EUROPABON
Europa Biodiversity Observation Network

A sampling design for the European Biodiversity Observation Network

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Designing a Biodiversity Observation Network

Monitoring design

(1) How to design sampling?

(2) What models to use?

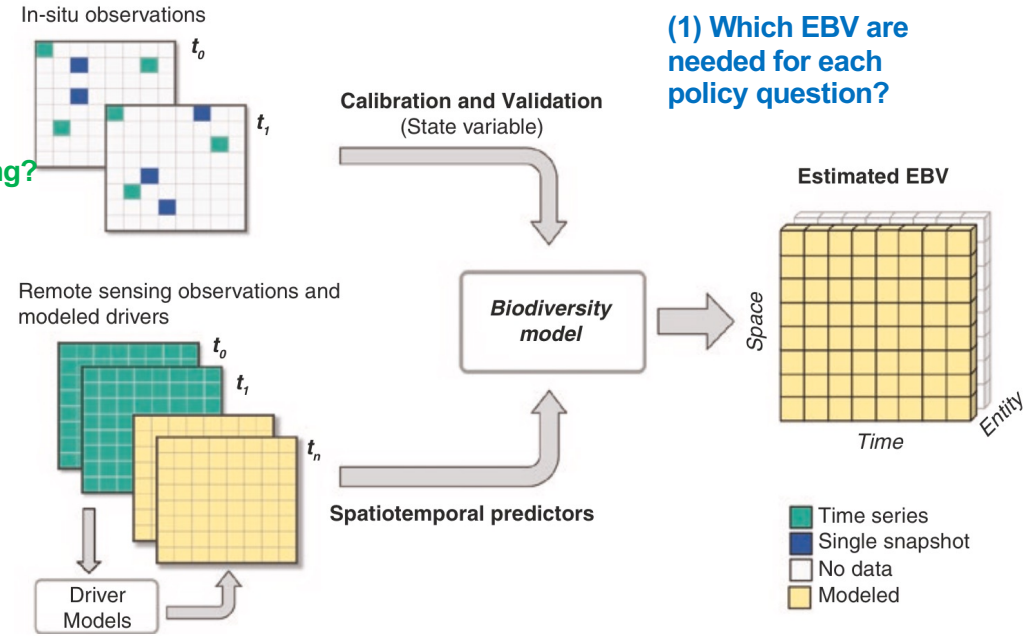
EBV Selection

(1) Which EBV are needed for each policy question?

EBV Specification

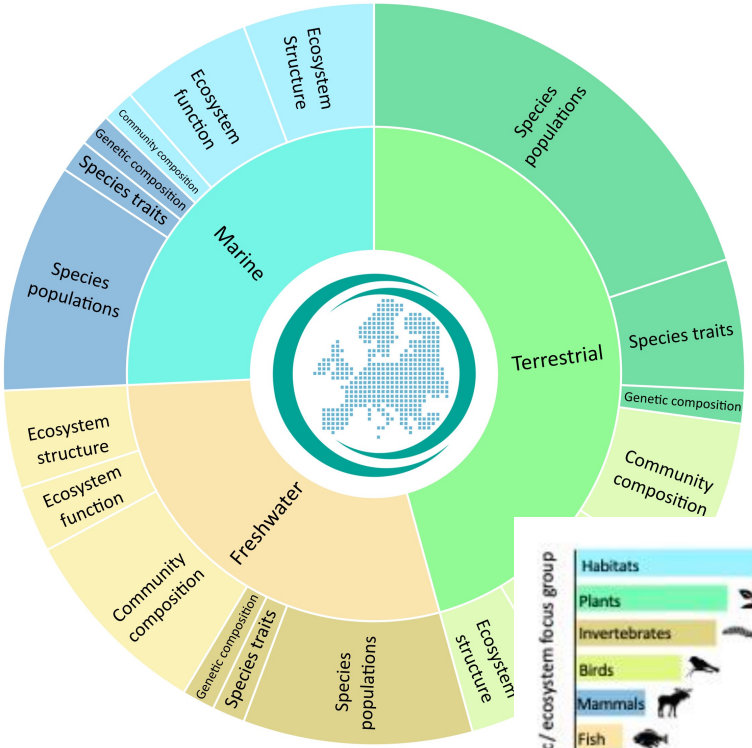
(1) What taxa and ecosystems?

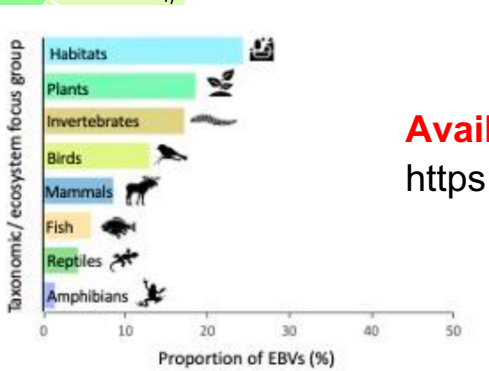
(2) What is the desired spatial and temporal resolution of EBV?



Fernández ... Pereira (2020) in Remote Sensing of Plant Biodiversity

A balanced EBV design: realms, EBV classes, taxa





Species level variables mostly addressing questions **about status of species of conservation interest** (Habitats, Birds Directives), and some species groups for which enough interest exists.

Ecosystem level variables mostly addressing questions about **trends in ecosystem condition and restoration,** across a range of taxonomic groups.

Some species level variables and some ecosystem level variables important to estimate **ecosystem services, ecosystem risks, and status of invasive species**

Available on GitHub

https://github.com/EuropaBON/EBV-Descriptions/wiki

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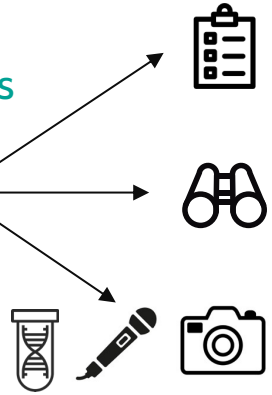
Co-design of EBV monitoring workflows

EBV & EESV list

72 EBVs

In-situ observations

57 EBVs



Structured monitoring programs (>50 EBVs)

(e.g. birds, butterflies, freshwater monitoring, other pollinators, mammals, reptiles, amphibians, plants, marine fish & turtles, plankton, soil microbes)

Citizen science observations (>20 EBVs)

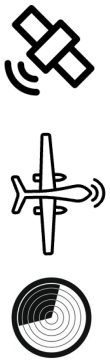
(e.g. phenology of mushrooms, plants and animals, free river flow)

Novel technologies (>10 EBVs)

(e.g. DNA metabarcoding of freshwater parasites, acoustic monitoring of marine mammal migration, insect cameras for flying arthropod biomass, wildlife camera traps for selected mammals)

Remote sensing

26 EBVs



Satellite remote sensing (>20 EBVs)

(e.g. distribution of EUNIS habitats, harmful algal blooms, carbon stock, marine primary productivity, forest disturbance by fire, ecosystem phenology)

Airborne remote sensing (2 EBVs)

(e.g. vegetation structure)

Weather radar (1 EBV)

(e.g. aerial biomass of migrating birds, bats and insects)

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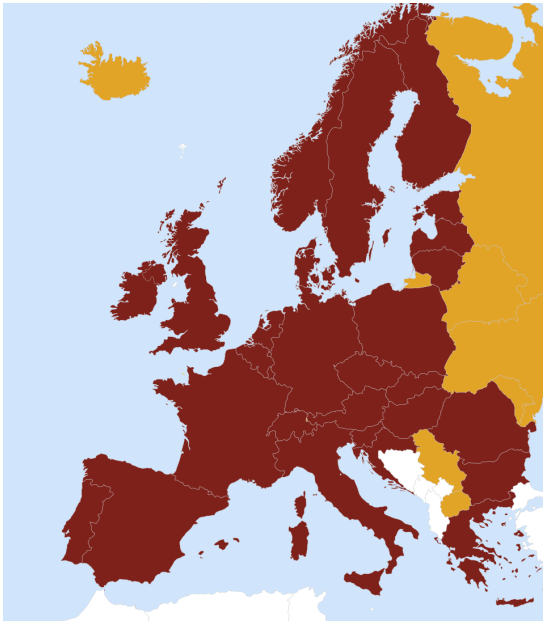
Different EBVs are being monitored in different sites

Community composition of plant plots

Pan European Common Bird Monitoring Scheme



Staude, I. R., et al (2021). *Ecology Letters*

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Advantages and disadvantages of (co)-location of sites

- Independent EBV monitoring sites
  - Advantages
    - Specific design matching the monitoring of each EBV
    - Uses existing communities and networks of monitoring
  - Disadvantages
    - High costs
    - Data from different EBVs may be difficult to integrate

- Co-located EBV monitoring sites
  - Advantages
    - All EBVs collected in same sampling locations facilitating cross-EBV integration and with other drivers
    - Low cost
  - Disadvantages
    - May fail to capture on-going monitoring
    - Spatial sampling design may not fit well some EBVs

Co-design of the in situ monitoring of EBVs

a) Nearly non-monitored EBV's (<20% EU-MS)

Genetic composition
- Genetic diversity of selected freshwater taxa
- Genetic diversity of selected marine taxa
- Genetic diversity of selected terrestrial taxa

Species populations
- Species distributions of lichens (as indicators of pollution)
- Species abundances of selected terrestrial disease vectors
- Species abundances of selected terrestrial crop pests
- Distributions of marine turtle species nesting grounds

Community composition
- Ecological Quality Ratio (EQR) of freshwater zooplankton

Species traits
- Phenology of fructification of mushrooms and wild fruits
- Phenology of flowering and leaf senescence

b) EBVs with major monitoring gaps (20-60% EU-MS)

Species populations
- Species distributions of amphibians and freshwater reptiles
- Species distributions of terrestrial reptiles
- Species distributions of freshwater mammals
- Species distributions of marine mammals
- Species distributions of all terrestrial mammals
- Species distributions of terrestrial priority invertebrates and key pollinators
- Species abundances of selected terrestrial mammals
- Species abundances of terrestrial migratory birds
- Species abundances of butterflies

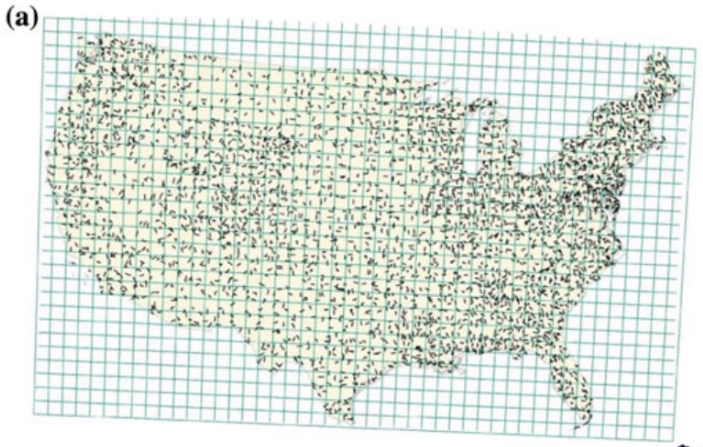
Species traits
- Phenology of the emergence of butterflies

Community composition
- Community abundance and taxonomic diversity of pollinator insects
- Aerial biomass of migrating birds, bats and insects

c) Highly monitored EBVs (60-80% EU-MS)

Candidates for co-monitoring across a network of European sites

Different approaches to placing sites of an observation system



Grid based

Environmental stratification

Opportunistic

Pereira et al. 2017 *The GEO Handbook on Biodiversity Observation Networks*

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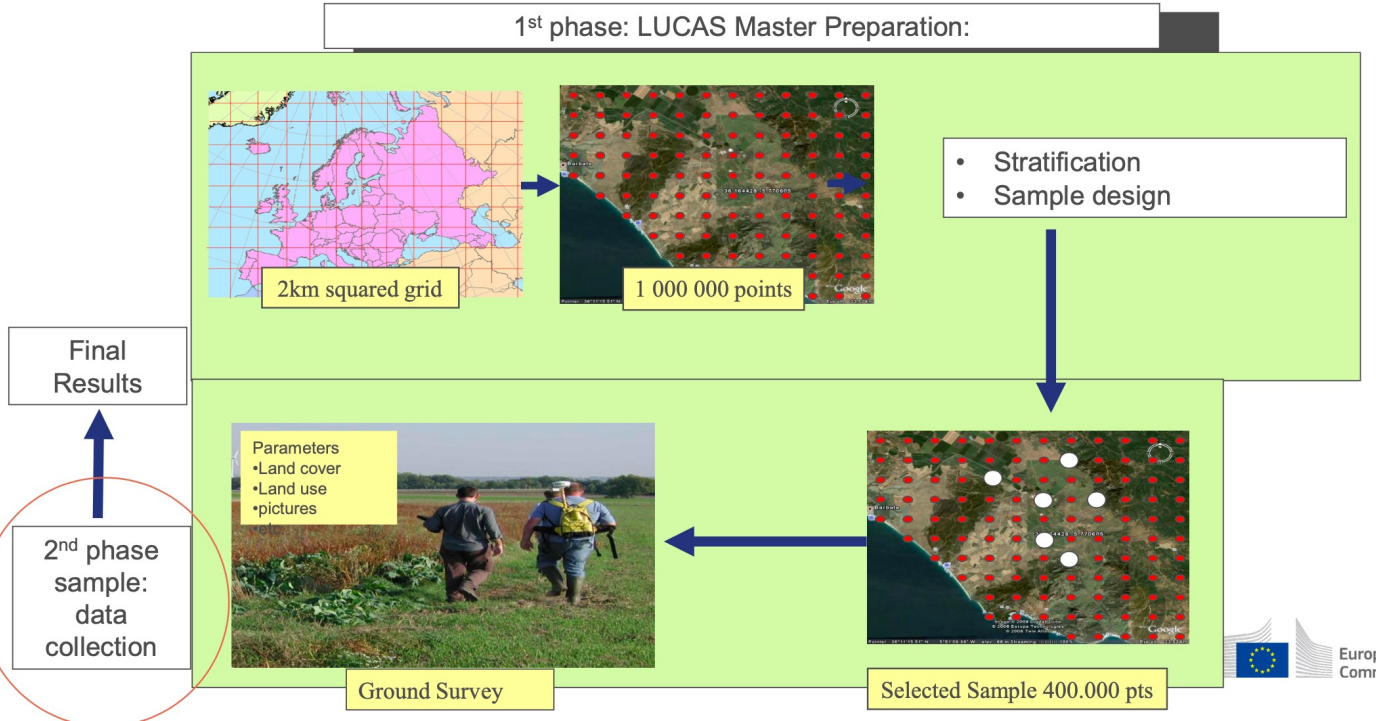
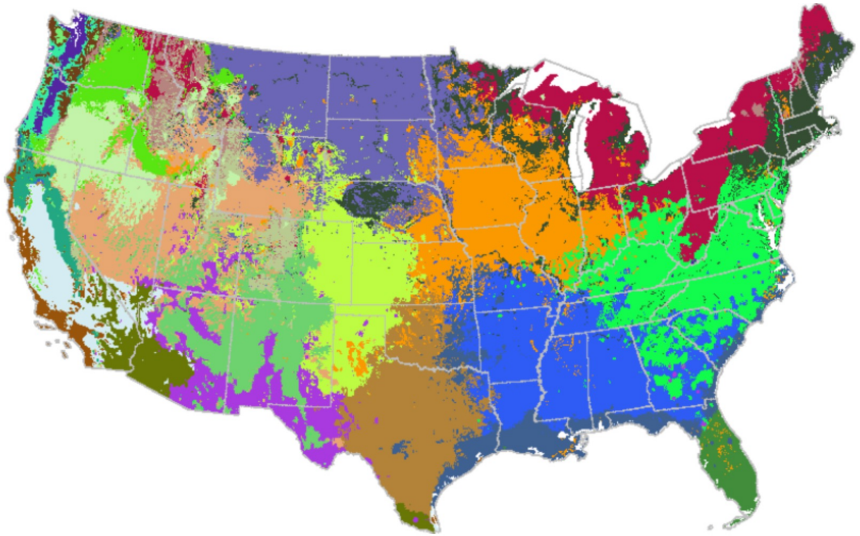
LUCAS survey: mixed grid based design

Sampling Design

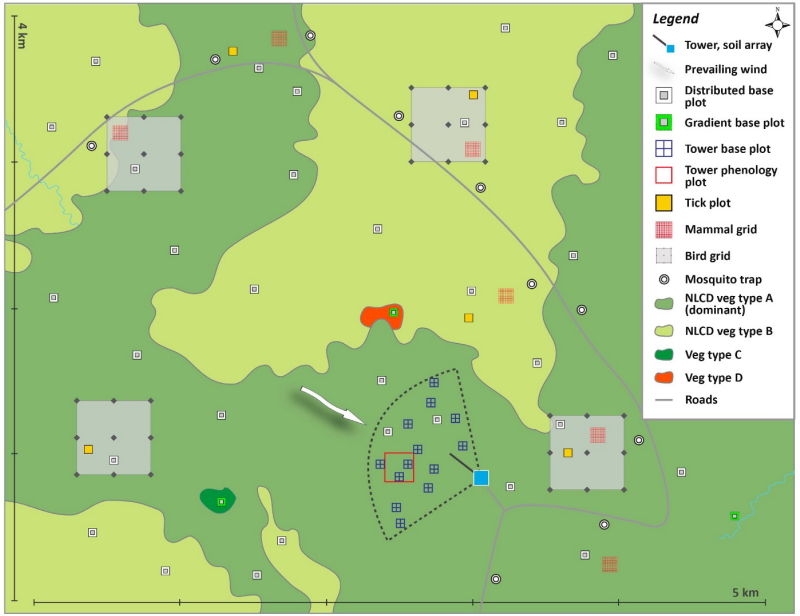


NEON: multiscale environmental stratification design



The initial 25-cluster map, based on the 9 climate variables, shown in random colors
1 square kilometer resolution, 7.8 million map cells

https://www.neonscience.org/impact/observatory-blog/primer-neon-sampling-design



Thorpe, AS et al (2016) *Ecosphere*

Advantages and disadvantages of each sampling design

- Grid based
  - Advantages
    - High spatial coverage
    - Potentially can be linked to any set of drivers (surveillance monitoring)
    - Potentially high taxonomic/habitat coverage
  - Disadvantages
    - Very high cost
    - May fit better terrestrial than freshwater and marine realms
    - Need for nested design (how are sites sampled inside the cells)
- Environmental stratification
  - Advantages
    - Can be designed to study the influence of different drivers (targeted monitoring)
    - Low cost
  - Disadvantages
    - May fail to capture changes across drivers not included in the stratification
    - No wall-to-wall coverage

Features to be considered in each sampling design

- Grid based
  - Size of grid
  - All cells or statistical sampling
  - Nested sampling inside grid
- Environmental stratification
  - Which drivers?
  - How to stratify?
  - How many points?
  - Sampling design in each point

THANK YOU

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