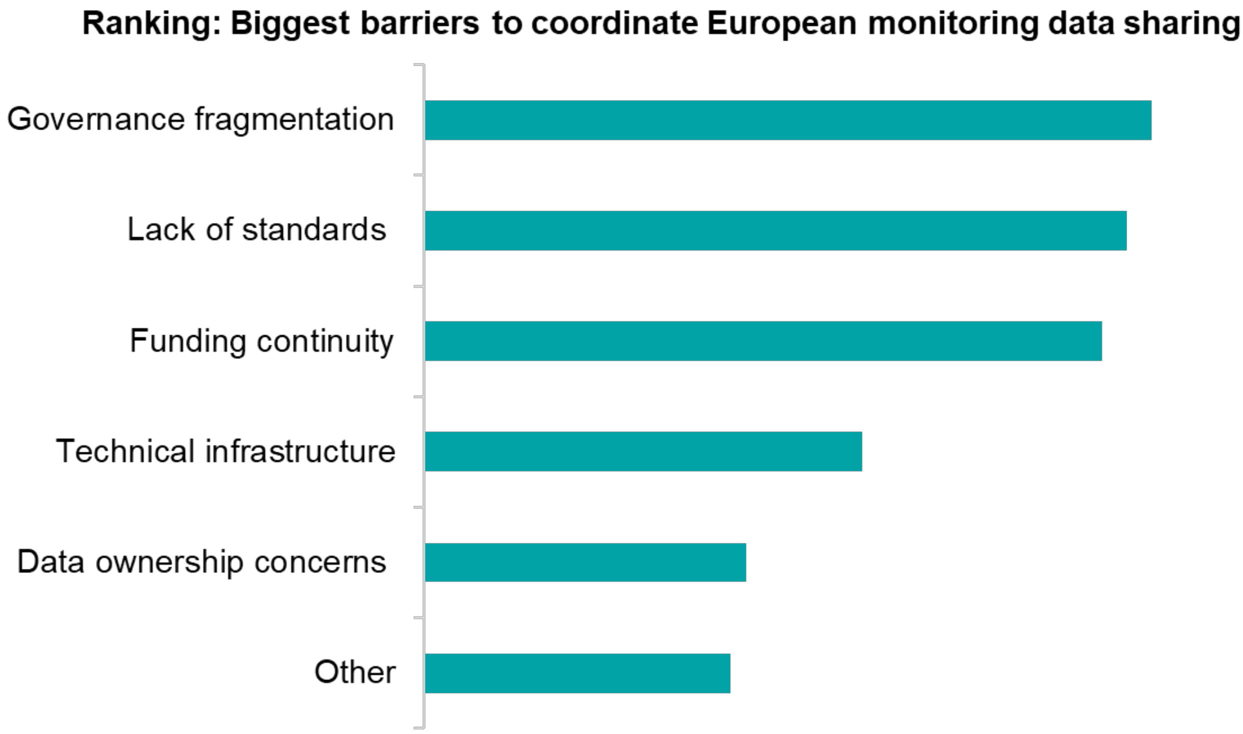

Figure 4. Barriers to coordinated European monitoring data sharing (participant ranking). Source: BioMonWeek 2026 workshop (Mentimeter) [14].

2.3. From monitoring outputs to policy-relevant indicators

The third theme addressed translation to policy support: How to move from complex, heterogeneous monitoring data to indicators that can reliably support decisions, evaluations and legal reporting. The EMBAL and JRC inputs emphasised that policy needs include statistical representativeness, comparability across time, cost-effective and robust indicators, and well-documented data that can stand up in a legal context [8-9, 11-12, 13]. The LUCAS Landscape Features module, for example, was designed to deliver consistent area estimates of landscape feature types across Europe, supporting a specific CAP impact indicator and enabling national and sub-national reporting [9].

Participants ranked 'scientific robustness' and 'sensitivity to change' above simplicity as the top priorities for biodiversity indicators, with comparability across countries also rated highly (Fig. 5). At the same time, open responses highlighted the practical difficulty of 'making complex data simple' and the risk of losing nuance when communicating with non-scientific audiences. Several participants explicitly framed the key challenge as bridging policy needs and scientific rigour, and improving dialogue between communities [14].

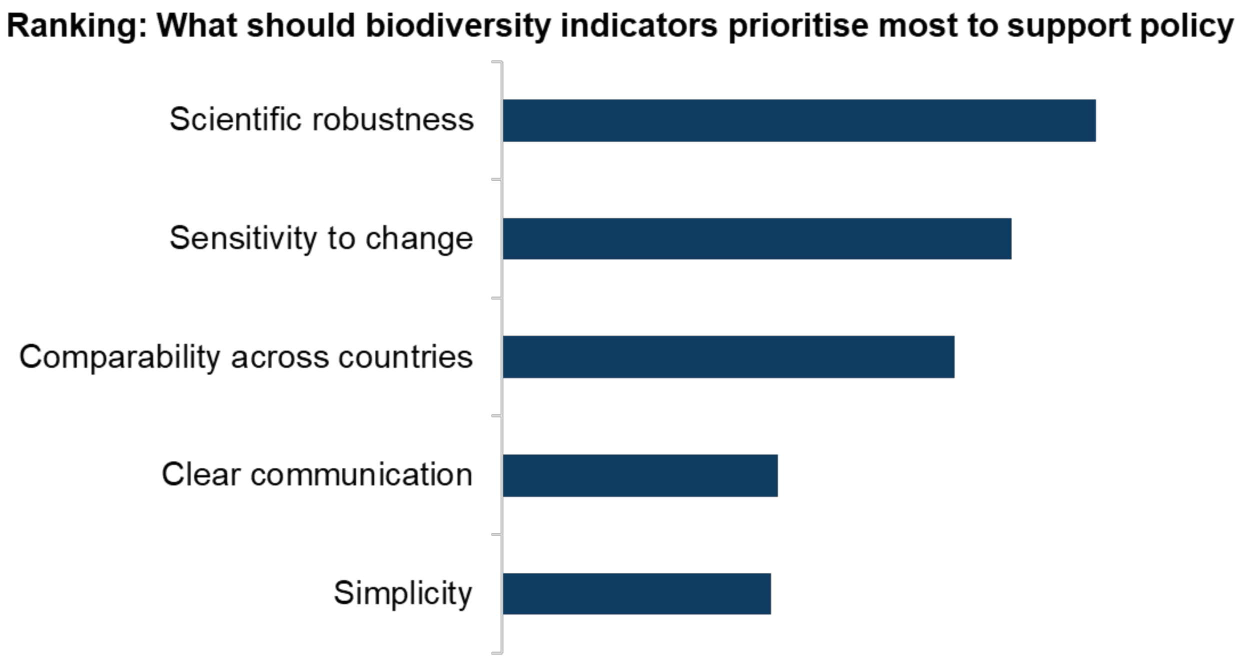

Figure 5. What biodiversity indicators should prioritise most to support policy (participant ranking). Source: BioMonWeek 2026 workshop (Mentimeter) [14].

The discussion also stressed that indicators become more actionable when they are explicitly linked to pressures and management levers, not only to the state of biodiversity. This is increasingly reflected in EU policy design, including pollinator monitoring and restoration planning, where monitoring is intended to support assessment of measure effectiveness rather than only describing status [1, 5, 8, 13].

2.4. Bottlenecks and needs

Participant polling and free-text responses provided a practical snapshot of constraints faced by monitoring programmes today. The most frequently reported limitations for drawing representative conclusions were insufficient data (including lack of historical data), limited spatial coverage, patchy or heterogeneous landscapes, and discontinuity of funding and time series [14]. These align with Europe-wide diagnoses that monitoring is often biased toward a subset of taxa and policy-mandated features, leaving gaps in ecosystems and genetic diversity and limiting continental-scale inference [4–5].

When asked what they would change in their current systems, participants emphasised stable long-term funding, fixed and revisited plot locations, stronger standardisation through training, broader coverage (including common species and multiple realms), and earlier planning for data management and analysis workflows [14]. Notably, ‘a priori planning of data management, workflows and analysis’ emerged as a concrete desired improvement, echoing the workshop’s message that the data pipeline is a prerequisite, not an afterthought [3, 10].

3. Discussion and future recommendations

The workshop outcomes converge with the current European evidence base on several practical issues. First, representativeness is a central issue to be clarified in the early stages of planning a monitoring scheme, as it determines the sampling frame and allocation rules. As environmental policies become increasingly data-driven, with explicit requirements for improved evidence on the status and trends of habitats and for harmonised monitoring schemes under the European Commission Nature Restoration Regulation (NRR), territorial representativeness implies that sampling should be probability-based or otherwise transparent and that uncertainty should be quantifiable [1, 10, 11, 13].

Second, Europe's biggest scaling barriers are institutional: governance fragmentation, inconsistent standards, and unstable funding. Participant rankings reflect this clearly (Fig. 4), and the same issues are repeatedly emphasised by EuropaBON and Biodiversa+, which both recommend coordination functions at European and national levels and to move from short-term project cycles to sustained support for core monitoring infrastructure [2, 4].

Third, 'from data to indicators' must be designed as an end-to-end pipeline. Biodiversa+ guidelines on indicator development and harmonisation recommend parallel workflows that maintain raw data while also producing harmonised EBV/indicator products [3, 15]. The workshop discussion illustrated that indicator development should begin with explicit policy use questions, and then work backwards to variables, sampling intensity, timing, and data governance [13]. Participant priorities (robustness and sensitivity to change) underline that indicators must remain scientifically defensible even when simplified for communication [14].

3.1. Recommended future steps

The following steps summarise actionable directions that emerged from the workshop and align with current European guidance. They are written for policy makers and organisations responsible for designing or reforming monitoring programmes.

(1) Establishing or strengthening a coordination function for monitoring design and data governance. Biodiversa+ and EuropaBON both stress the value of national coordination centres or well-resourced focal points that can align monitoring priorities, oversee standards, and connect national schemes to European networks including scientific networks [2, 4].

(2) Adopting 'minimum common requirements' for transnational comparability. Rather than forcing full standardisation, European guidance recommends agreeing shared baselines for sampling design principles, core variables/metadata, quality control, and FAIR data practices, while allowing national extensions [2–3].

(3) Designing monitoring around an explicit inference statement. For each indicator and reporting need, specify the target population, sampling frame, stratification, and what inference is valid. This is essential to avoid the common pitfall where data exist but cannot be generalised [1, 10, 11].

(4) Building the indicator pathway early. Start with policy questions and required decision formats; define indicators and uncertainty reporting; then define variables and sampling. This improves relevance and reduces the 'lost in translation' problem highlighted by participants [1, 3, 13].

(5) Investing in continuity: stable funding, long-term plot networks, and capacity. Participant responses repeatedly emphasised funding continuity, fixed plot locations, and training for standardised sampling, echoing broader European conclusions that long-term capacity is a limiting factor [2, 4, 14].

3.2. Topics suggested for future workshops

The workshop generated a rich set of ideas for future sessions, reflecting both practical needs and broader strategic challenges in biodiversity monitoring. Participants highlighted the importance of improving indicator design, strengthening links between modelling and monitoring, and sharing insights on cost-efficient sampling.

A recurring theme was the need to better connect data with decision-making both by translating scientific results into policy action and at the same time by understanding how European policy can support research. Participants also emphasized the human side of monitoring, including people management and building participatory processes with stakeholders.

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Appendix 1: Designing monitoring programmes

Presentation by Henrik Hedenås, BioMonWeek 2026 workshop "How to Design Biodiversity Monitoring Programmes"

SLU

Designing Monitoring Programmes

Often in monitoring design

- We start with a question
- We carefully choose variables
- We design detailed field protocols

But …

We forget to design how the data should actually be sampled.

SLU

Designing Monitoring Programmes

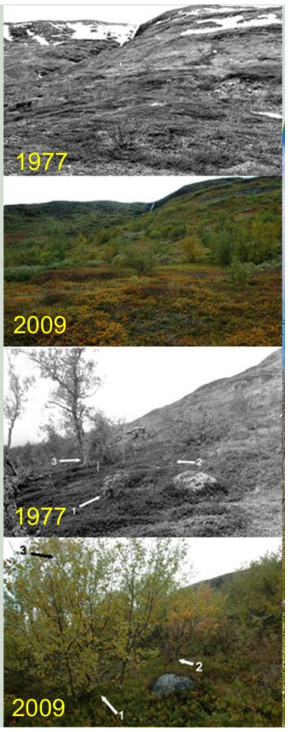
Without a rigid sampling design

Our results may be meaningless.

- What do the data represent?
- Can we generalize?

=> *Data does not guarantee good inference.*

Photo 1977 N-Å Andersson
Photo 2009 H Hedenås

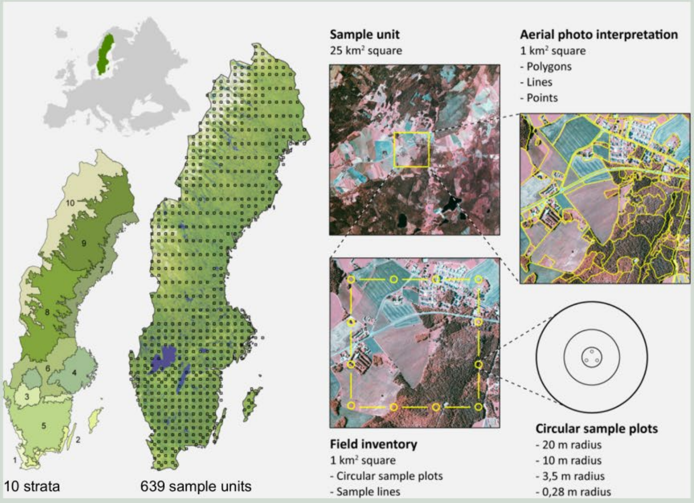


SLU

NILS 2003:2020

•**Sampling frame:**
National 5×5 km grid covering Sweden
•**Probability-based sample:**
639 squares (5×5 km) randomly selected
•**Stratified design:**
10 geographic strata

Inference? *What population does this represent?*



SLU

Citizen science/monitoring

A citizen science program where volunteers select their own survey routes or sites.

This means:

- the observer decides *where* to sample i.e. no random selection of sites.

Inference? *What population does this represent?*

Citizen science

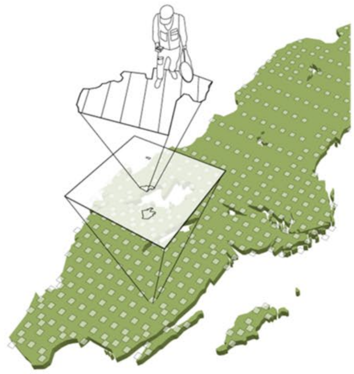
Volunteer → Chooses location → Registers site → Standardized protocol → Data

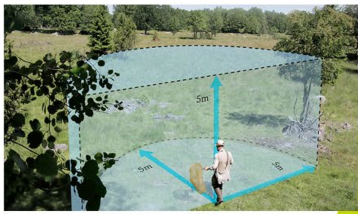
SLU

FHIN
Butterfly and Bumblebee Inventory

- **Sampling frame:**
  Registered semi-natural grasslands from the TUVA database
- **Probability-based sample:**
  Random selection of sites from the sampling frame
- **Spatial structure:**
  Sampling within NILS grid

Inference? *What population does this represent?*



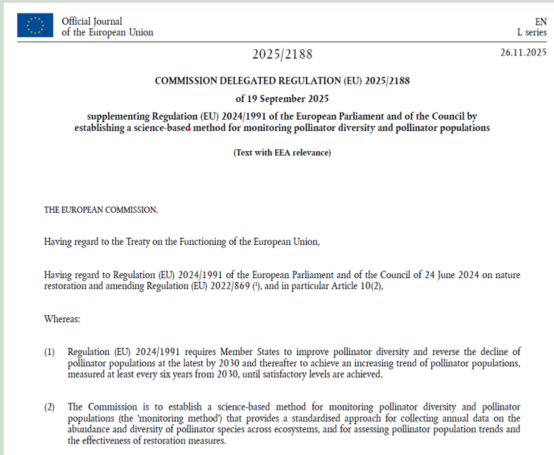


SLU

EU pollinator monitoring

- **Sampling frame**
  Systematic LUCAS grid covering the landscape
- **Probability-based**
  Random selection of monitoring stations
- **Stratified design**
  By biogeographic region and ecosystem type *(forest, agriculture, others)*
- **Proportional allocation**
  Sampling effort proportional to area of each stratum
- **Flexible transect placement (not specified)**
  Transects defined within stations, but placement rules are unclear → allows multiple implementation choices

Inference? *What population does this represent?*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COMMISSION DELEGATED REGULATION (EU) 2025/2188

of 19 September 2025

supplementing Regulation (EU) 2024/1991 of the European Parliament and of the Council by establishing a science-based method for monitoring pollinator diversity and pollinator populations

(Text with EEA relevance)

THE EUROPEAN COMMISSION,

Having regard to the Treaty on the Functioning of the European Union,

Having regard to Regulation (EU) 2024/1991 of the European Parliament and of the Council of 24 June 2024 on nature restoration and amending Regulation (EU) 2022/869 [1], and in particular Article 10(2),

Whereas:

(1) Regulation (EU) 2024/1991 requires Member States to improve pollinator diversity and reverse the decline of pollinator populations at the latest by 2030 and thereafter to achieve an increasing trend of pollinator populations, measured at least every six years from 2030, until satisfactory levels are achieved.

(2) The Commission is to establish a science-based method for monitoring pollinator diversity and pollinator populations (the 'monitoring method') that provides a standardised approach for collecting annual data on the abundance and diversity of pollinator species across ecosystems, and for assessing pollinator population trends and the effectiveness of restoration measures.

SLU

Current NILS 2020-
National Inventories of Landscapes in Sweden

•**Target population** e.g. grasslands

• **Sampling frame**
National 1×1 km grid covering all land and freshwater

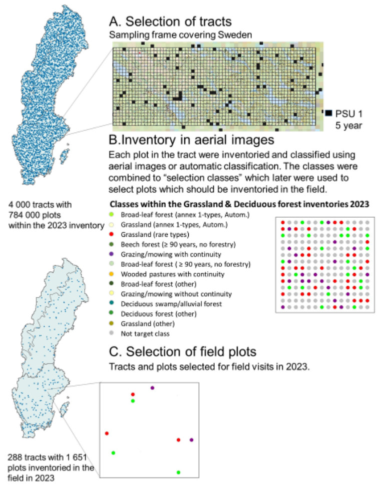
Two-phase sampling design
Phase 1: Selection of tracts using coordinated balanced sampling
Phase 2: Selection of plots within tracts

• **Stratified random subsampling for fieldwork**
Higher sampling intensity of rare/priority habitats

• **Non-visited units retained in sample**
Plots/tracts without target habitats contribute as zero observations

• **Spatially balanced sampling**
Ensures coverage across environmental gradients

Inference? *What population does this represent?*



SLU

Importance of randomness

- Every location gets a **known** chance of being selected
- Captures the **full variation** in the landscape
- **Reduces risk of systematic bias**
- Enables **statistically valid inference**

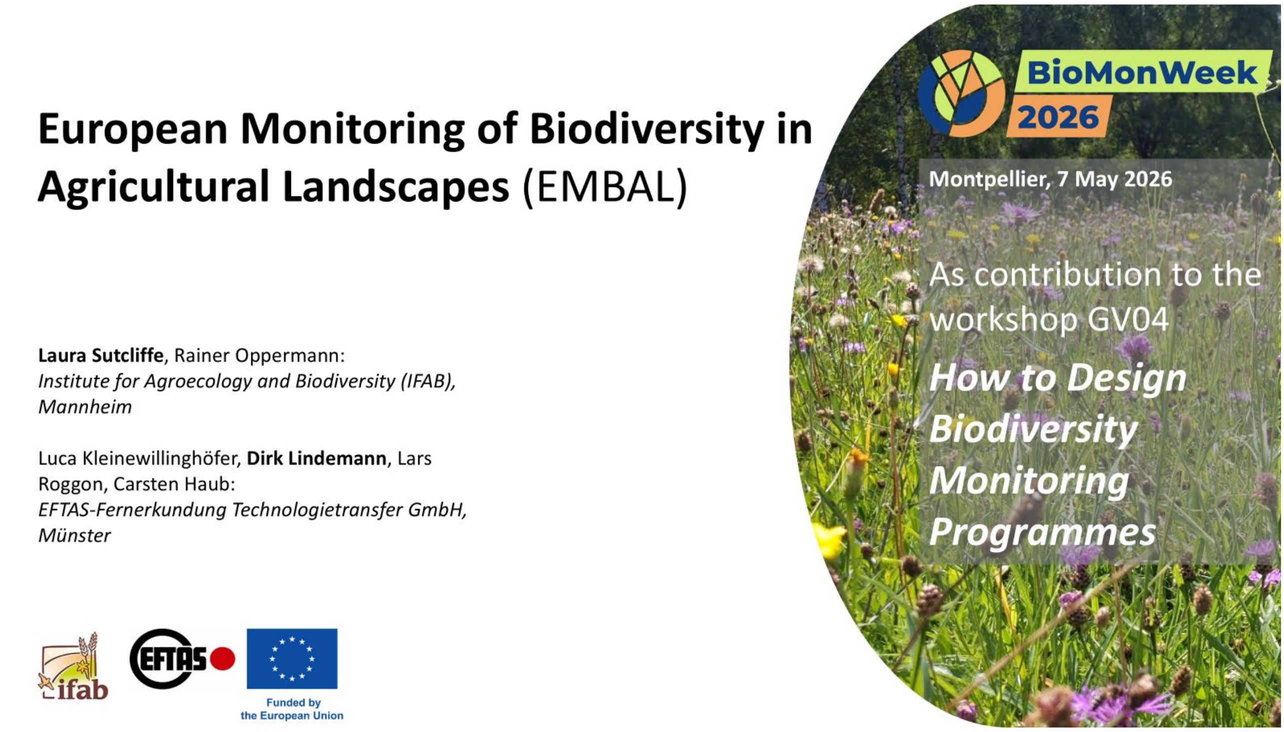
=> Randomness is what allow us to generalise

However,

- Stratification/ weighting needed to capture rare habitats

Appendix 2: European Monitoring of Biodiversity in Agricultural Landscapes (EMBAL)

Presentation by Laura Sutcliffe and Dirk Lindeman, BioMonWeek 2026 workshop "How to Design Biodiversity Monitoring Programmes"



EMBAL Methodology

- 25 ha plots: pre-processing using orthophotos
- Fieldwork: three observation levels
  - **Plot** (e.g, number of parcels, area of landscape elements…)
  - **Parcel** (all parcels; land cover and rapid parameters such as crop density, number of flower colours)
  - **Transect** (up to 9 per plot; detailed parameters, e.g. indicator species)
  - Also photo documentation of features

EMBAL - European Monitoring of Biodiversity in Agricultural Landscapes

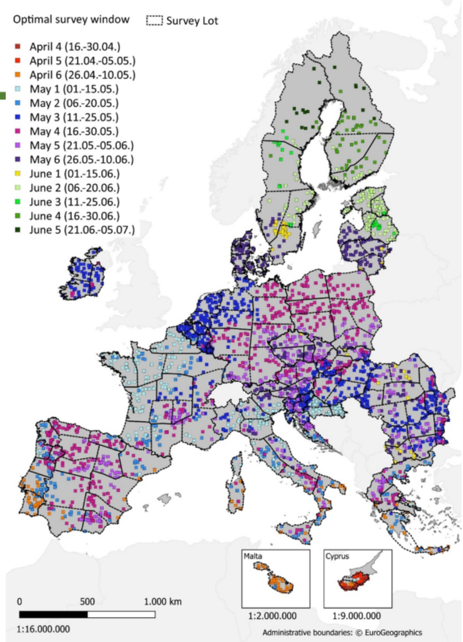
Farmland biodiversity monitoring in the EU

- There are many approaches to monitor farmland biodiversity, but these are either limited to a national scale (e.g., HNVF monitoring in Germany) or limited to a single species group (e.g., Farmland Bird Index)
- Challenge: to develop a methodology that is
  - **rapid** (creating a large sample size)
  - **in-situ** (and **in-depth)**
  - **focussed on general agricultural biodiversity**, not single species groups or specific habitats
  - capable of **detecting meaningful changes over time**
  - **standardised and comparable** across the EU-27

EMBAL - European Monitoring of Biodiversity in Agricultural Landscapes

EMBAL Roll-out 2022/23

- Survey of 3,000 plots in 2022 and 2023: between 30 (MT) and 250 (FR) plots per country
- Stratified random sampling based on **LUCAS master grid** (2x2 km) to create representative sample (NUTS0/Biogeographic region/elevation class)
- Including >110,000 parcels and >23,000 transects
- Specified timeframe for each plot
- ~75 surveyors coordinated per season
- On average roughly 1 - 2 plots per surveyor and day



EMBAL - European Monitoring of Biodiversity in Agricultural Landscapes

Biodiversity parameters and indices

Funded by the European Union

- > 60 parameters recorded in the field
- Many indices can be derived from the raw data, e.g., number of crop types per plot…

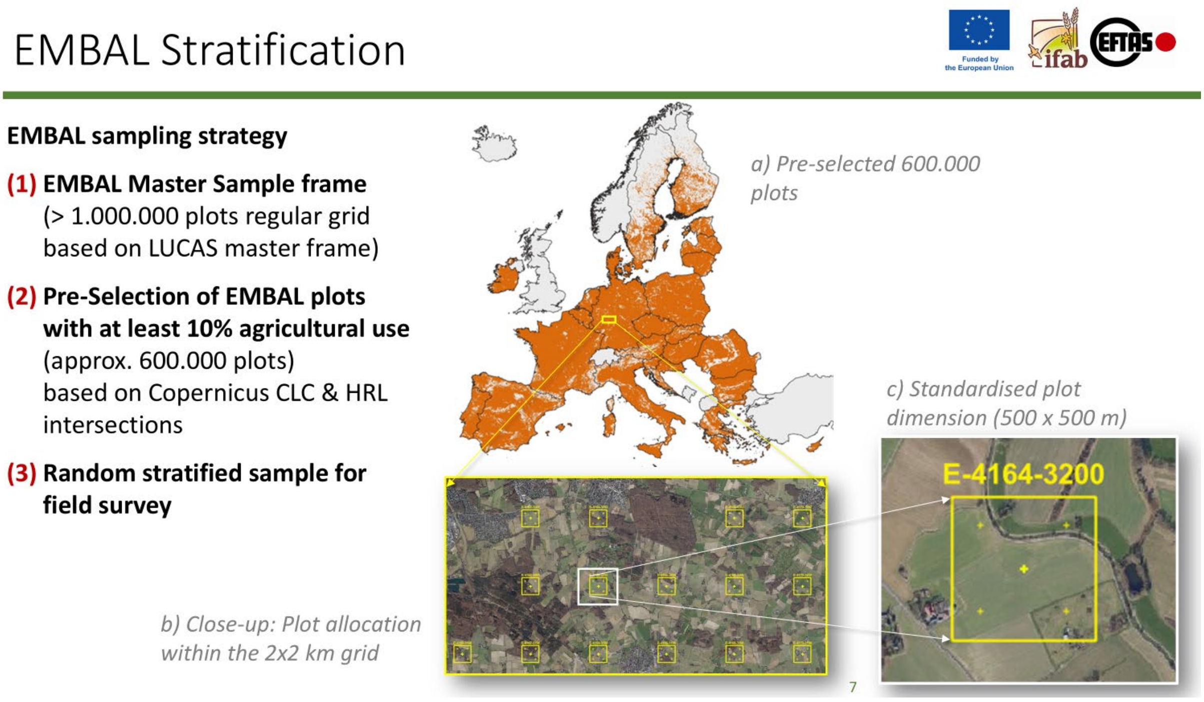
Measured parameter/**derived index**	Level of observation
Landcover 1	Parcel / Transect
Landcover 2	Parcel / Transect
Number of indicator species	Transect
Flower density (all flowers)	Parcel / Transect
Colours of flowering forbs	Parcel / Transect
Number of different flower colours	Parcel / Transect
Agricultural Nature Value Index (ANVI)	Parcel/Plot
Agricultural Land Use intensity Index (ALUI)	Parcel/Plot
Agricultural Landscape Connectivity Index (ALCI)	Plot
Agricultural Pollinator Resource Index (APRI)	Parcel/Plot
Proportion of woody landscape features	Plot
Proportion of high-diversity landscape features	Plot
Crop diversity	Plot
Crop coverage in %	Parcel
Wild plant coverage in %	Parcel
Graminoid:forb ratio	Parcel / Transect
Height herbaceaous layer (cm)	Transect
Height of crop (cm)	Transect
Woody layer coverage	Transect
Total cover of legumes (%)	Transect
EUNIS Grass habitat / complex	Transect
[illegible]	Transect

etc…

EMBAL - European Monitoring of Biodiversity in Agricultural Landscapes

EMBAL Stratification and parameter design

1. How can European biodiversity monitoring programmes be designed to be scalable and representative across local, national, and European levels?

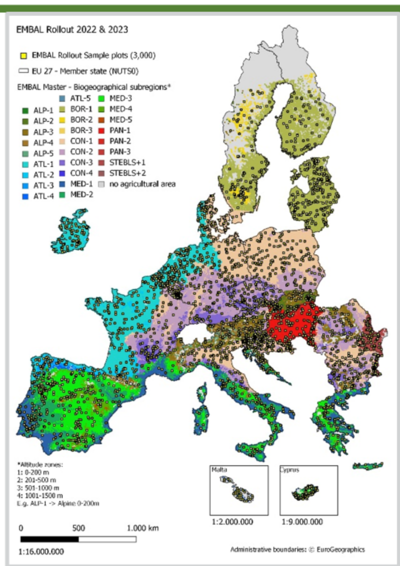


EMBAL Stratification

EMBAL Survey 2022 & 2023

- 3,000 plots across EU27 *(visited in 2022 and 2023)*
- **Stratified Random Sampling** based on
  - **Member States**
    No. of plots depending on the size of Member State (min. 30, max. 250) and its share of agricultural land
  - **Biogeographic Regions**
    (aggregated regions
  - **Altitude zones**
    4 zones per Biogeographic Region:
    1: 0-200 m
    2: 200-500 m
    3: 500-1000 m
    4: 1000-1500 m

➢ Targeting estimates at Member State and Biogeographical region



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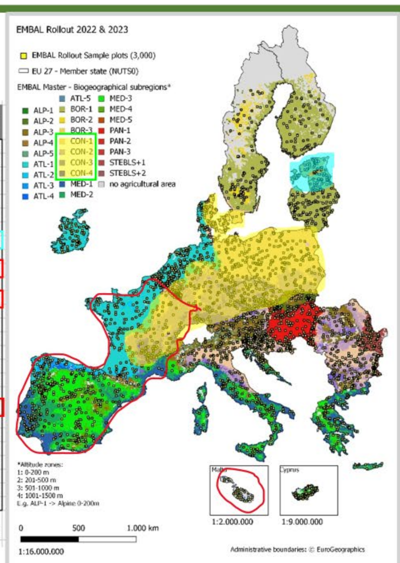
EMBAL Stratification

Allocation of 3,000 plots to EU-27 and BIOGEO subregions

REGION	ALP-1	ALP-2	ALP-3	ALP-4	ATL-1	ATL-2	ATL-3	BOR-1	BOR-2	CON-1	CON-2	CON-3	CON-4	MED-1	MED-2	MED-3	MED-4	PAN-1	PAN-2	STEBLS +1	STEBLS +2	Sum per country
AT		8	35	25						6	20	12	1									107
BE					56	1				4	15	2										78
BG		1	5	8						34	29	13	8							9	30	137
CY														25	19	11	5					60
CZ										2	42	29	1					7	20			101
DE		1	1	1	52	1				63	58	33	2									212
DK					21					39												60
EE								56	4													60
EL														30	25	28	6					89
ES		1	1	1	2	8	44							9	31	101	52					250
FI								54	6													60
FR	1	1	3	3	99	33	7			11	30	17	32	4	4	4	1					250
HR		4	14	1						67	10	1		9	12	2						120
HU																		53	16			69
IE					63	7																70
IT	8	5	7	11						42	15	7	5	31	44	34	7					216
LT								60	8	1												69
LU										2	54	4										60
LV								48	12													60
MT														27	3							30
NL					59	1																60
PL		2	6	1						128	30	1										168
PT					4	2	2							29	40	32	3					112
RO		3	16	6						30	29	9	1					35	4	48	26	207
SE		1	1					43	51	3	1											100
SI	7	12	25	4						9	33	11	2									103
SK	34	13	8	1														23	13			92
Sum per BioGeo	50	52	122	62	356	53	53	261	81	441	366	139	52	164	178	212	74	118	53	57	56	3000



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Parameter design - Timeframing

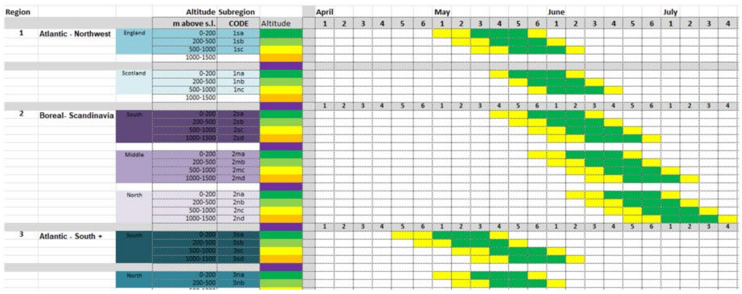
Funded by the European Union

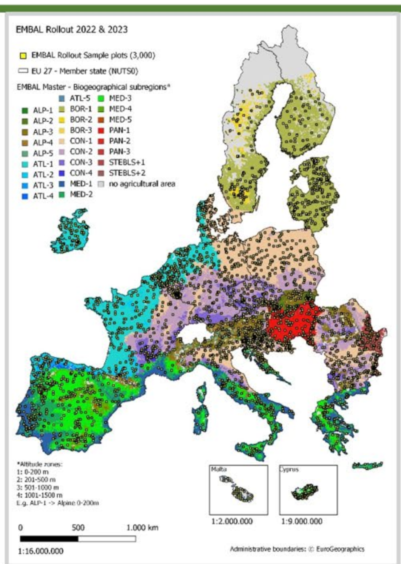
- Vegetation parameters (and many/most biodiversity parameters) are variable according to the time of year
  - Affected by weather and climate: e.g., flower density peaking in June/July in northwestern Europe, but May(/June) in southeastern Europe
  - Affected by management: e.g. first cut in moderately intensive meadows end of May in northwestern Europe

EMBAL - European Monitoring of Biodiversity in Agricultural Landscapes 10

Parameter design - Timeframing

Funded by the European Union





EMBAL - European Monitoring of Biodiversity in Agricultural Landscapes 11

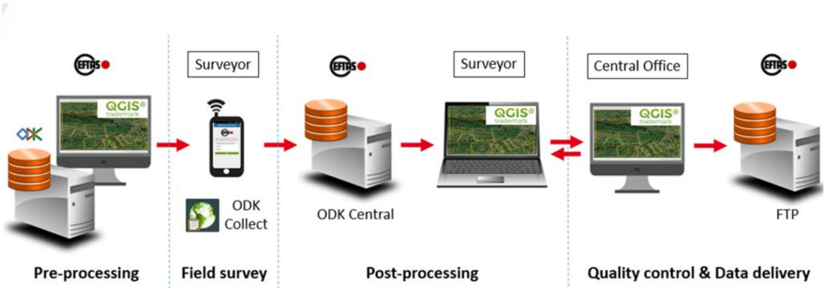
Parameter design - Timeframing

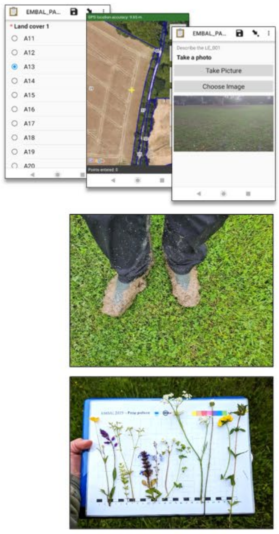
- Vegetation parameters (and many/most biodiversity parameters) are variable according to the time of year
  - Affected by weather and climate: e.g., flower density peaking in June/July in northwestern Europe, but May(/June) in southeastern Europe
  - Affected by management: e.g. first cut in moderately intensive meadows end of May in northwestern Europe
- This leads to a narrow window to collect phenologically comparable results: a logistical challenge, that was mostly met, but not always.
- Records were flagged for the analysis according to
  - Time frame (early-optimal-late)
  - Vegetation stage (unmown/ungrazed-mown a while ago-recently mown)

EMBAL - European Monitoring of Biodiversity in Agricultural Landscapes 12

EMBAL internal data workflow

1. Pre-processing of the plots using digital orthophotos
2. Field survey
3. Post-processing of recorded data
4. Data exchange & Quality control





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EMBAL on JRC Data Catalogue

- Joint Research Centre Data Catalogue - European Monitoring of Biodiversity in Agricultura... - European Commission

DATASET

European Monitoring of Biodiversity in Agricultural Landscapes (EMBAL)

Collection: DRLL : Digital Rural Landscape Lab >

Important note Close

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Description

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Description

The EMBAL dataset (2022–2023) compiles detailed information on agricultural environments all over EU with a focus on crop types, management practices, and associated ecological features.

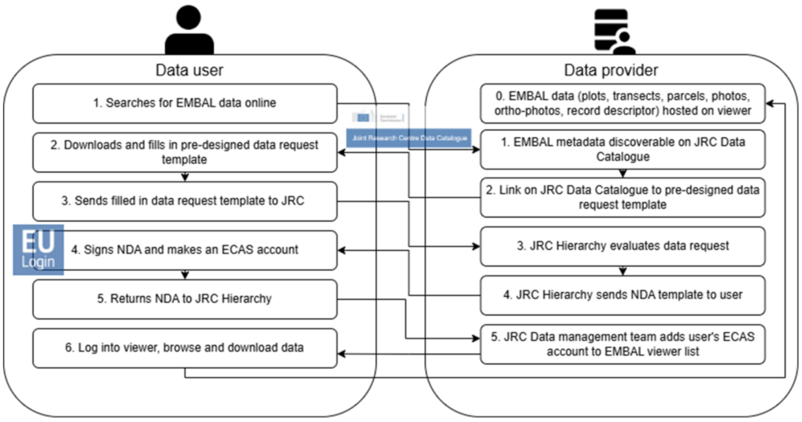
*Slides provided by **Andrea Hagyo**, Joint Research Centre*

Workflow for EMBAL data sharing

Funded by the European Union

1. JRC publishes discoverable entry for **geo-anonymized** EMBAL data on **JRC Data Catalogue**
2. Upon approval of **research proposal** and signature of **Non-disclosure agreement**

→Access to, viewing, exploring, and **downloading** EMBAL data with **geo-location**

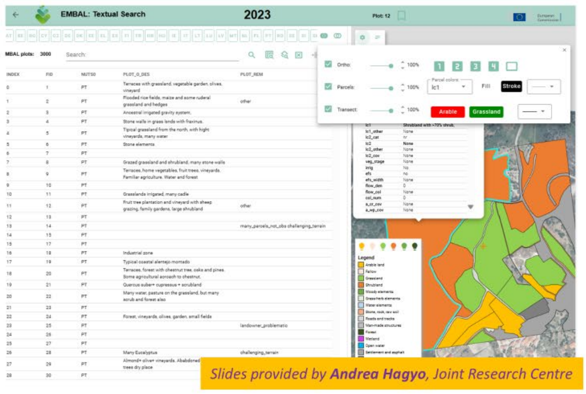


*Slides provided by **Andrea Hagyo**, Joint Research Centre*

EMBAL geo-anonymised viewer

Funded by the European Union

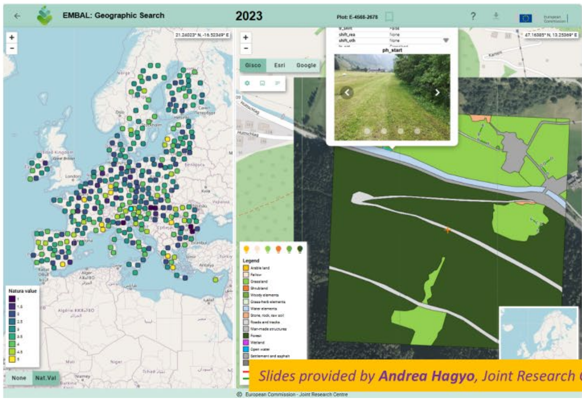
- Access with **ECAS account**
- Available in JRC Data Catalogue
- GPS coordinates not available
- Attribute fields with location deleted
- **No EMBAL_id** available
- Photos are not available



*Slides provided by **Andrea Hagyo**, Joint Research Centre*

EMBAL full dashboard

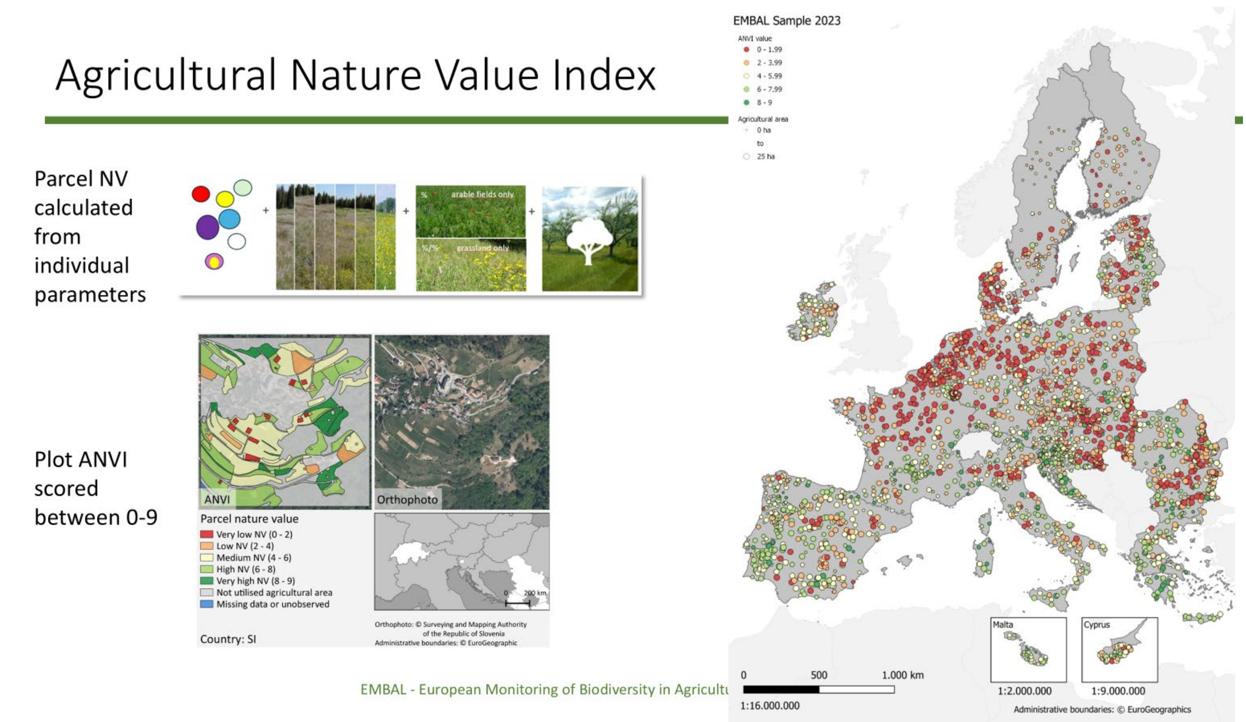
- **Full version** of the data (plots, transects, photos, …)
- Accessible after **approved research proposal** and **NDA** signature
- Has textual and geographical search across all fields
- Access to the photos taken during the survey
- **Orthophoto pairing** (new Eurostat GISCO service!)

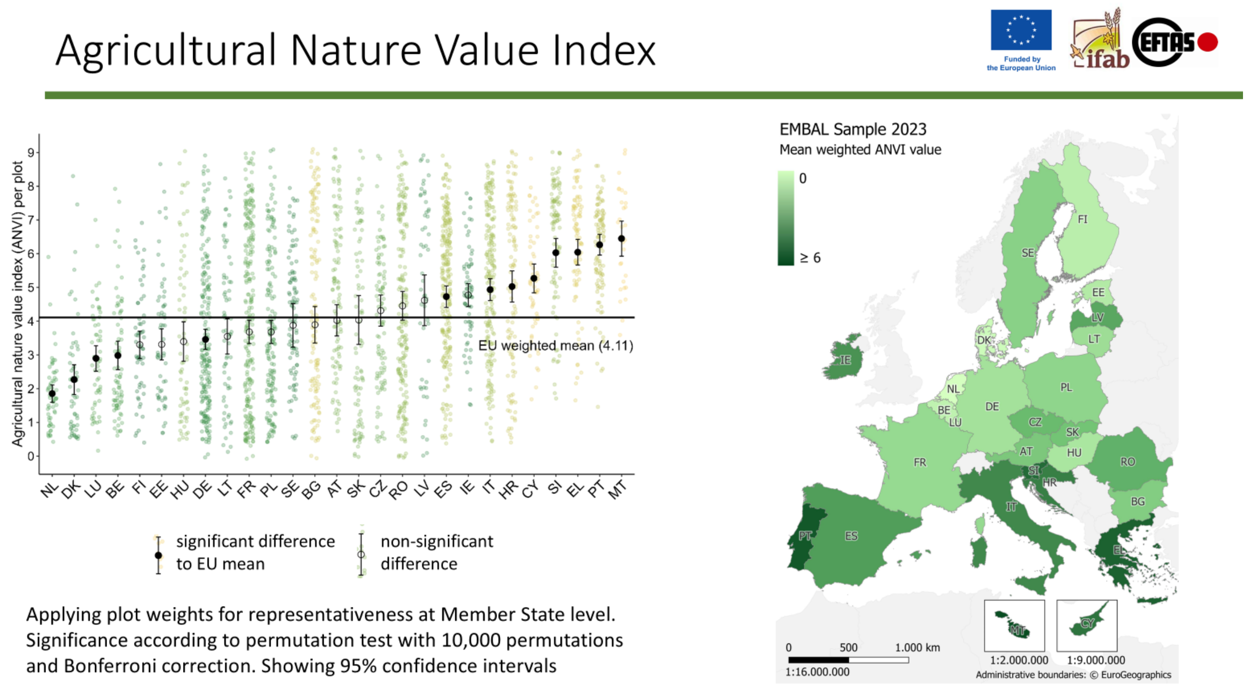


Slides provided by ***Andrea Hagyo****, Joint Research Centre*

EMBAL Supporting policy

3. How can monitoring data be translated into formats that effectively support decision making and policy processes?


Agricultural Nature Value Index
Parcel NV calculated from individual parameters
arable fields only
grassland only
Plot ANVI scored between 0-9
ANVI
Orthophoto
Parcel nature value
Very low NV (0 - 2)
Low NV (2 - 4)
Medium NV (4 - 6)
High NV (6 - 8)
Very high NV (8 - 9)
Not utilised agricultural area
Missing data or unobserved
Country: SI
Orthophoto: © Surveying and Mapping Authority of the Republic of Slovenia
Administrative boundaries: © EuroGeographic
EMBAL - European Monitoring of Biodiversity in Agricultu
EMBAL Sample 2023
ANVI value
0 - 1.99
2 - 3.99
4 - 5.99
6 - 7.99
8 - 9
Agricultural area
0 ha
to
25 ha
Malta
Cyprus
0 500 1.000 km
1:16.000.000
1:2.000.000
1:9.000.000
Administrative boundaries: © EuroGeographics


Agricultural Nature Value Index
Funded by the European Union
ifab
EFTAS
Agricultural nature value index (ANVI) per plot
EU weighted mean (4.11)
NL DK LU BE FI EE HU DE LT FR PL SE BG AT SK CZ RO LV ES IE IT HR CY SI EL PT MT
significant difference to EU mean
non-significant difference
Applying plot weights for representativeness at Member State level.
Significance according to permutation test with 10,000 permutations and Bonferroni correction. Showing 95% confidence intervals
EMBAL Sample 2023
Mean weighted ANVI value
0
≥ 6
FI
SE
EE
LV
LT
DK
IE
NL
BE
LU
DE
PL
CZ
SK
FR
AT
HU
RO
SI
HR
IT
BG
PT
ES
EL
MT
CY
0 500 1.000 km
1:16.000.000
1:2.000.000
1:9.000.000
Administrative boundaries: © EuroGeographics


Thank you for your attention!
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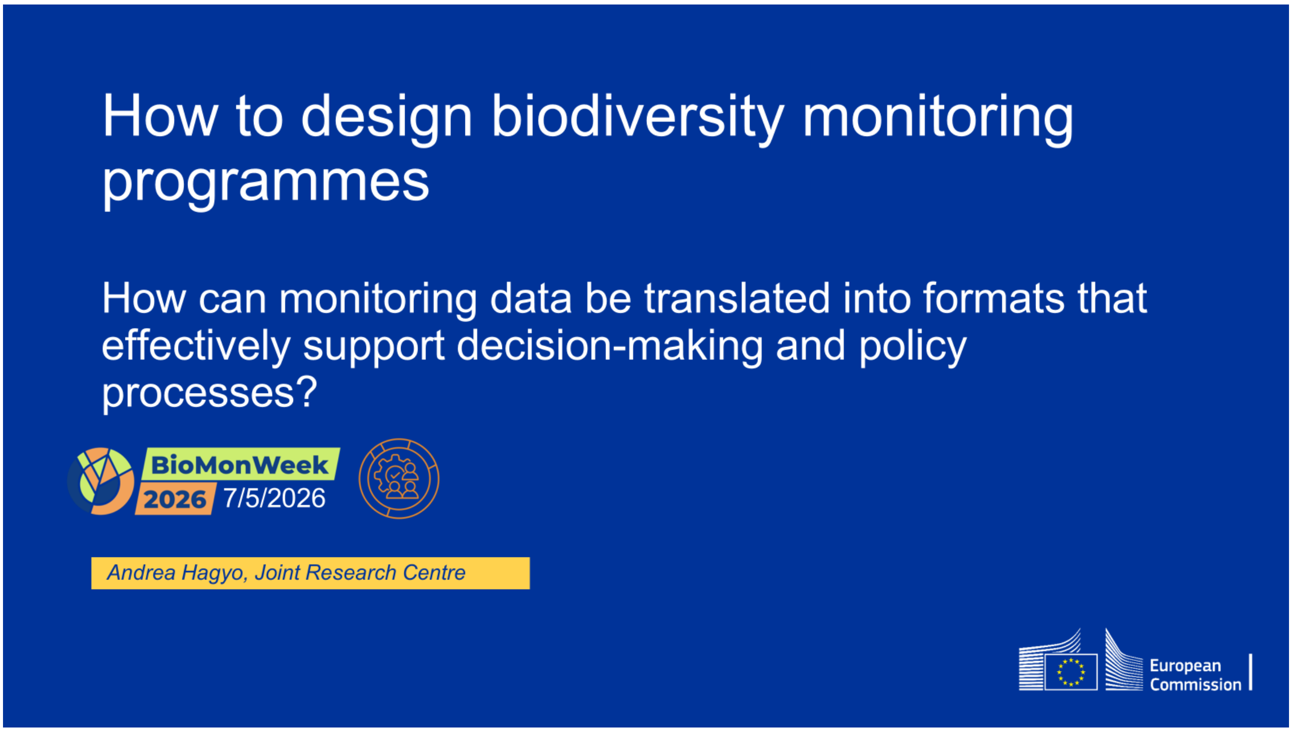
Appendix 3: How can monitoring data be translated into formats that effectively support decision-making and policy processes?

Presentation by Andrea Hagyo, BioMonWeek 2026 workshop "How to Design Biodiversity Monitoring Programmes"



How biodiversity monitoring data can support policy?

- Monitor biodiversity
  - to underpin why biodiversity conservation and restoration are needed
  - evidence to design effective policies
  - to track policy impact and performance

- Monitor biodiversity/ proxies AND management/actions
  - What human activities, pressures have an impact on biodiversity?
  - What actions can lead to positive changes, halt and reverse biodiversity loss?
  - Where, how, how much?

Clear links between biodiversity and actions regulated or incentivised by the policy

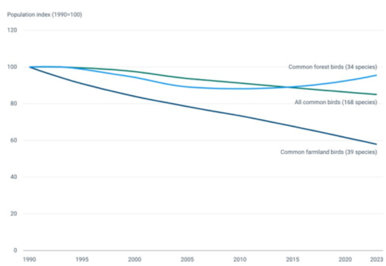
- Biodiversity targets
  EU Biodiversity Strategy
- Protected areas
  Natura 2000

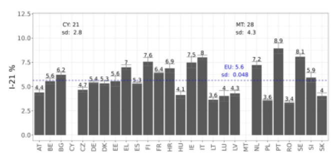
- Conservation/restoration policies
  Nature Restoration Law

- Sectoral policies with biodiversity objectives
  Common Agricultural Policy

How can monitoring data be translated into formats that effectively support decision-making and policy processes?

- Cost-effective and robust indicators, reliable in a legal context
- Detect changes at a comparable timescale with policies, comparability across time
- Statistical representativeness
- Well-documented, open data





3

From design to policy-relevant data and indicators

Land Use and Cover Area frame Survey, LUCAS

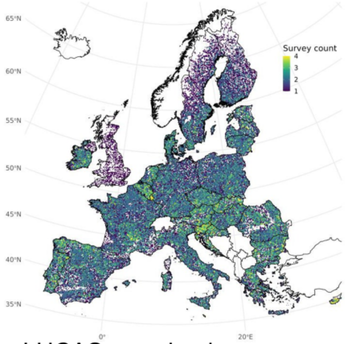
- Multiannual planning
- Align pogramming with policy and implementation cycles
- Implementation of robust data governance principles
- Data quality, interoperability
- Identification of user needs
- Survey design, data collection, processing, analysis, dissemination, and post-survey evaluation

Soil biodiversity 2018, 2022

Landscape Features 2022

LUCAS Grassland 2018, 2022

Co-location



LUCAS grassland
LUCAS Landscape features
LUCAS soil biodiversity
EMBAL

4

Monitoring landscape features

Common Agricultural Policy (CAP) supports maintaining landscape features since 1992

Impact indicator I-21

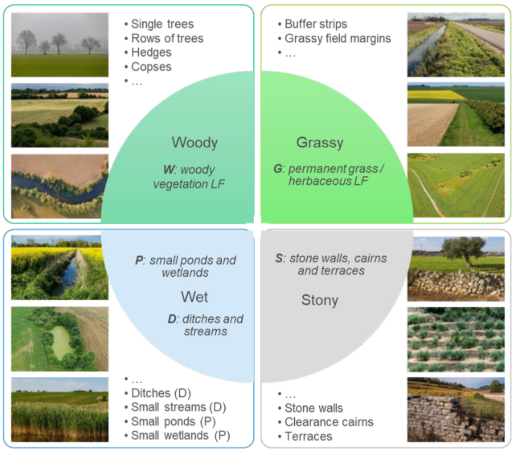
'share of agricultural land covered with landscape features'

developed by JRC at the request of DG-AGRI

Clear objective

A European Union typology of landscape features

Clear and simple definitions for cost-efficient sampling and robust data



Indicator: The ratio (%) between the area covered by LF and the area covered by agricultural land at Member State (and possibly at NUTS2) level

LF definition: small fragments of non-productive and typically, but not only, semi-natural vegetation present in, or adjacent to, agricultural land.

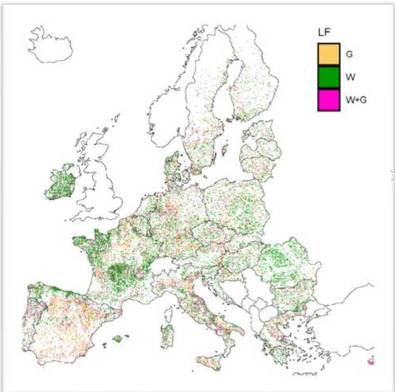
- 4 main LF types
- Geometry

< 20m wide OR
< 0.5 ha size (area)

LUCAS Landscape Features 2022

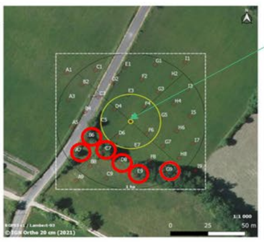
- Clear methodology
- Robust area estimation

in collaboration
Policy
Research
Statistics



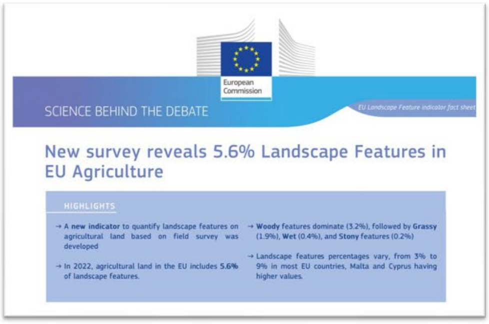
- Nested point sampling
- Agricultural land

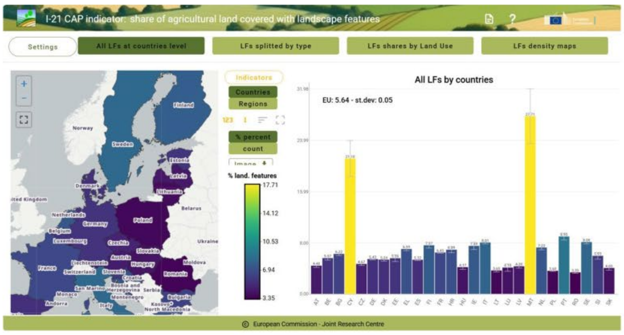
93,000 quadrats of 100x100m
x 41 sub-points-> 3.8 million

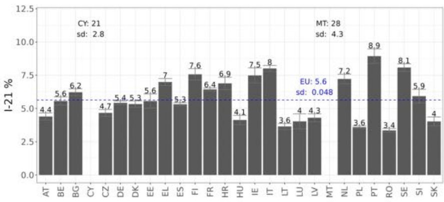


LUCAS core point

I.21 CAP indicator







Setting a baseline

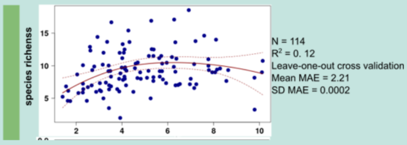
Change detection?

Evidence on links between biodiversity, proxies and management

A. Combining data from different monitoring programs

Gridded data from the Pan European Common Bird Monitoring scheme (PECBMS) site-level data, 2018-2023

Mean species richness and abundance, weighted by sampling effort



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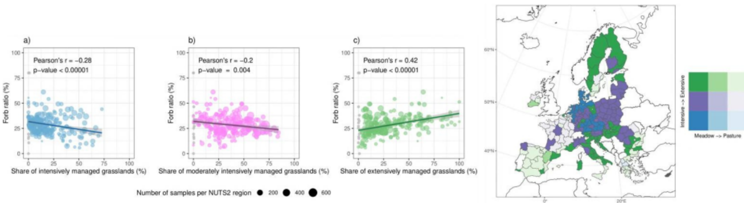
B. Monitoring multiple biodiversity and management metrics - LUCAS Grassland



C. Knowledge synthesis from multiple studies

- JRC Farming practices evidence library: Systematic review of meta-analyses

Thank you