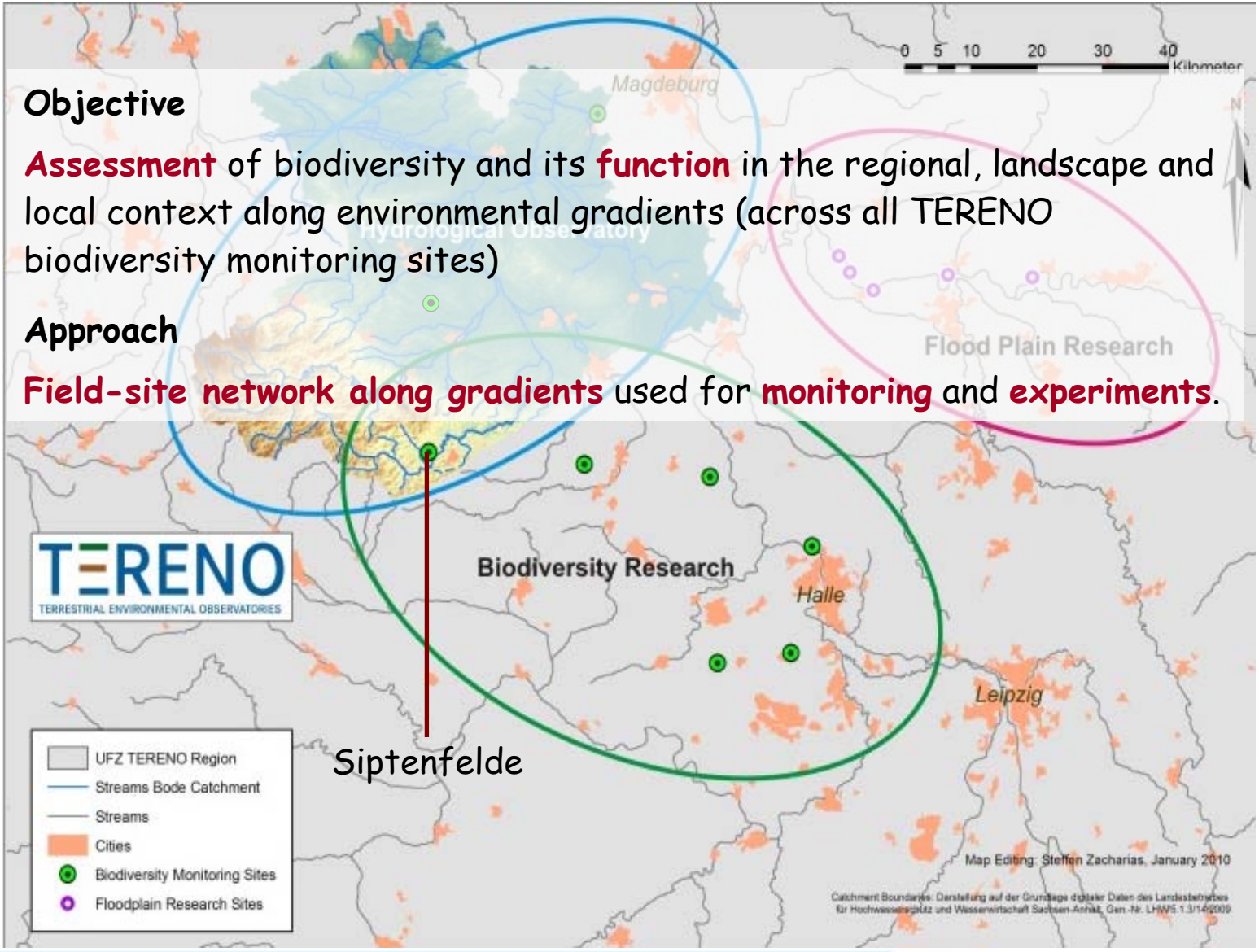
TERENO and Biodiversity research in European context

Ingolf Kühn, Cornelia Baessler, Stefan Klotz, Mark Frenzel et al.

Long-term approaches across space to tackle regional consequences of global change



Objective

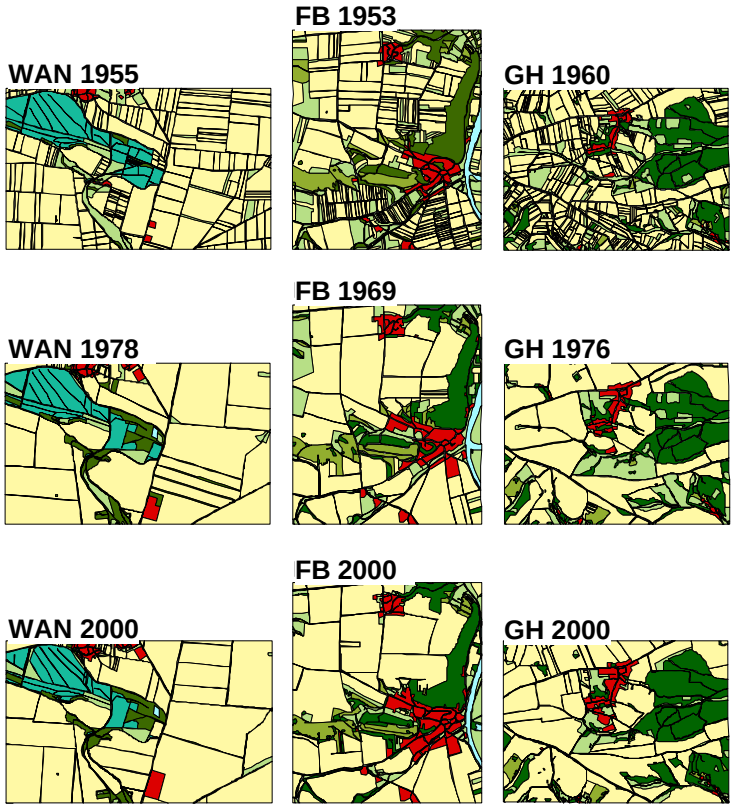
Assessment of biodiversity and its **function** in the regional, landscape and local context along environmental gradients (across all TERENO biodiversity monitoring sites)

Approach

Field-site network along gradients used for **monitoring** and **experiments**.

Changes in land-use intensity across space and time

- Land-use intensification during second half of 20th century
  - increasing level of inputs of agrochemicals
  - conversion of natural ecosystems to agriculture



Period	Nitrogen (N; kg/ha)		Phosphorus (P_2O_5; kg/ha)		Potash (K_2O; kg/ha)		Lime (CaO; kg/ha)		Livestock density (1/ha)		
	WAN	FB/GH	WAN	FB/GH	WAN	FB/GH	WAN	FB/GH	WAN	FB	GH
1950s	34	35	27	31	85	76	84	57	0.56	0.65	0.70
1970s	117	124	51	61	69	68	145	143	1.10	0.98	1.08
2000	174	178	28	32	81	72	184	126	0.45	0.26	0.20

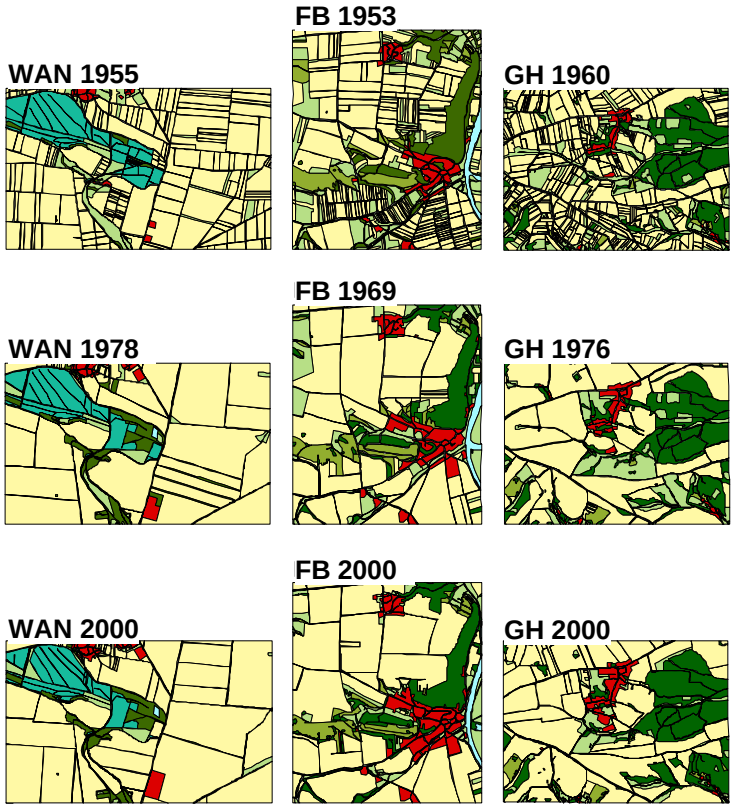
(Statistical yearbooks of the former GDR and the states of East Germany)

(Baessler 2008)

Structural changes across space and time

- Land-use changes are predicted to have largest global impact on species diversity (SALA *et al.* 2000)
- Land-use intensification during second half of 20th century
  - increasing level of inputs of agrochemicals
  - conversion of natural ecosystems to agriculture

⇒ Reduction of diversity and habitat quality of agricultural landscapes (BAESSLER & KLOTZ 2006)

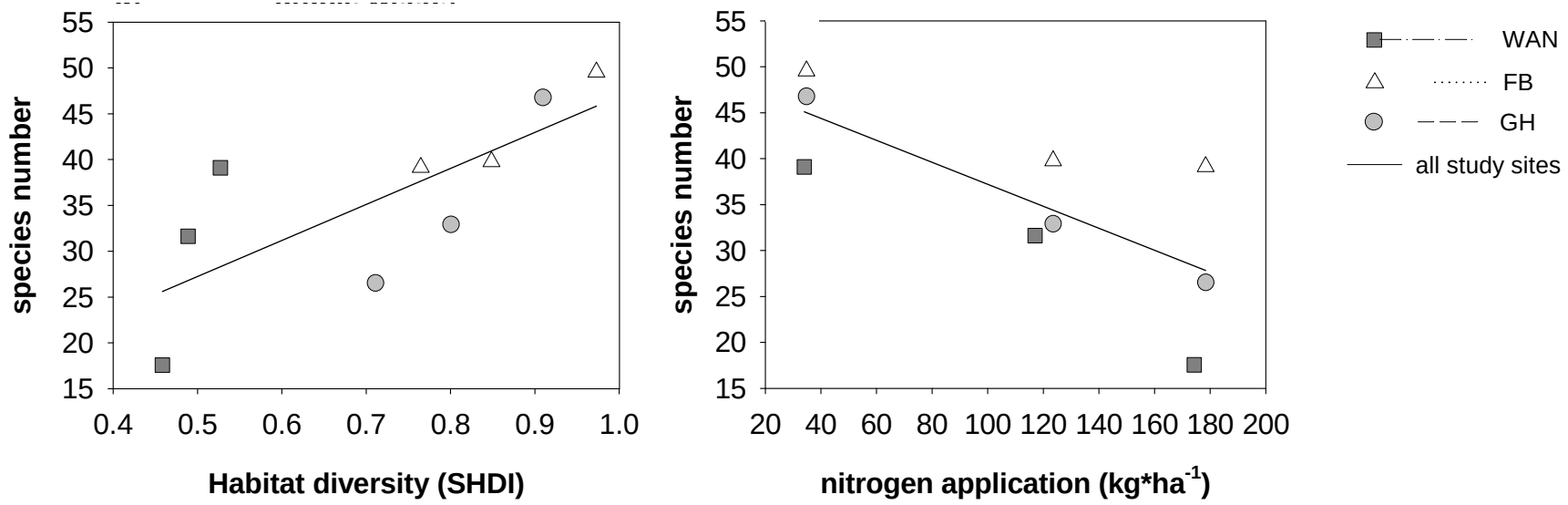


Period	SHDI			Share semi-natural habitats			PROX whole landscape (*10³)			MPS arable fields (ha)			MPS meadows (ha)		
	WAN	FB	GH	WAN	FB	GH	WAN	FB	GH	WAN	FB	GH	WAN	FB	GH
1950s	**0.53**	0.97	0.90	**22.1**	36.1	39.3	8.01	1.61	3.87	**3.6**	**1.6**	**1.2**	0.64	0.67	0.57
1970s	**0.49**	0.85	0.80	**20.9**	29.8	39.2	8.80	3.41	6.48	17.5	8.1	10.5	0.89	1.33	**1.54**
2000	**0.46**	0.77	0.71	**18.4**	25.8	33.8	10.27	**4.83**	**6.87**	12.8	10.5	7.3	0.72	0.71	0.67

(Baessler 2008)

Species richness *vs* landscape structure and land-use intensity

Arable fields (Arable weeds)



Each habitat patch outside of the fields poses potential for enhancement of 'arable weeds' diversity – source-sink relationships (WAGNER & EDWARDS 2006), neighbourhood effects (DUNNING *et al.* 1992)

Decreasing number of 'arable weeds' with increasing nitrogen applications

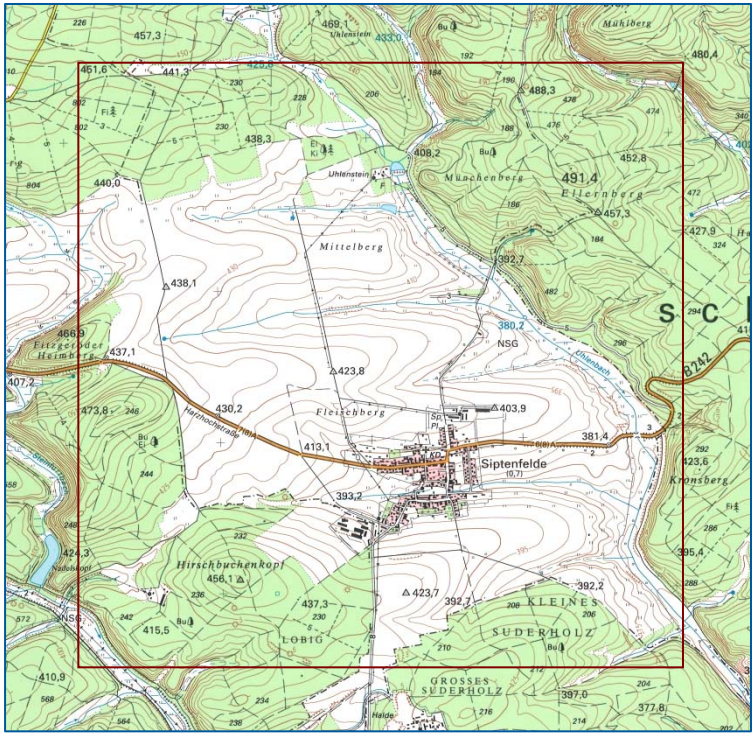
Ruderal species are nowadays most abundant on arable fields – indicators of human impact (HILL *et al.* 2002)

(Baessler 2008)

Biodiversity and ecosystem function research

Assessment targets

- Land use and landscape structure (based on GIS)
- Soil (type, depth, quality, water retention)
- Vegetation analyses (145 permanent plots - composition, productivity, functional types)
- Organism groups (protocols of EU projects BIOASSESS and GREENVEINS)
  - Vascular plants → primary producers (overall biodiversity indicators)
  - Bees, Hoverflies → important pollinators (ecosystem service agents)
  - Butterflies → popular indicators for habitat quality, pollinators (*TMD – Tagfalter Monitoring*)
  - Birds → highly mobile, sensitive to landscape context, integrative on landscape scale
- Genetic variation of selected species (microevolution; sensitive to landscape structure and land use intensity)



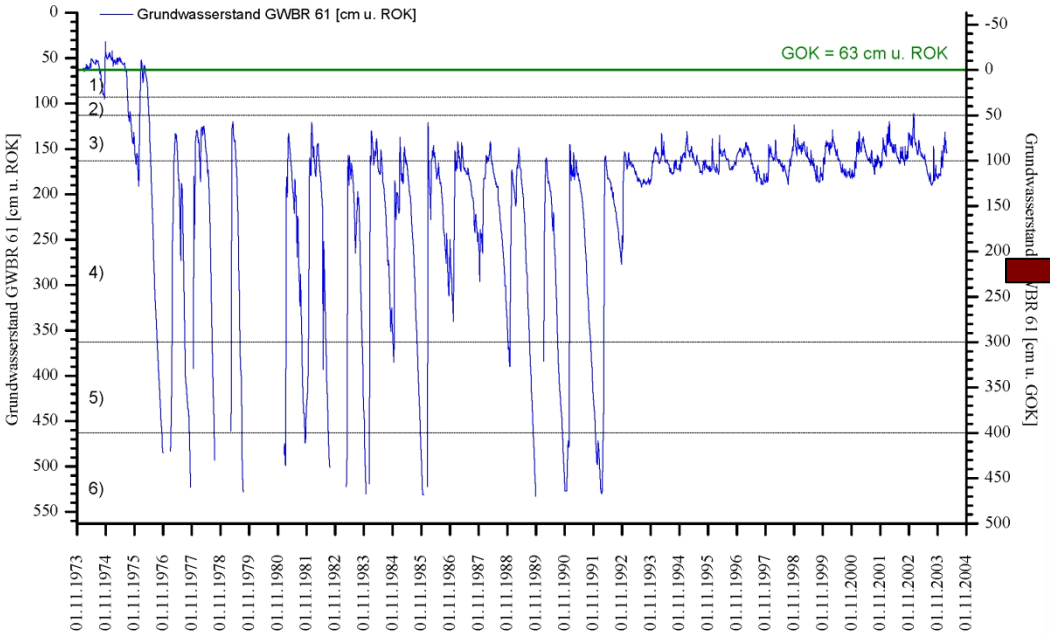
Schäferbachtal – extend of biodiversity site

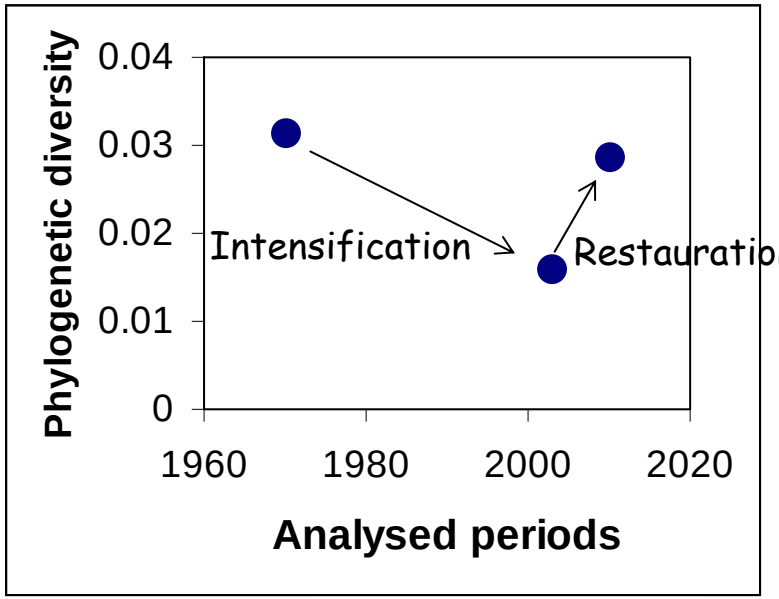
TERENO
TERRESTRIAL ENVIRONMENTAL OBSERVATORIES

Biodiversity and ecosystem functions at local level (Schäferbachtal)

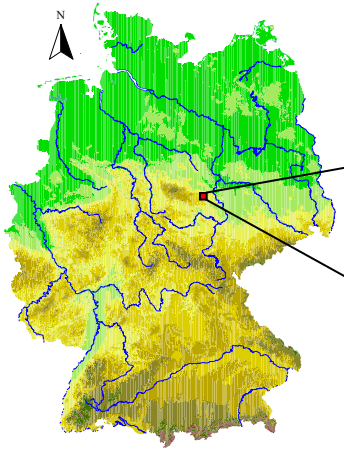
- Cooperation with University of Magdeburg/Stendal (Prof. F. Reinstorf)
- Diploma thesis 2010/2011 Thomas Bölsche (University of Leipzig):

  "Biodiversity changes influenced by hydrological conditions and fertilizer applications"
- Permanent plots – annual investigations





Changes in Ecosystem services



Changes in landscape structure and fertilizer applications

Policy (EU, national)

Land-use intensity

Biodiversity

Ecosystem function

Ecosystem services

Social, Environmental and Economic value

Pressure:

landscape structure

fertilizer applications

Soil conditions

Water balance

Species composition (traits)

Soil erosion

Water quality

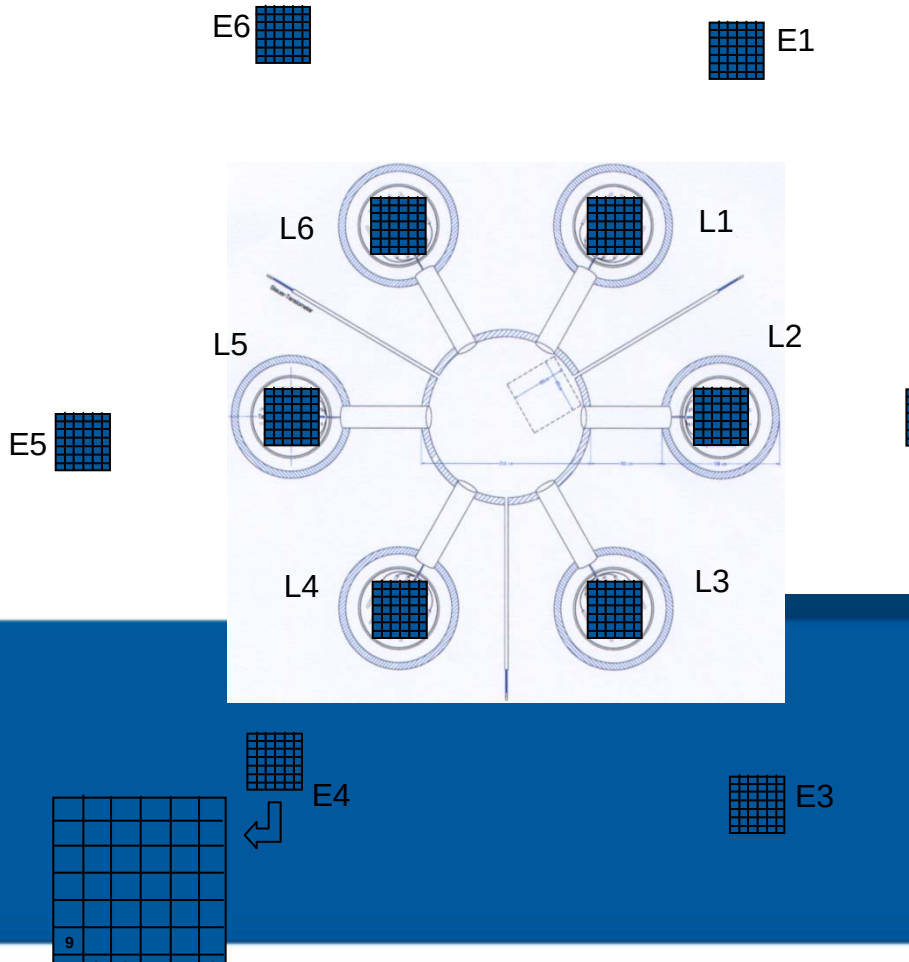
Species – Gene pool

Pollination

HELMHOLTZ CENTRE FOR ENVIRONMENTAL RESEARCH – UFZ

Baessler 2008

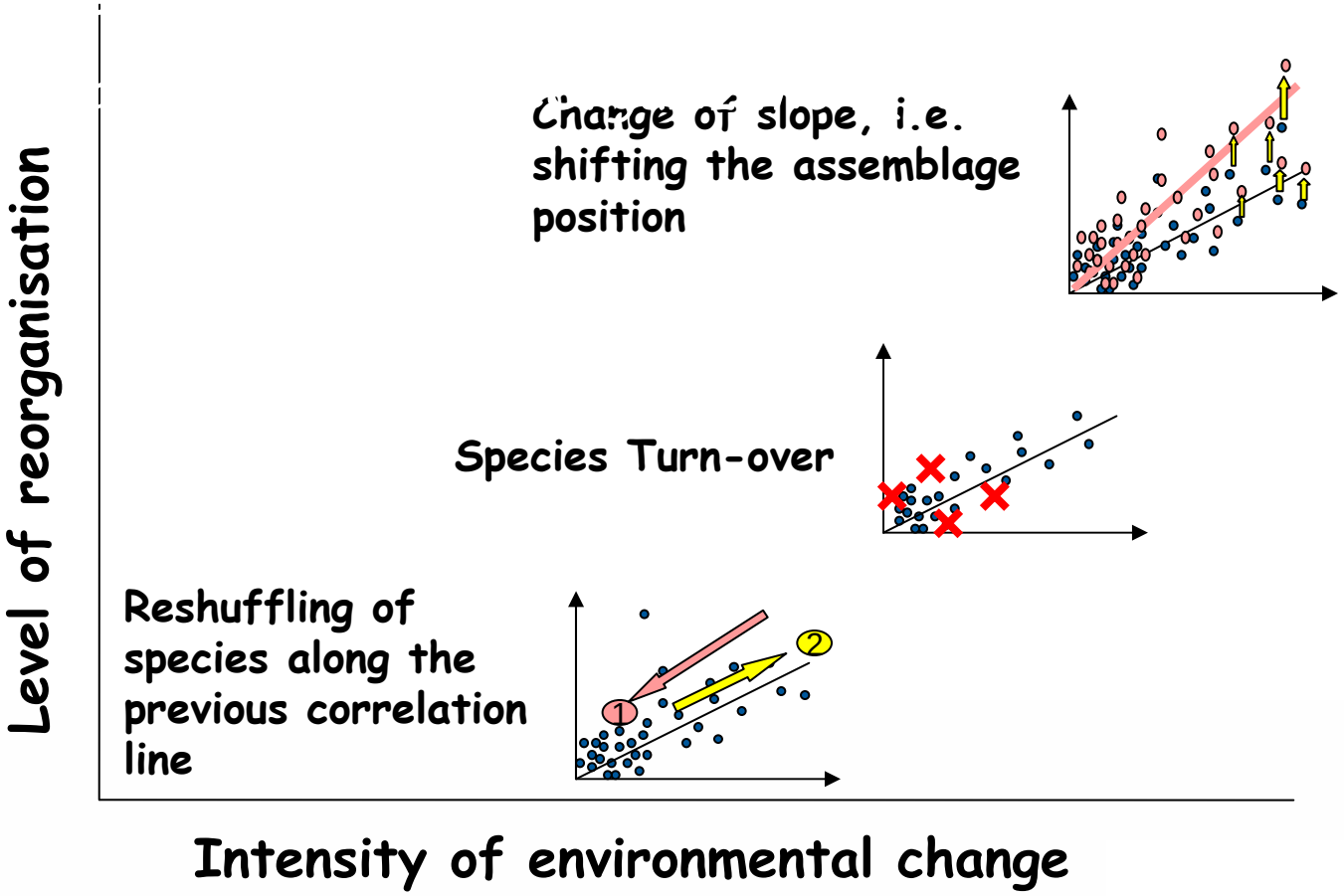
➢ **Assessment** of (changes in) biodiversity and its functioning in local and regional context along environmental gradients (temperature, precipitation)



Start 2010 (Diploma thesis Sebastian Jank, University Bonn):

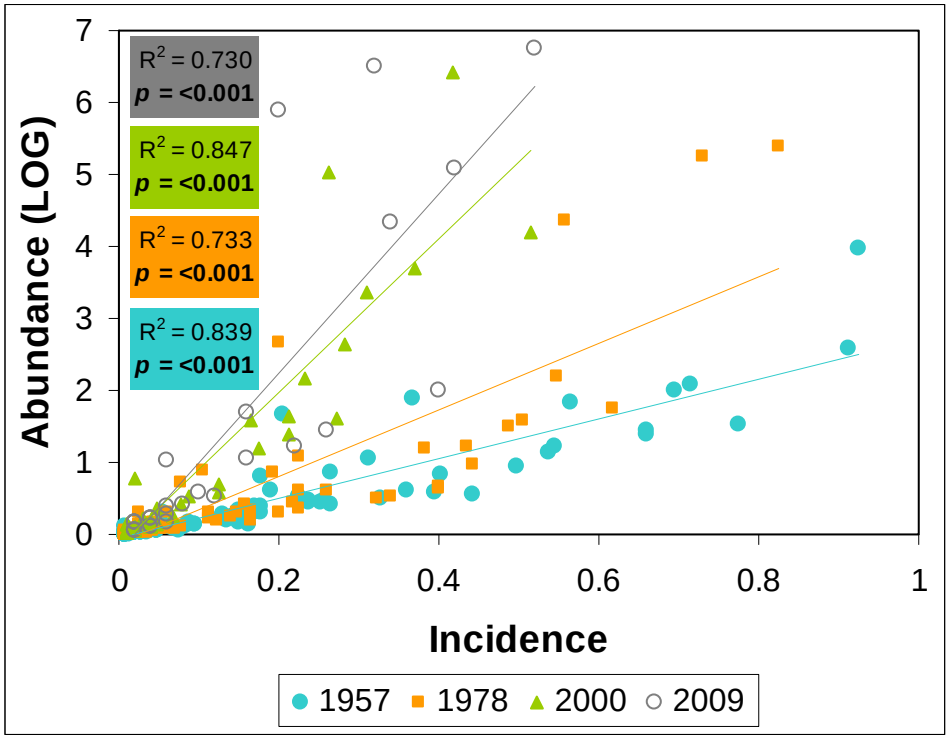
- Quadrates inside and outside 80x80 cm
- Raster = 10x10 cm
- presence-absence of each species per raster

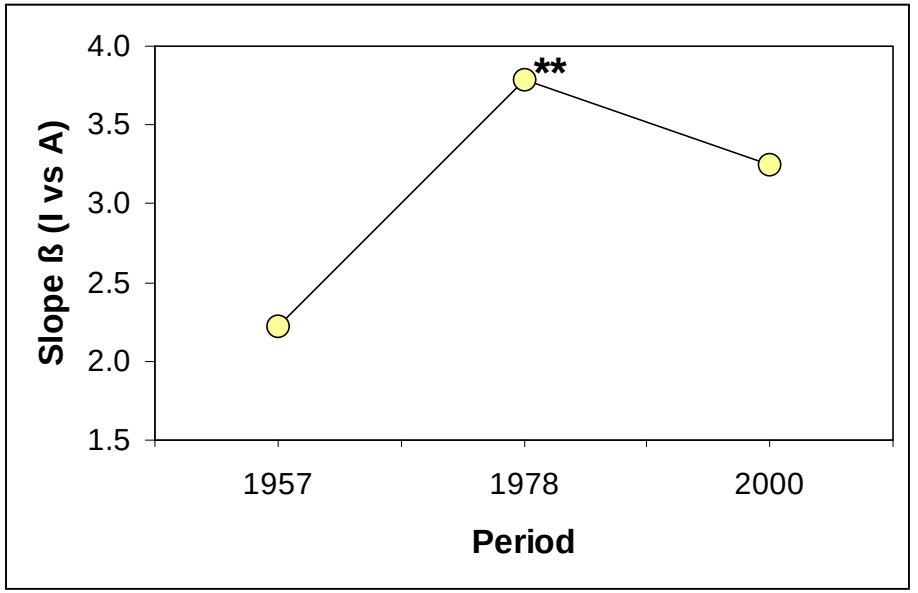
Reorganisation of assemblages as an indication of environmental changes



Incidence-Abundance – Arable fields
TERENO site Friedeburg

Incidence-Abundance for habitats without dominance of phanerophytes



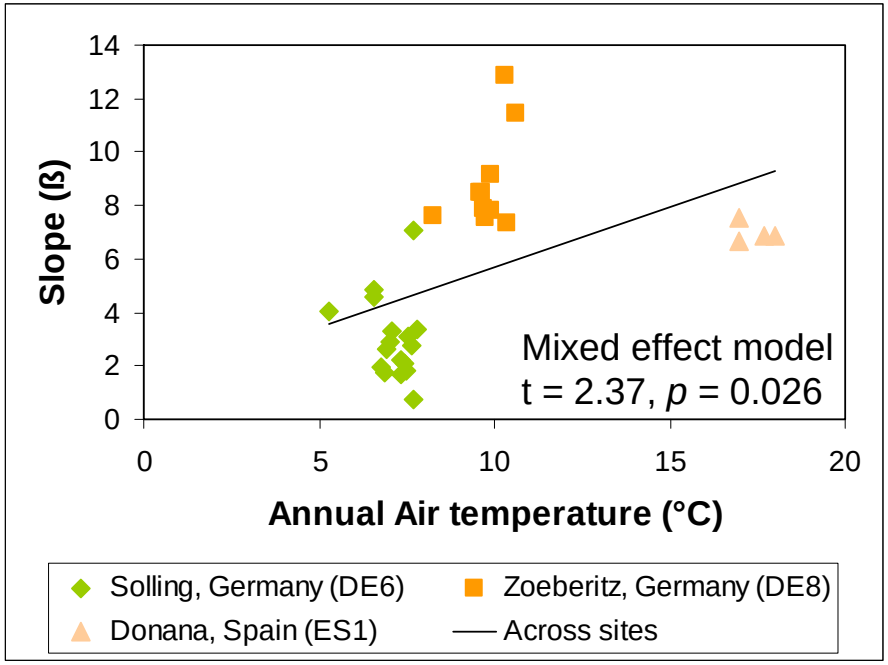


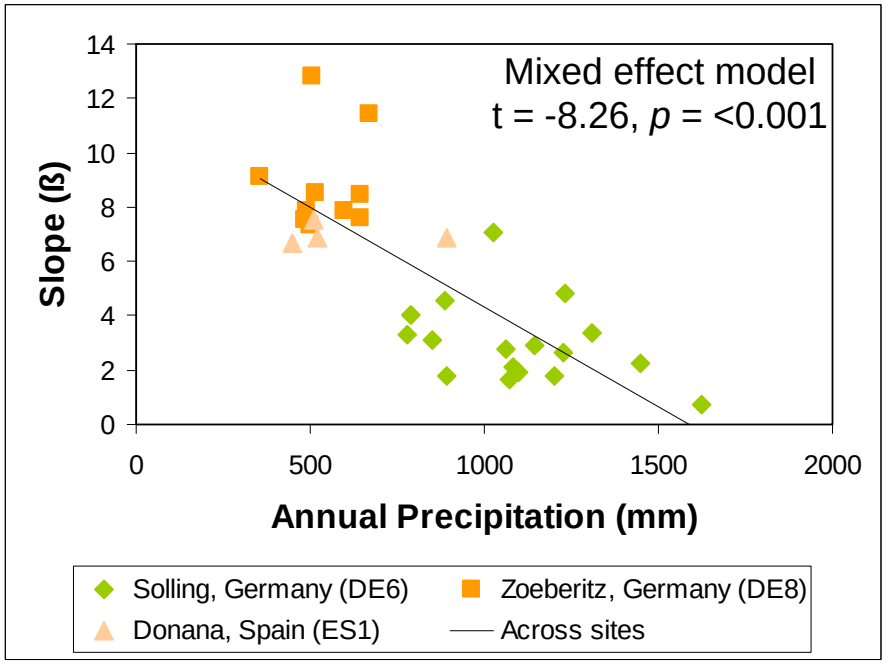
- Changes in I-A relationships because of changes in land-use intensity and landscape structure

Baessler et al. 2009

Respons of plant community structure to environmental variation

- Results of mixed effect models showing the effects of (a) annual air temperature temperature and (b) annual precipitation on the Incidence-Abundance slopes across time and across three European LTER sites, taking into account the effects of the other climatic parameters in the models.
- Next step: Including all LTER sites into the model, analysing the effects of environmental factors on community organisation across and within different habitat types.





TERENO in a wider context

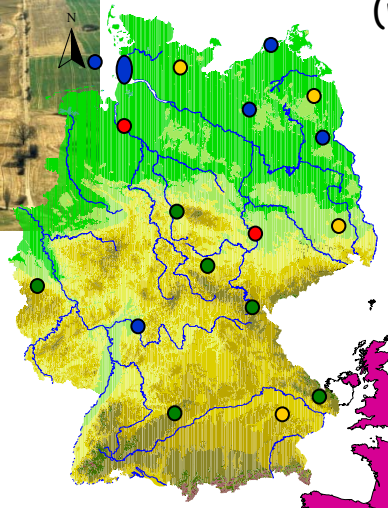
TERENO

TERRESTRIAL ENVIRONMENTAL OBSERVATORIES

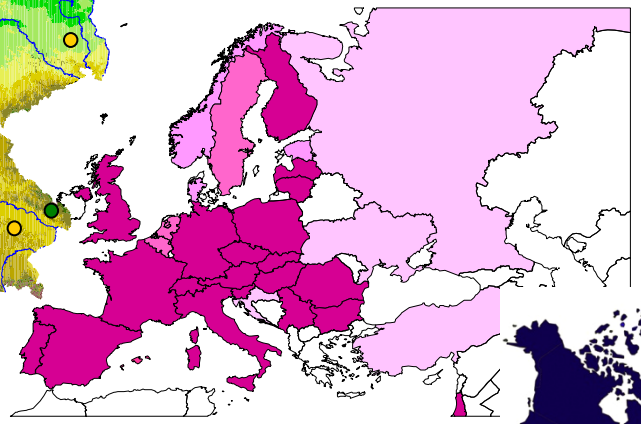
Global Network LTER
Long-Term Ecological Research

local LTER sites

National LTER Networks
(www.lter-d.ufz.de)

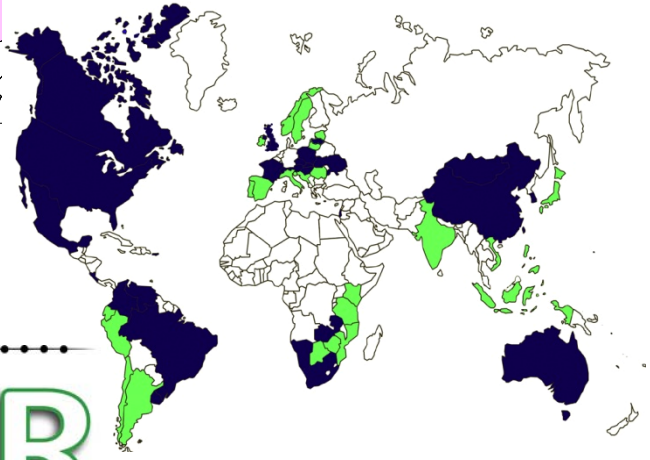


Regional LTER Networks



LTER europe

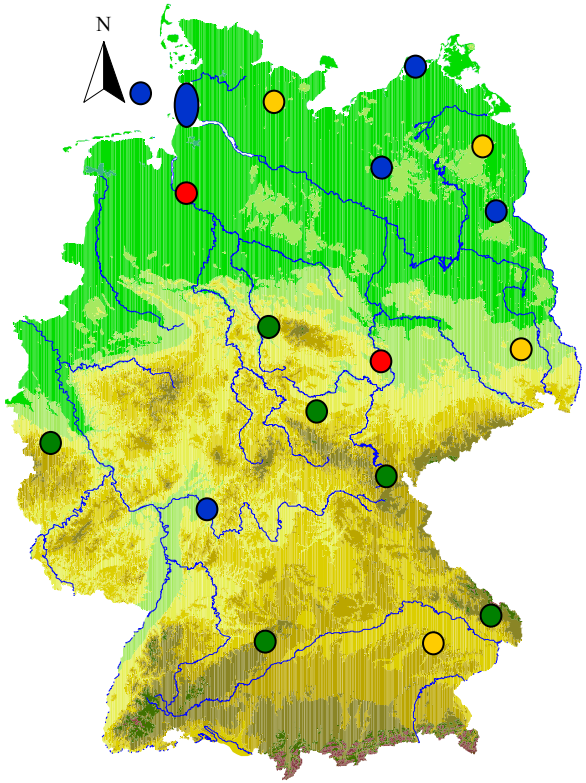
Global - ILTER



Networks of scientists
engaged in long-term,
site-based ecological and
socioeconomic research

ILTER

LTER-D: Organization



- Aquatic
- Agriculture
- Urban
- Forest

LTER-sites: 18
Members: 28

- Universities (Ecosystem research)
- National Parks, Biosphere Reserves
- Research projects (e.g. DFG-Exploratories for functional biodiversity research)
- State Research Centres (e.g. Leibniz Association; Helmholtz Association of German Research Centres, TERENO)

➢ Annual meeting

Global Network LTER
Long-Term Ecological Research

Mission

• improve understanding of global ecosystems and inform solutions to current and future environmental problems

Aims & Objectives

• promote collaboration and cooperation among ecological researchers and research networks at different spatial scales

• improve comparability of long-term ecological data, and facilitate exchange and preservation of this data (EnvEurope on European level)

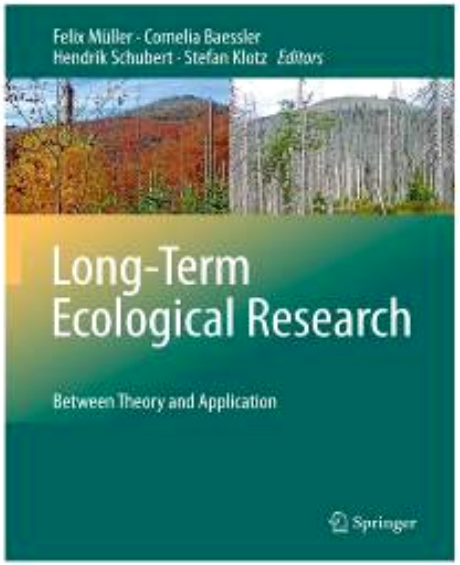
• deliver scientific information to scientists, policymakers, and the public and develop best ecosystem management practices to meet the needs of decision-makers at multiple levels

• facilitate education of the next generation of long-term scientists

LTER-D: Book-project

Springer
the language of science

springer.com



F. Müller, University of Kiel, Germany; C. Baessler, Helmholtz Centre for Environmental Research UFZ, Halle, Germany; H. Schubert, University of Rostock, Germany; S. Klotz, Helmholtz Centre for Environmental Research UFZ, Halle, Germany (Eds.)

Long-Term Ecological Research

Between Theory and Application

Ecosystems change on a multitude of spatial and temporal scales. While analyses of ecosystem dynamics in short timespans have received much attention, the impacts of changes in the long term have, to a great extent, been neglected, provoking a lack of information and methodological know-how in this area. This book fills this gap by focusing on studies dealing with the investigation of complex, long-term ecological processes with regard to global change, the development of early warning systems, and the acquisition of a scientific basis for strategic conservation management and the sustainable use of ecosystems. Within this book, theoretical ecological questions of long-term processes, as well as an international dimension of long-term monitoring, observations and research are brought together. The outcome is an overview on different aspects of long-term ecological research. Aquatic, as well as terrestrial ecosystems are represented.... *more on http://springer.com/978-90-481-8781-2*

2010. Approx. 360 p. Hardcover

ISBN 978-90-481-8781-2

→ Published July 2010

EU-Projects with participation of TERENO

- EnvEurope = **Env**ironmental quality and pressures assessment across **Europe**: the LTER network as an integrated and shared system for ecosystem monitoring (01.2010-12.2013)
- EXPEER = Distributed Infrastructure for **EXPE**rimentation in **E**cosystem **R**esearch (FP7; 12.2010-11.2014; UFZ – 630.000€; Dep. BZF, Monitoring- und Erkundungstechnologien, Bodenökologie)
- LifeWatch Initiative

Thank you very much
for you attention!