Coordination Team (CT) Biosphere

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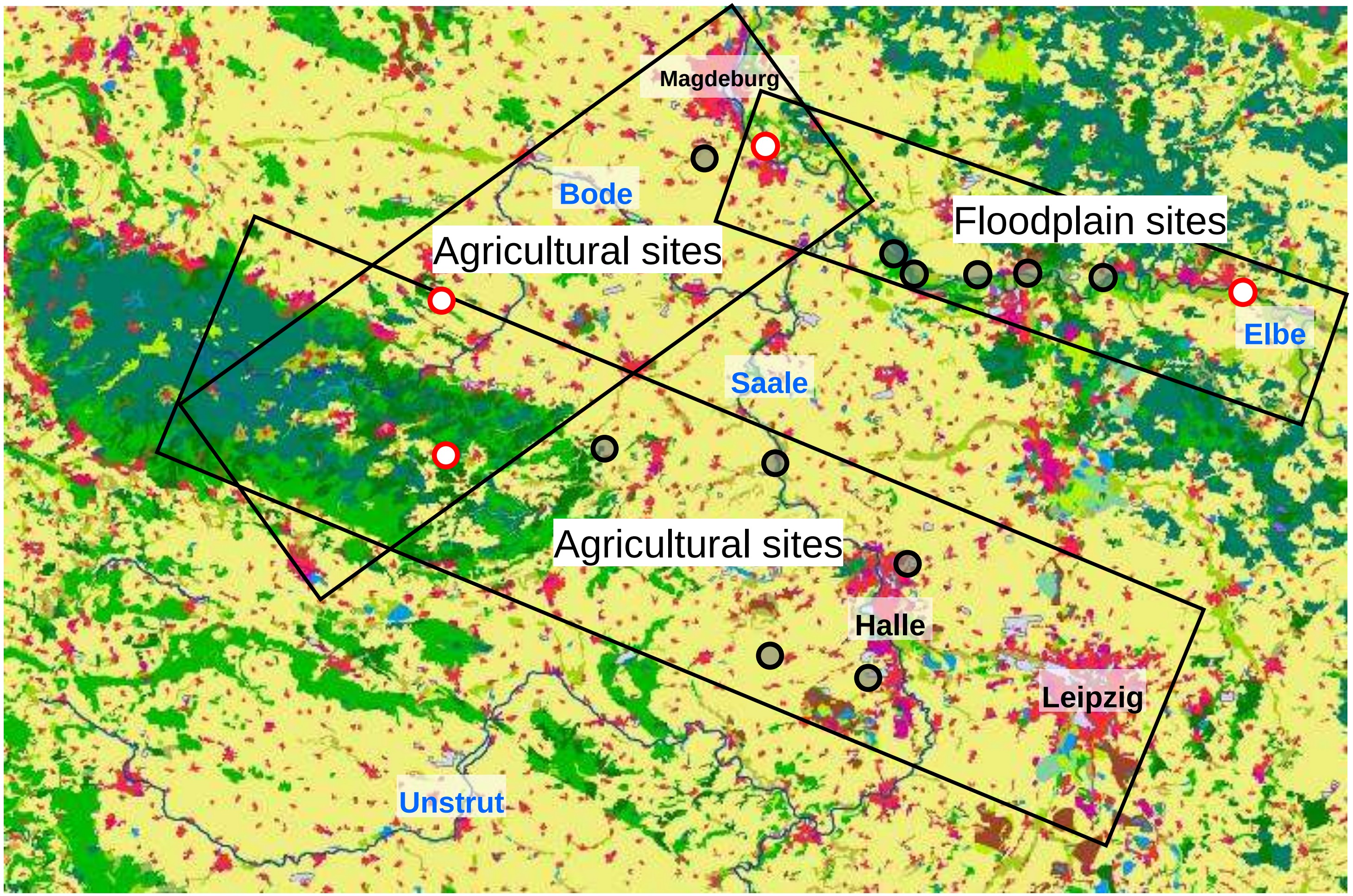
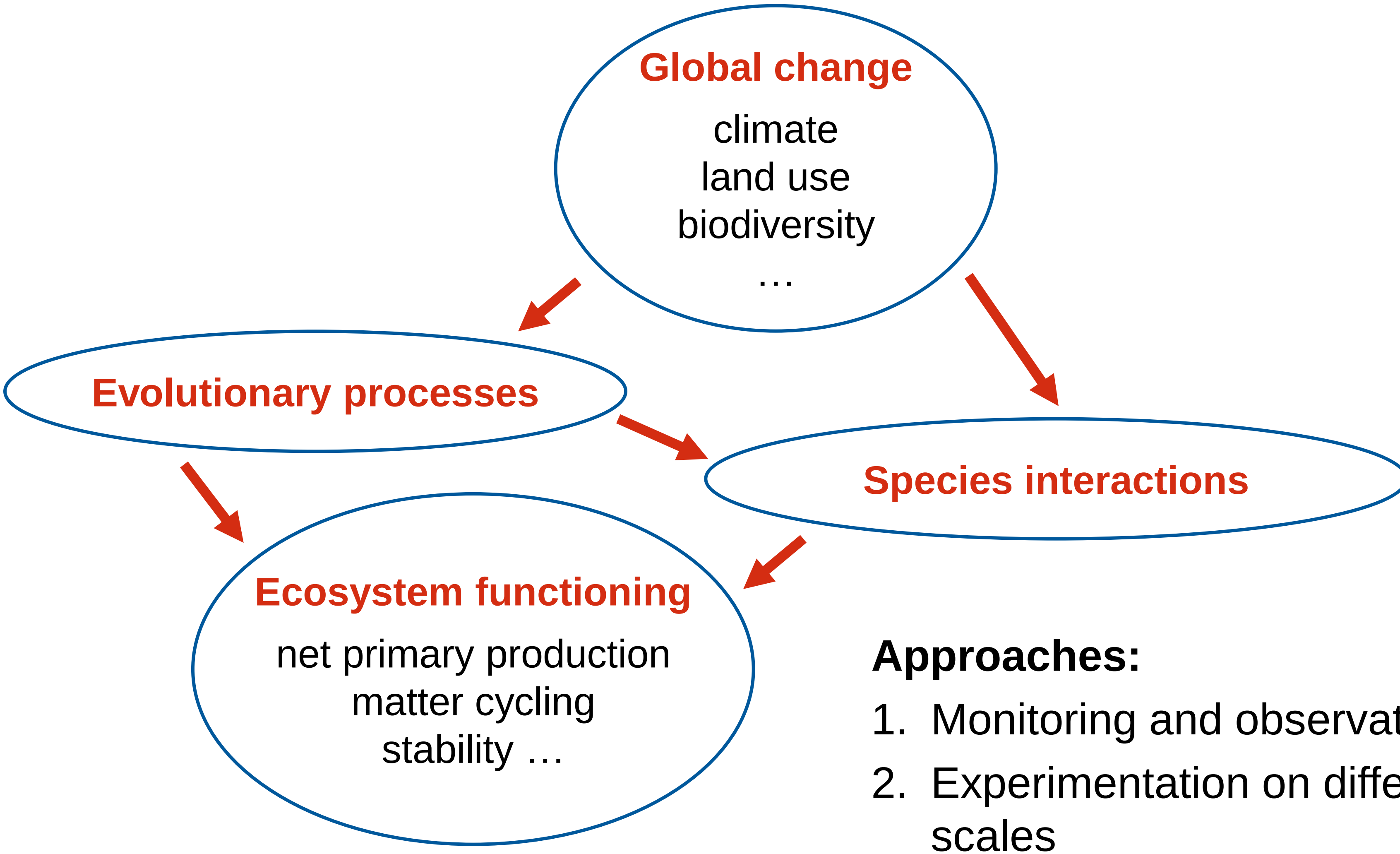
Helmholtz Centre for Environmental Research - UFZ
Dept. Community Ecology

Harz/Central German Lowland Observatory



- Core sites with (historical) data held by UFZ
- Core sites established in 2009

Issues of CT Biosphere



Approaches:

1. Monitoring and observation
2. Experimentation on different scales

SWOT-Analysis

- **Strengths**: characteristics of business / project team
- **Weaknesses** (or Limitations): characteristics placing the team at a disadvantage relative to others
- **Opportunities**: external chances to improve performance
- **Threats**: external elements that could cause trouble for business / project

Origin	**Helpful**	**Harmful**
Internal (attribute of organization)	Strengths	Weaknesses
External (attribute of environment)	Opportunities	Threats

- Source: Wikipedia

Strengths (helpful, internal)

- Hypothesis-driven

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CT Biosphere Hypotheses

- **Climate and land use change** influence…

SCALE

1. … **local adaptation** => depends on genetic variation
2. … **population genetics** of plants => microevolutionary processes
3. … **areal shifts of species** => changes in existing communities
4. … **ecological communities** => consequences for ecosystem functions and services (productivity, erosion control, pollination)
5. …the **adaptability of selected ecosystems** in the long-term

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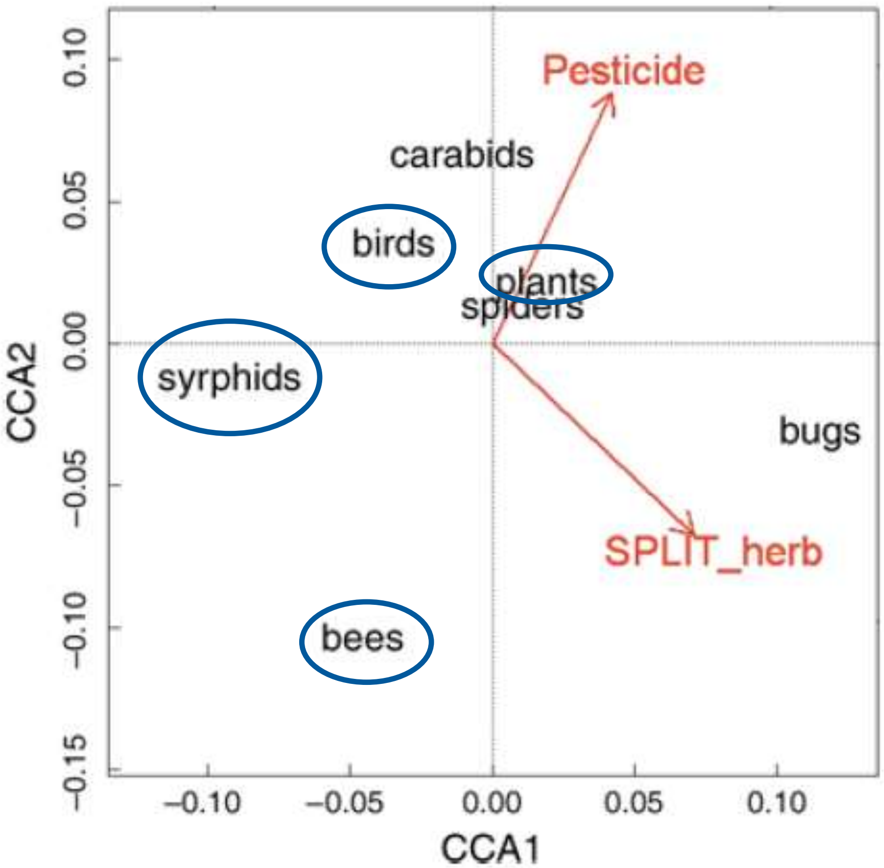
Strengths (helpful, internal)

- **Hypothesis-driven**
- **Bioindication**: organism-based integrative indication (reaction or accumulation) of diverse (anthropogenic) impacts on / characteristics of ecosystems

Bioindication: community similarity



Responses of community similarity in seven different communities to

- ❖ land-use intensity (pesticide index)
- ❖ landscape structure (splitting index of herbaceous vegetation)

Dormann et al. (Global Ecol Biogeogr; 2007)

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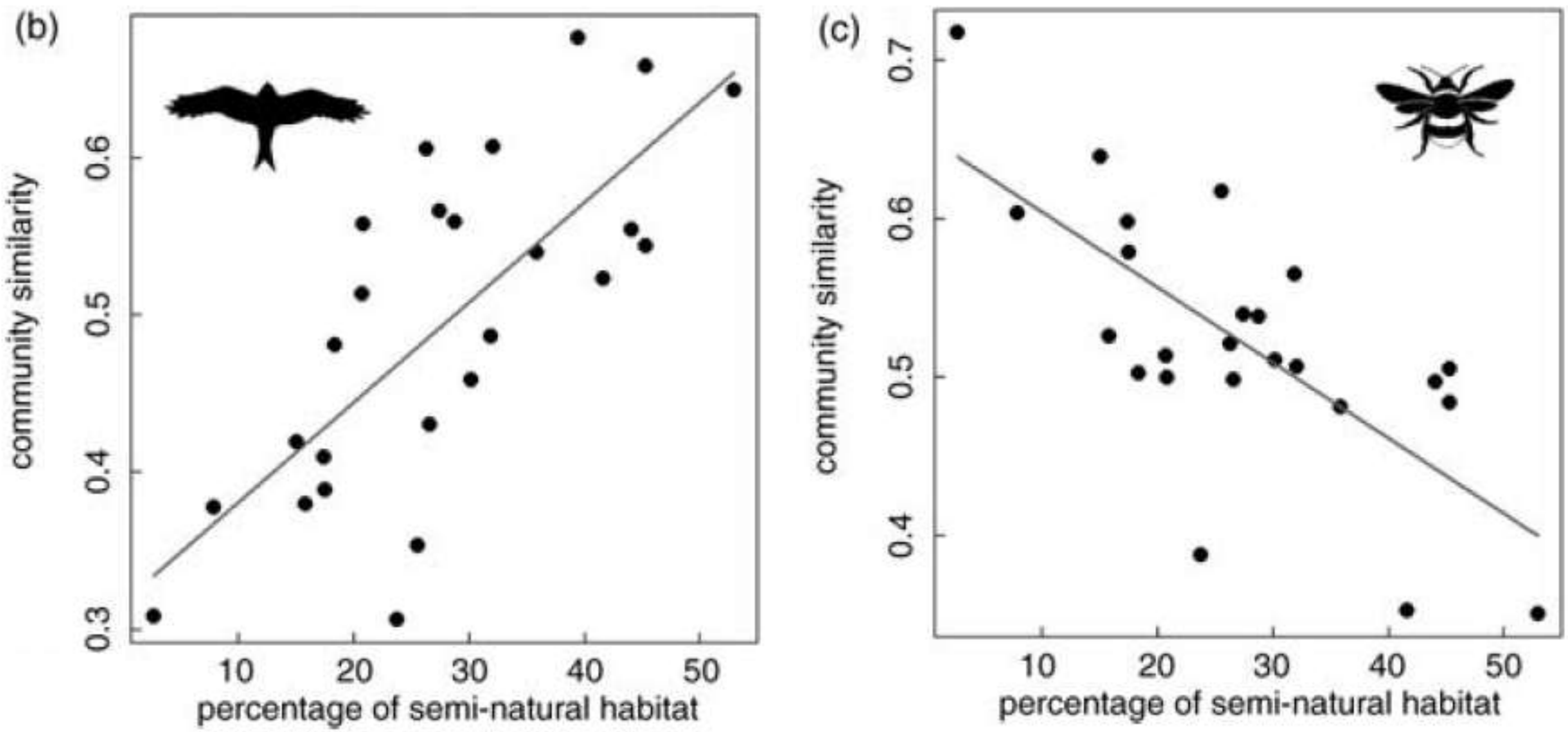
Bioindication: community similarity



Response of bird and bee community similarity to landscape configuration

Dormann et al. (Global Ecol Biogeogr; 2007)

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Strengths (helpful, internal)

- **Hypothesis-driven**
- **Bioindication**: organism-based integrative indication (reaction or accumulation) of diverse (anthropogenic) impacts on / characteristics of ecosystems
- Indispensible ⇨ **Important indicator groups** (what happens to the biotic part of ecosystems?)
  - **Vascular plants** => Primary producers (overall biodiversity indicators)
  - **Bees & Hoverflies** => Important pollinators (ecosystem service agents) (TMD – Tagfalter Monitoring)
  - **Butterflies** => Indicators for habitat quality, pollinators
  - **Birds** => Highly mobile, sensitive to landscape context, integrative on landscape scale

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Weaknesses (harmful, internal)

- ❖ Small team (UFZ staff only): biodiversity related research within TERENO ⇨ main focus at UFZ
  - Harz/Central German Lowland Observatory (6 sites à 4x4km, 6 floodplain sites)
  - SoilCan sites (4 + replications)
- ❖ Selected species groups (organism groups, frequency)
- ❖ Low frequency data (e.g. bird surveys each third year)
- ❖ Labor-intensive observations (traps, field surveys)
- ❖ Not device-based (no automated measurements possible)
- ❖ Extra budget for external assistance (specialists for specific groups)
- ❖ Integration with abiotic measurements can still be improved

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Opportunities (helpful, external)

Well-embedded in European initiatives (biotic and abiotic issues as well):

- **NETWORKS**
  - LTER-Europe (Long-Term Ecosystem Research and Monitoring): Expert Panel Standardization & Technology
  - LTER-D (German network)
- **PROJECTS**: WP's related to standardization of parameters and methods based on ecological integrity concept
  - **EnvEurope** (Life+; 2010-13): Environmental quality and pressures assessment across Europe: the LTER network as an integrated and shared system for ecosystem monitoring
  - **Expeer** (FP7; 2010-14): Experimentation in Ecosystem Research
  - **DBU Nature heritage sites**: Monitoring concept

Threats (harmful, external)

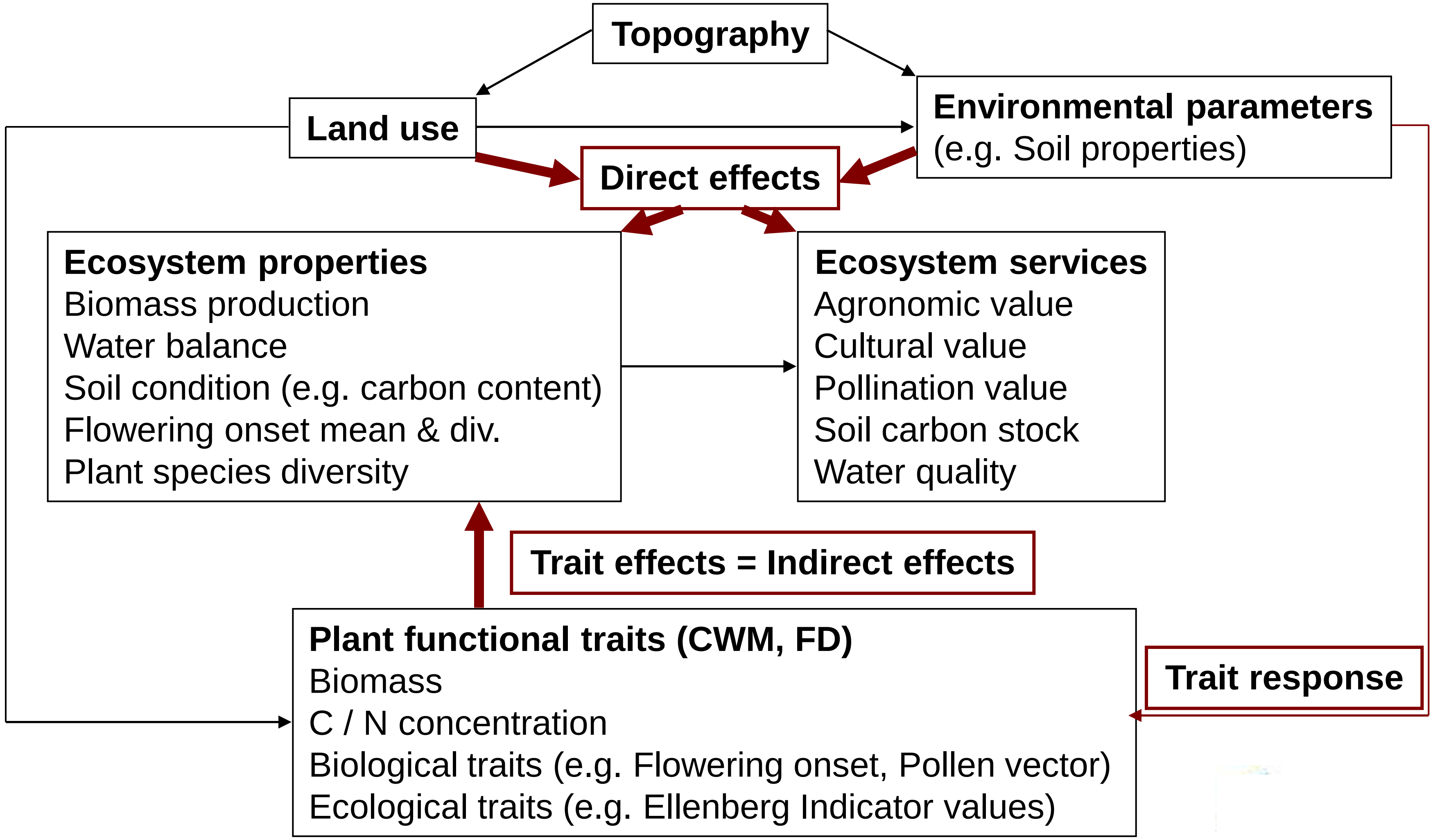
- Biodiversity measurements: Basic measurements comparable in international context, but others (e.g. ECN – Environmental Change Network UK) have resources to do more
- All our efforts may be (suddenly) overridden by unexpected climate change effects (see worst scenarios of CO_2 increase of the past have already become true…)

Proposals for improvement

Within TERENO

- Enhancing interdisciplinary links
  - Joint workshops
  - Tuning of measurement campaigns (see SoilCan)
- … and of course some more

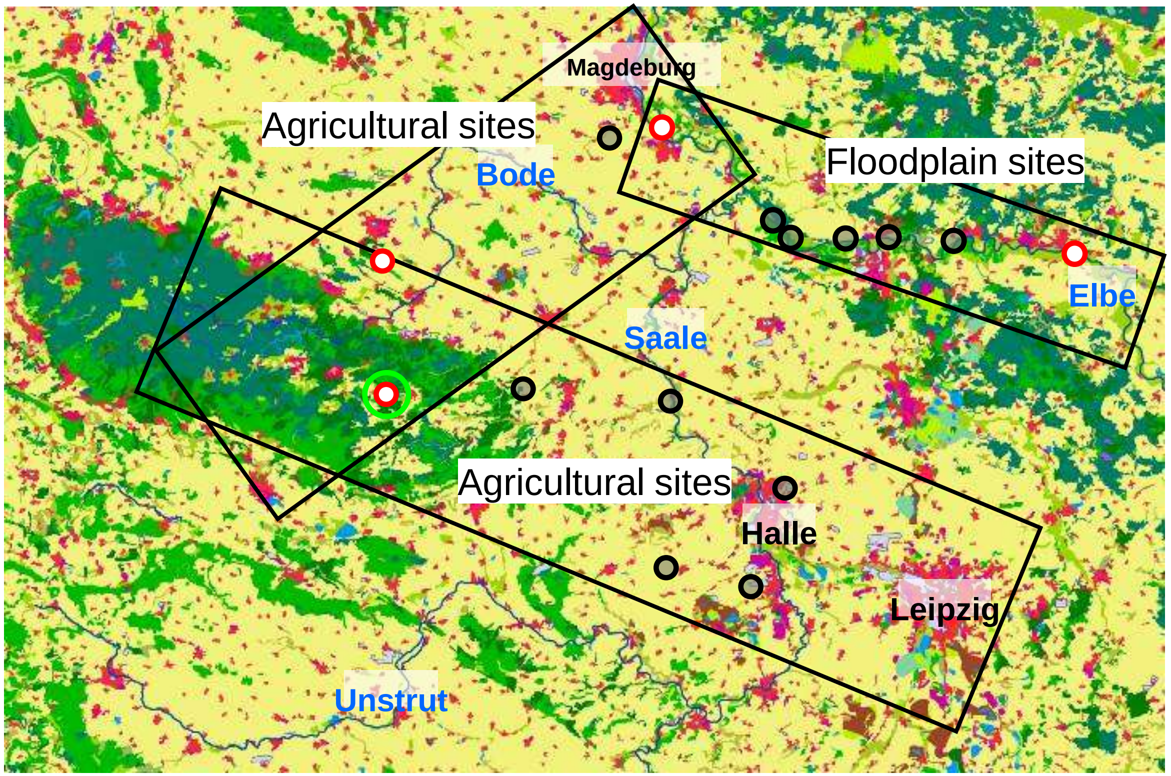
Relationships between plant functional types and ecosystem properties/ecosystem services



(*nach Lavorel et al. 2011*)

Relationships between plant functional types and ecosystem properties/ecosystem services

TERENO Observatory Schäfertal



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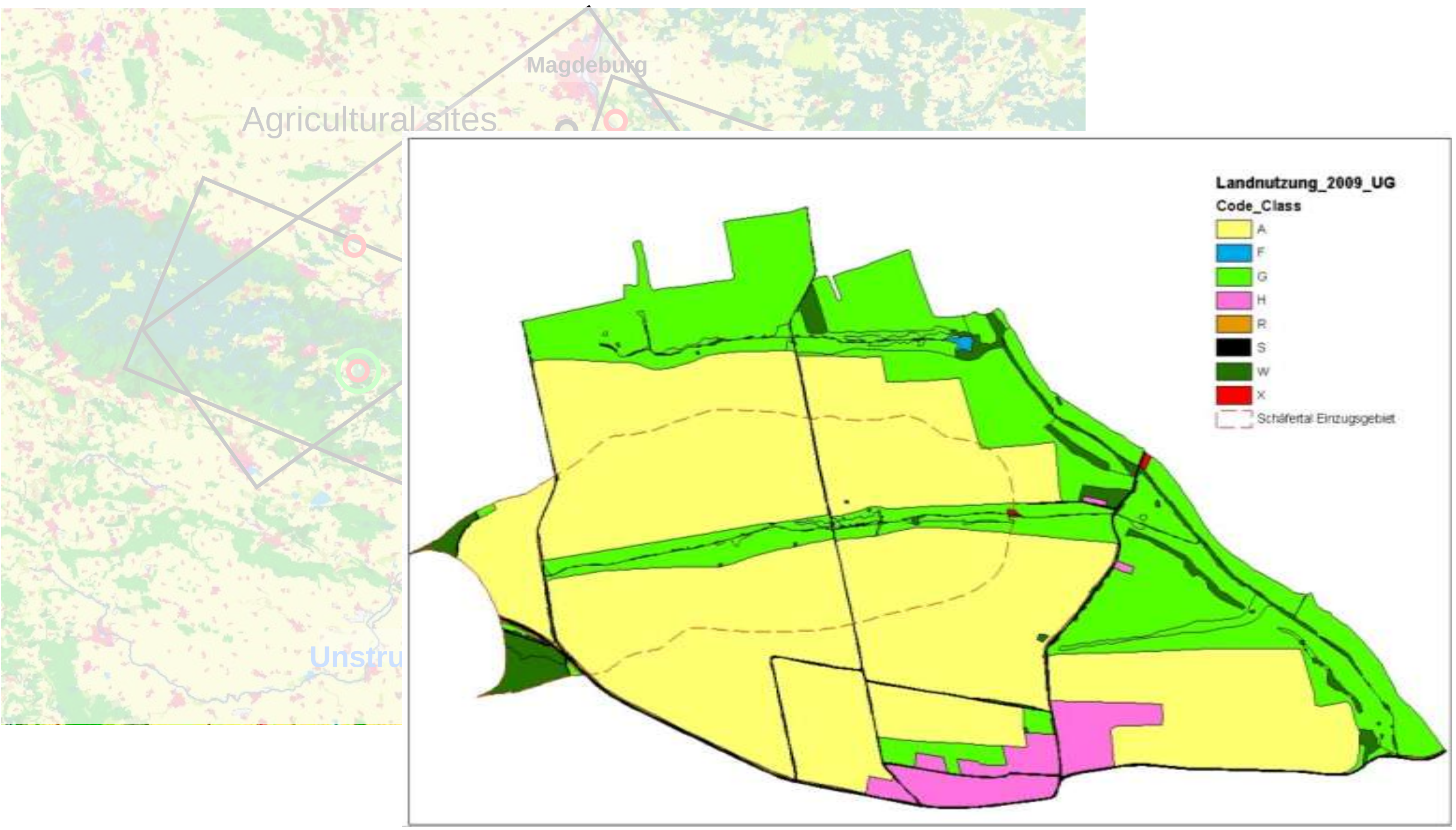

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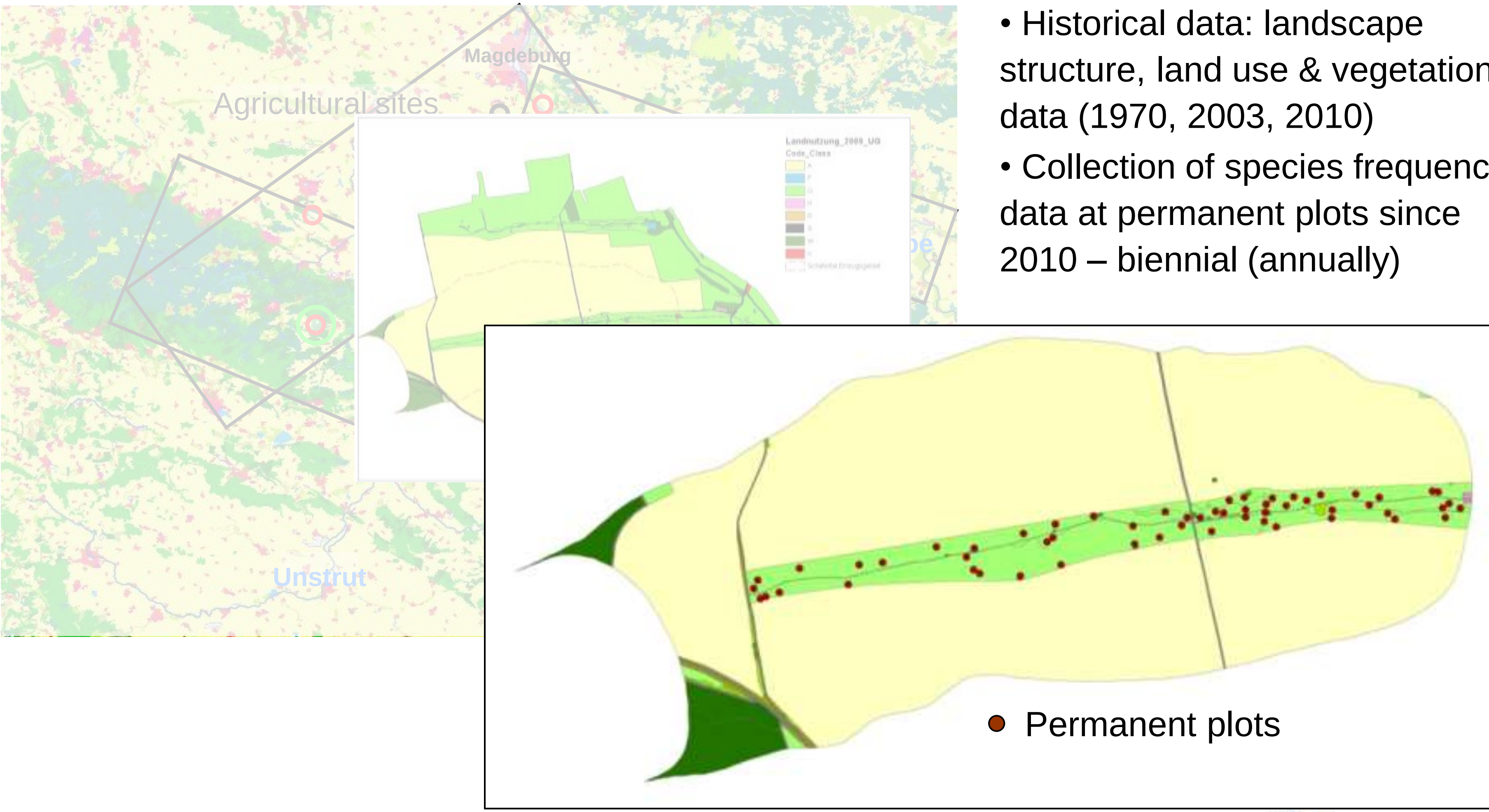

- Historical data: landscape structure, land use & vegetation data (1970, 2003, 2010)
- Collection of species frequency data at permanent plots since 2010 – biennial (annually)

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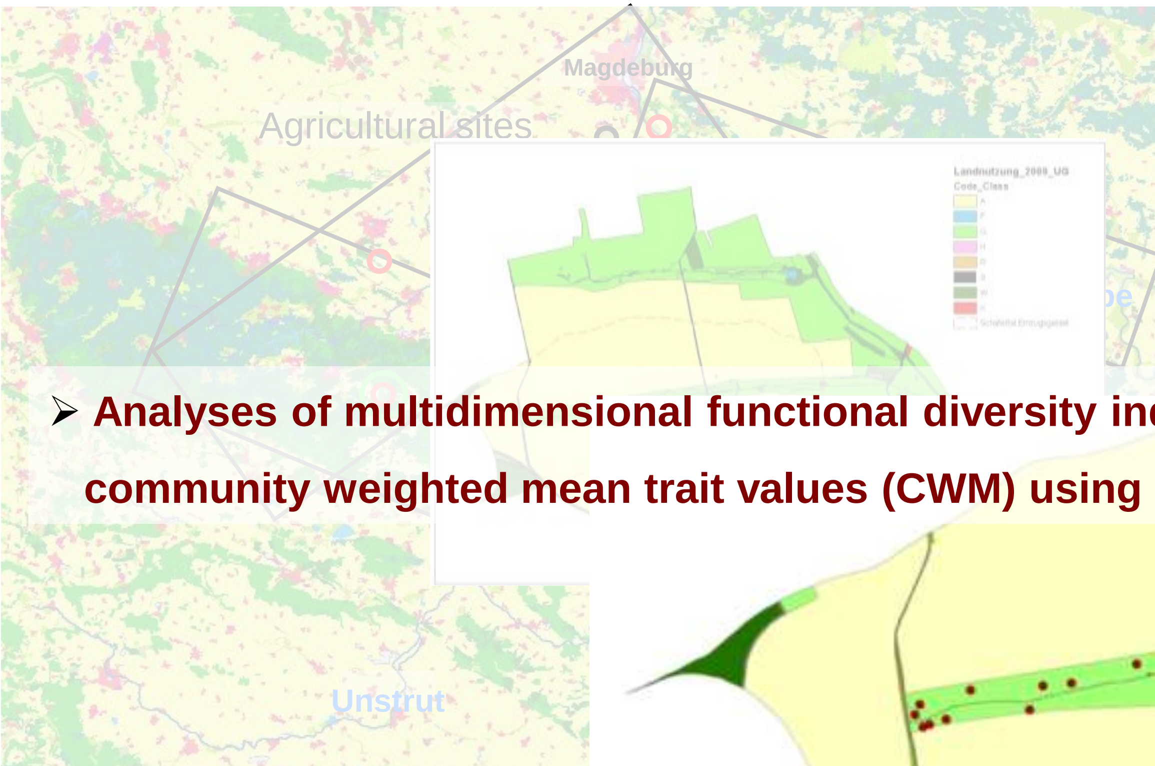

- Historical data: landscape structure, land use & vegetation data (1970, 2003, 2010)
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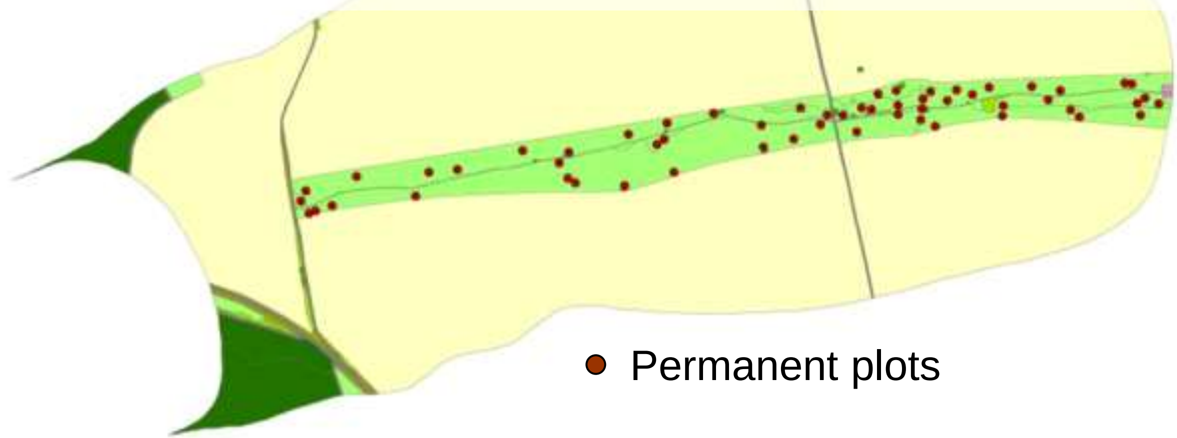
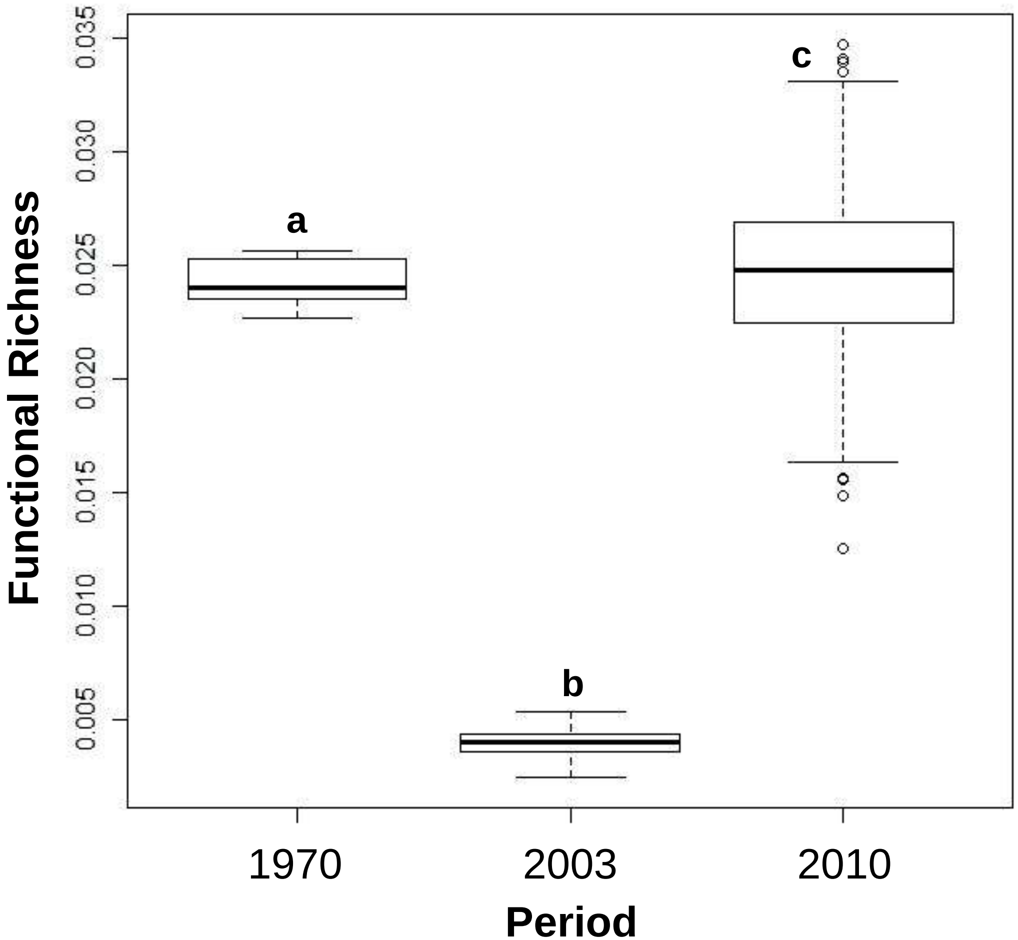
➢ **Analyses of multidimensional functional diversity indices (FD) and community weighted mean trait values (CWM) using plant functional traits**



Relationships between plant functional types and ecosystem properties/ecosystem services

Multidimensional functional diversity (FD)



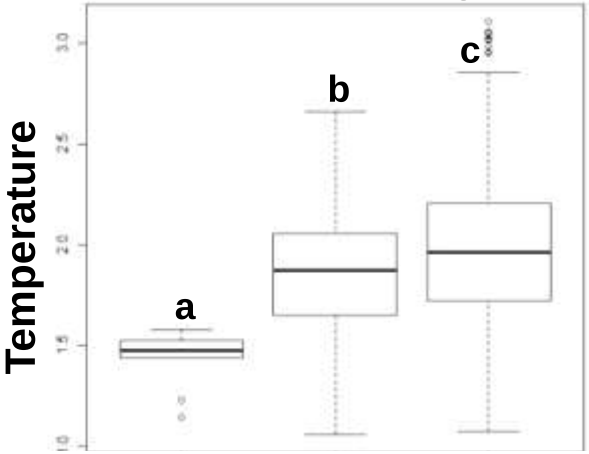
(*ANOVA, Tukey HSD with Bonferroni correction*)

- Analysis of functional diversity indices using different biological and ecological trait values, taking the frequency of each species into account

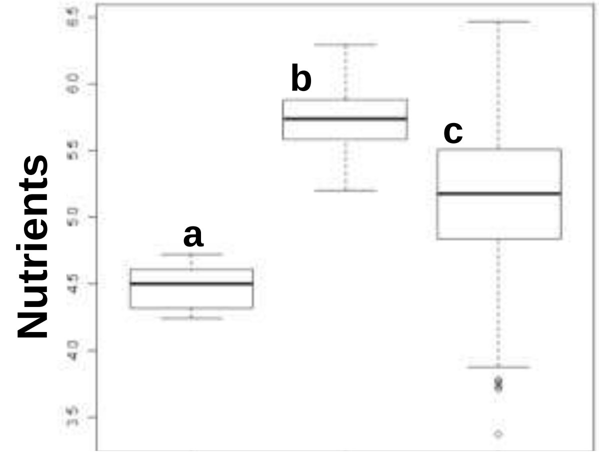
➢ Changes in functional diversity across time

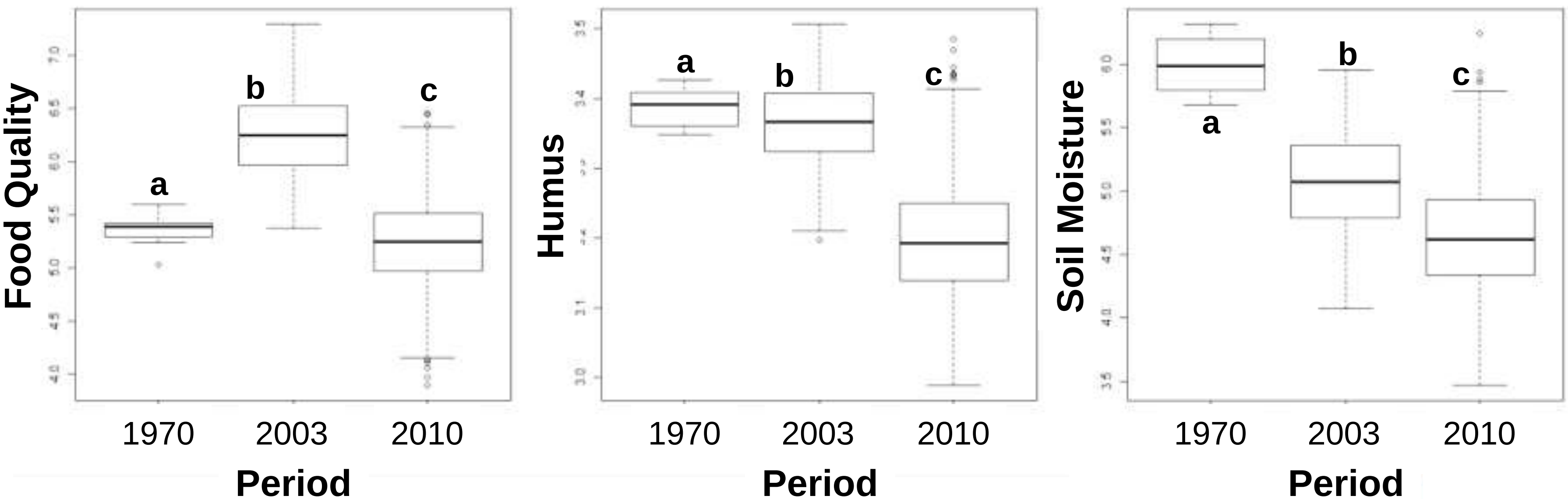
Relationships between plant functional types and ecosystem properties/ecosystem services

Community Weighted Mean trait values (CWM)



- Significant shifts of Community-weighted traits across time





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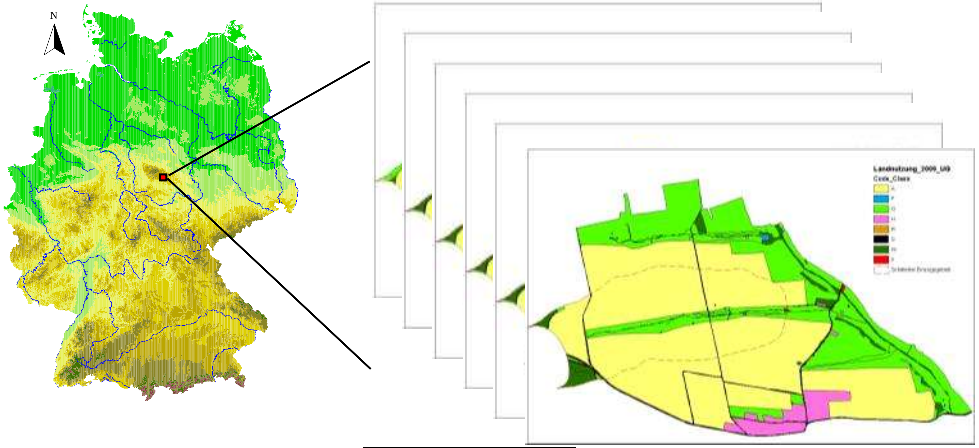

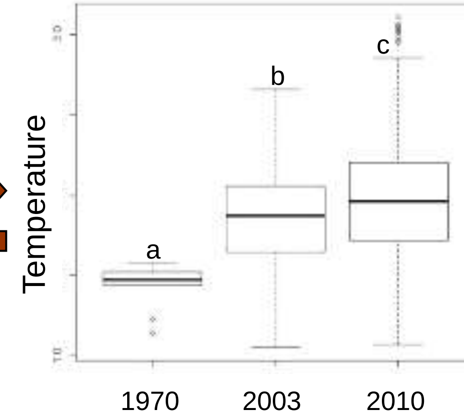

+ Environmental parameter

Policy (EU, national)

Land-use Intensity

Biodiversity

Ecosystem function

Ecosystem services

Social, Environmental and Economic value

PRESSURE
- **landscape structure**
- **fertilizer application**

Soil conditions
Water balance
Species composition (traits)

Soil erosion
Water quality
Species – Gene pool
Pollination

(Baessler 2008)

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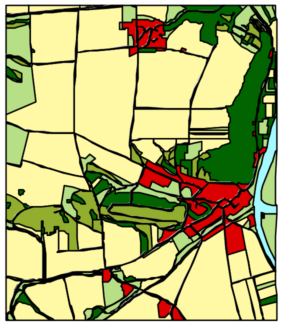
Vielen Dank!

Thank you very much!

Landscape structure (Core site Friedeburg)

FB 1953

FB 1969



Period	Nitrogen (N; kg/ha)	Phosphorus (P_2O_5; kg/ha)
1950s	35	31
1970s	124	61
2000	178	32

Period	Shannon Diversity	Share semi-natural habitats	PROX whole landscape (*10³)	Mean size arable fields (ha)
1950s	0.97	36.1	1.6	1.6
1970s	0.85	29.8	3.4	8.1
2000	0.77	25.8	4.8	10.5

Baessler & Klotz 2006

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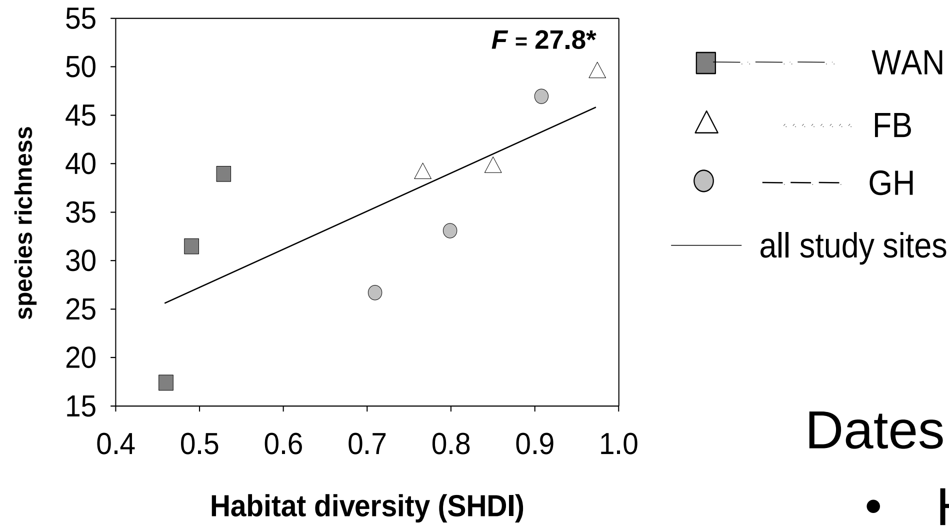
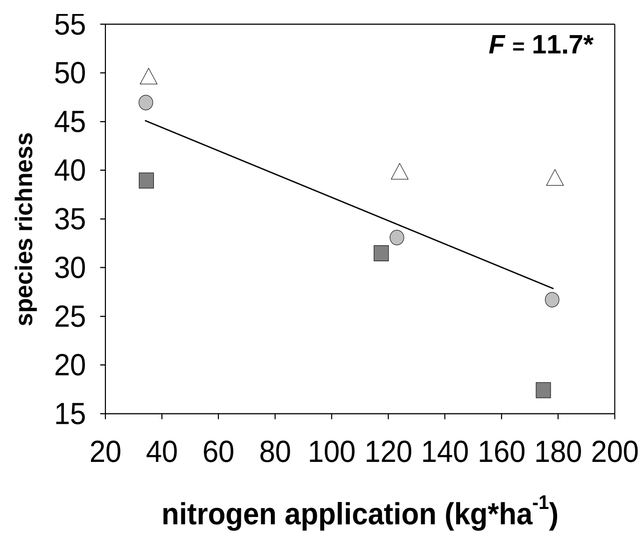
Vegetation analyses: arable weeds species richness (3 core sites)





Dates of relevés: 50ties, 70ties, 2000

- High habitat diversity => high species richness
- High nitrogen application => low species richness

Baessler 2008

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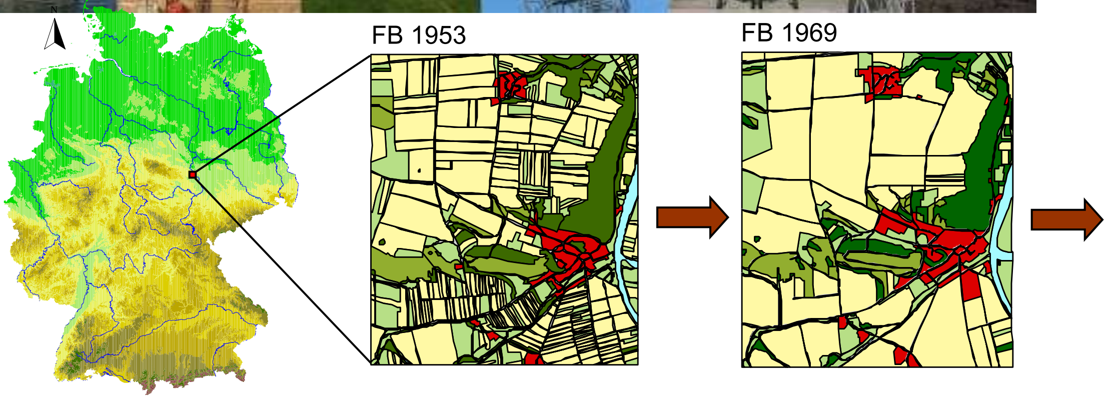

Policy (EU, national)

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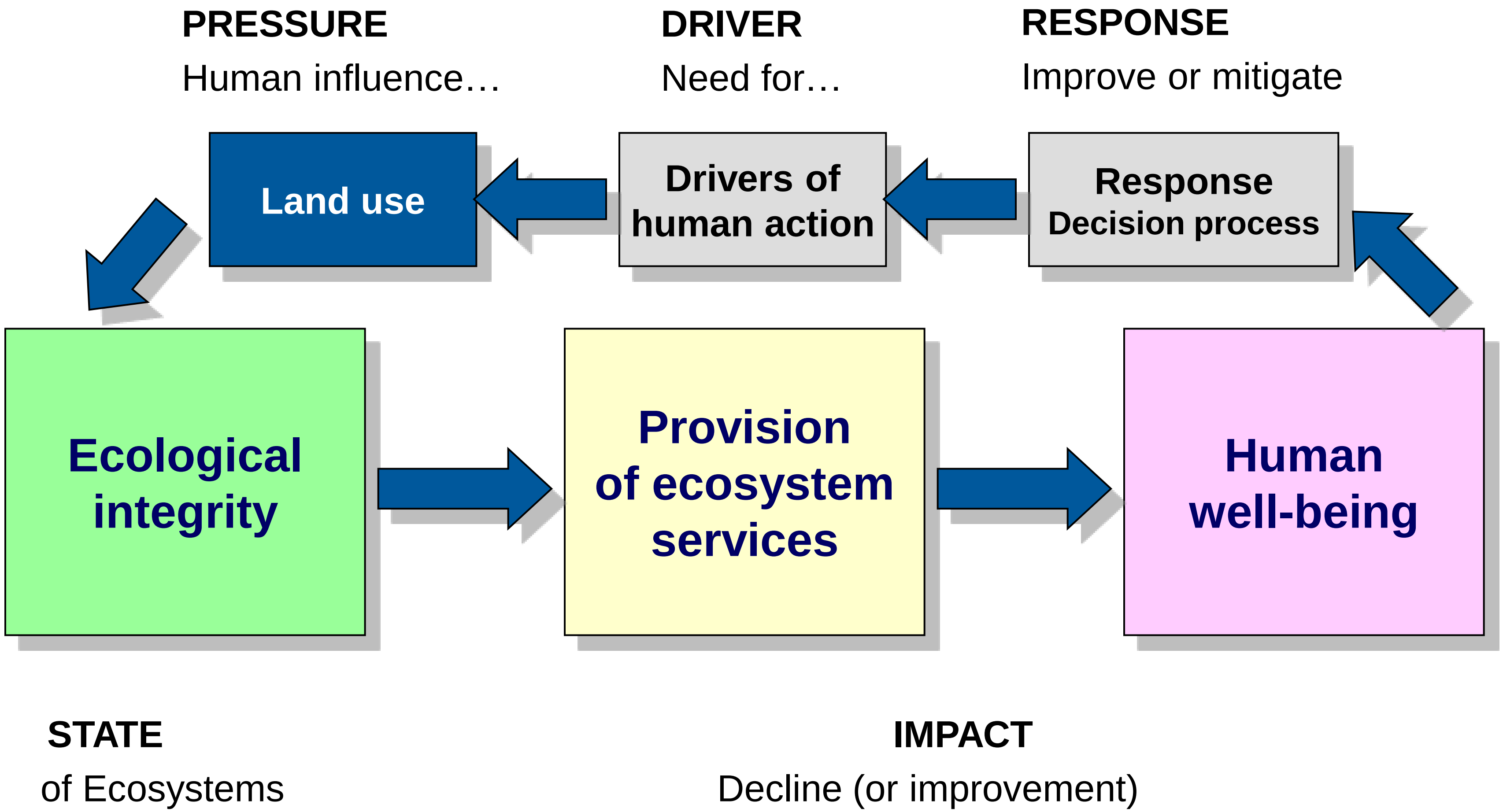
Concepts I: DPSIR



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Connection Ecol. Integrity - Ecosystem Services

STATE → ESS → HUMAN WELFARE

Ecosystem structures
- biotic diversity
- abiotic heterogeneity

Ecosystem processes
- energy balance
- water balance
- matter balance

Regulating services
- climate regulation
- water purification

. . .

Provision services
- food
- fuels

. . .

Cultural services
- inspiration
- genetic ressources

. . .

Social well-being
- health
- social security
- education
- nutrition
- accommodation
- leisure

. . .

Economy
- employment
- spending power
- infrastructure
- progress

. . .

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ECOLOGICAL INTEGRITY

Ecosystem Structures	**Biotic Diversity / Processes and Interactions**		flora diversity
			fauna diversity
			habitat structure
			additional variables
	Abiotic Heterogeneity		soil heterogeneity
			water heterogeneity
			air heterogeneity
			habitat heterogeneity
			additional variables
Ecosystem Process	**Energy Budget**	input	exergy capture
		storage	exergy storage
		output	entropy production
		additional state variables	meteorology
		efficiency measures	metabolic efficiency
	Matter Budget	input	matter input
		storage	matter storage
		output	matter loss
		additional state variables	element concentrations
		efficiency measures	nutrient cycling
	Water Budget	input	water input
		storage	water storage
		output	water output
		additional state variables	element concentrations