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Biodiversity observations: Why and what?

- WHY? Organisms as indicators at high integration levels (reacting to abiotic and biotic parameters)
  - Habitat quality
  - Ecosystem services (e.g. food production, pollination)

- WHAT? Different levels of biodiversity: Diversity of ...
  - ecosystems, habitats
  - species (occurrence, abundance)
  - functional relationships (species traits)
  - population genetics (within species)

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Examples of candidate Essential Biodiversity Variables

EBV class	EBV examples	Measurement and scalability	Temporal sensitivity	Feasibility	Relevance for CBD targets and indicators (*1,9*)
Genetic composition	Allelic diversity	Genotypes of selected species (e.g., endangered, domesticated) at representative locations.	Generation time	Data available for many species and for several locations, but little global systematic sampling.	Targets: 12, 13. Indicators: Trends in genetic diversity of selected species and of domesticated animals and cultivated plants; RLI.
Species populations	Abundances and distributions	Counts or presence surveys for groups of species easy to monitor or important for ES, over an extensive network of sites, complemented with incidental data.	1 to >10 years	Standardized counts under way for some taxa but geographically restricted. Presence data collected for more taxa. Ongoing data integration efforts (Global Biodiversity Information Facility, Map of Life).	Targets: 4, 5, 6, 7, 8, 9, 10, 11, 12, 14, 15. Indicators: LPI; WBI; RLI; population and extinction risk trends of target species, forest specialists in forests under restoration, and species that provide ES; trends in invasive alien species; trends in climatic impacts on populations.
Species traits	Phenology	Timing of leaf coloration by RS, with in situ validation.	1 year	Several ongoing initiatives (Phenological Eyes Network, PhenoCam, etc.)	Targets: 10, 15. Indicators: Trends in extent and rate of shifts of boundaries of vulnerable ecosystems.
Community composition	Taxonomic diversity	Consistent multitaxa surveys and metagenomics at select locations.	5 to >10 years	Ongoing at intensive monitoring sites (opportunities for expansion). Metagenomics and hyperspectral RS emerging.	Targets: 8, 10, 14. Indicators: Trends in condition and vulnerability of ecosystems; trends in climatic impacts on community composition.
Ecosystem structure	Habitat structure	RS of cover (or biomass) by height (or depth) globally or regionally.	1 to 5 years	Global terrestrial maps available with RS (e.g., Light Detection and Ranging). Marine and freshwater habitats mapped by combining RS and in situ data.	Targets: 5, 11, 14, 15. Indicators: Extent of forest and forest types; mangrove extent; seagrass extent; extent of habitats that provide carbon storage.
Ecosystem function	Nutrient retention	Nutrient output/input ratios measured at select locations. Combine with RS to model regionally.	1 year	Intensive monitoring sites exist for N saturation in acid-deposition areas and P retention in affected rivers.	Targets: 5, 8, 14. Indicators: Trends in delivery of multiple ES; trends in condition and vulnerability of ecosystems.

H M Pereira et al. Science 2013;339:277-278

Science
AAAS

Biodiversity approach of the UFZ in TERENO

- **Landscape structure** - types of land use, land use intensity, configuration, fragmentation
- **Soil** - type, depth, quality, water retention
- **Vegetation analyses** - composition, productivity
- **Monitoring of selected organisms groups**
  - **Vascular plants** ⇨ Primary producers (overall biodiversity indicators)
  - **Bees** ⇨ Important pollinators (ecosystem service agents)
  - **Butterflies** ⇨ Indicators for habitat quality, pollinators (TMD)
  - **Hoverflies** ⇨ Important pollinators (ecosystem service agents)
  - **Birds** ⇨ Highly mobile, sensitive to landscape context, integrative on landscape scale
- **Genetic** variation of selected species, microevolution

Bundesministerium für Bildung und Forschung

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[Farmland] Bird abundance in Central Germany: Trend analysis based on species traits and land use

Mark Frenzel, Jeroen Everaars, Oliver Schweiger
Helmholtz Centre for Environmental Research - UFZ
Dept. Community Ecology

TERENO International Conference, Bonn (29 Sept - 2 Oct 2014)

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Why study birds in farmlands?

- Farmland (landscapes dominated by agricultural use) **dominating land use type** in Central Germany
- **Declining biodiversity** in farmlands (intensification, crops grown)
- **European Union agri-environmental indicator** ⇨ population trends of farmland birds
- Biodiversity monitoring within the **long-term** project TERENO ⇨ investigation of local bird communities in “normal“(= agricultural) landscapes

...still analysis in progress

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Guiding questions

How does the proportion of arable fields (= land use) in landscapes affect

Q1: …bird **occurrence**?

Q2: …number of **territories**?

Q3: …**specialist** (e.g. farmland birds) and **generalist** species?

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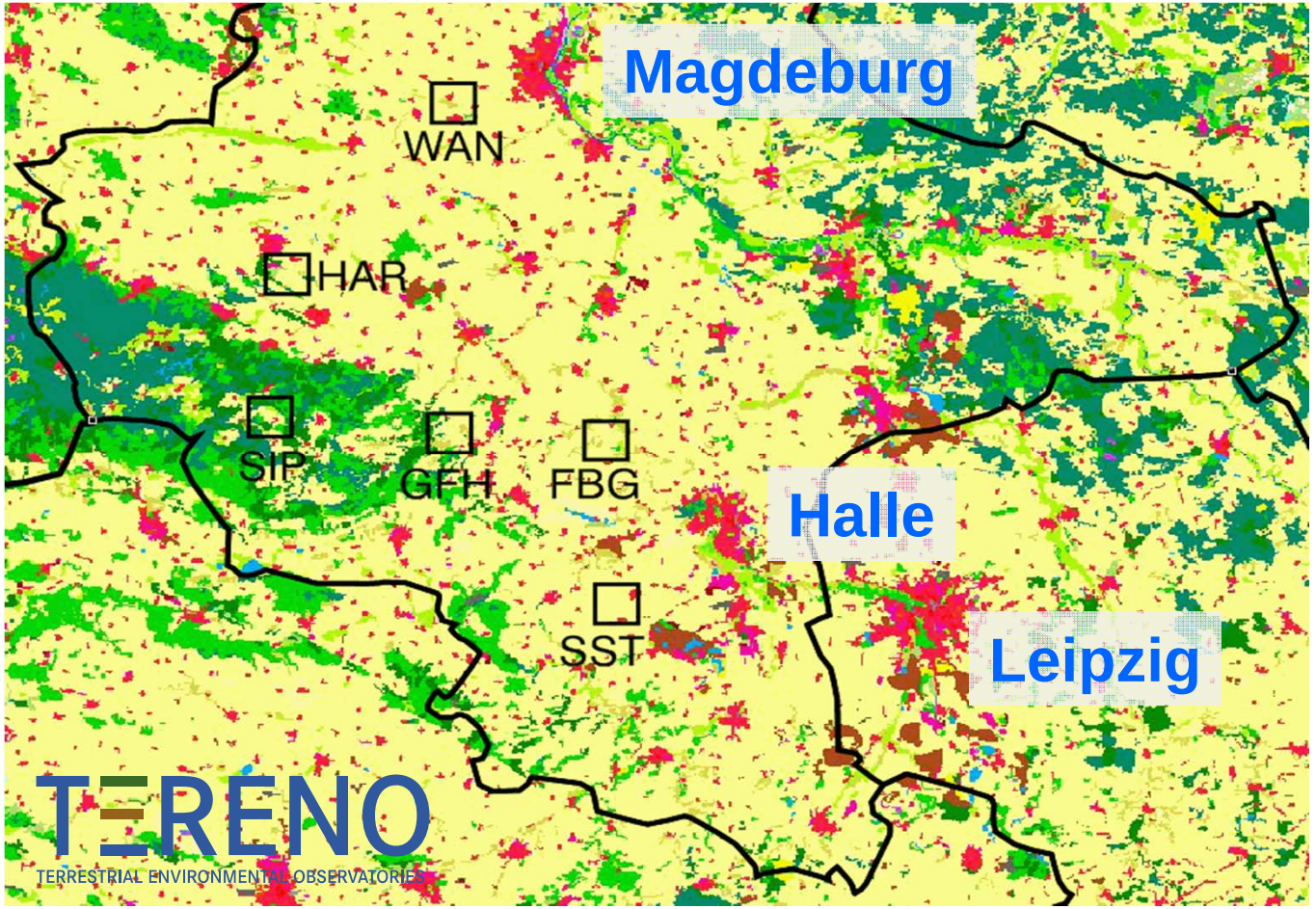
Site locations in Saxony-Anhalt



CORINE land cover map

- Arable land
- Broad-leaved forest
- Coniferous forest

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Site characteristics

	WAN	HAR	SIP	GFH	FBG	SST
Crop fields (%)	78	65	45	74	71	97
Forest (%)	3	14	35	11	4	0.4
Grassland (%)	4	1	10	8	10	0.4
Elevation (ASL)	100-120	120-160	360-460	220-300	65-150	160-190
Annual mean temp. (ºC)	8.8	8.8	6.9	7.9	8.6	8.7

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Bird surveys & additional data

- Point-Stop Counts (singing, calling, seen birds)
- Years: 2001, 2009, 2012, 2013, 2014
  - 3 visits per year: April, May, June
- 4x4 km sites: 2001 (4 sites), since 2009 (6 sites)
  - 20 stopping points per site
- Parameters
  - Species richness (loose or tight habitat connection)
  - n territories (suitable for breeding = tight habitat connection)

ADDED VALUE

- Bird trait database (BioBase 1997, Register biodiversiteit; Centraal Bureau voor de Statistiek, NL)

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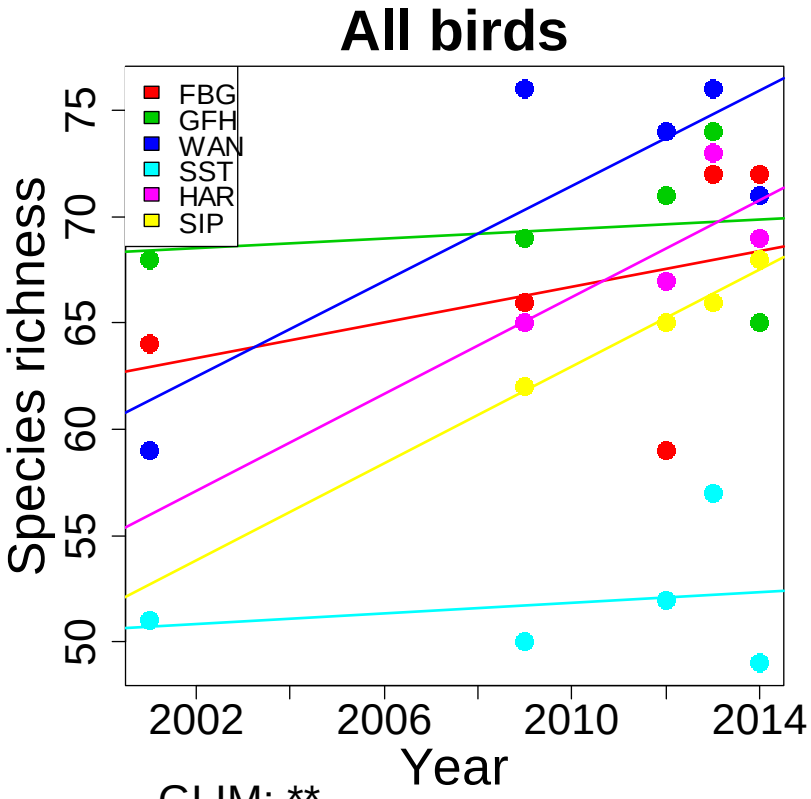
All species: species richness per year and site



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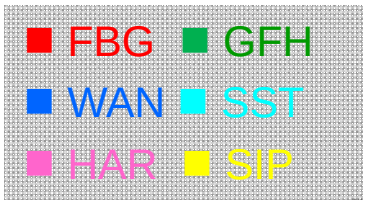
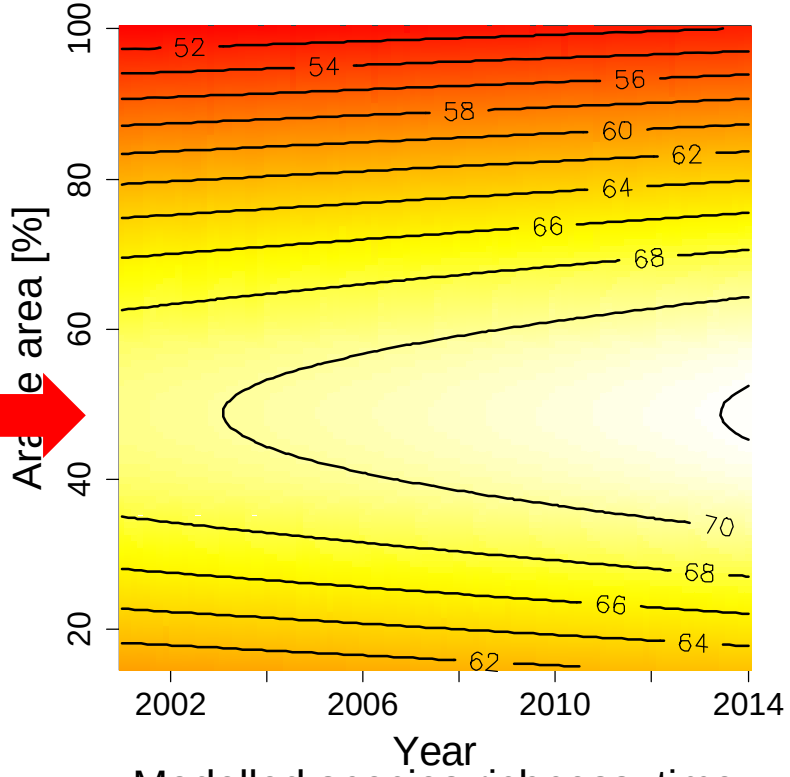


Model: most changes happen at about

50 % arable land cover

POSITIVE TREND



Modelled species richness: time related to arable land proportion

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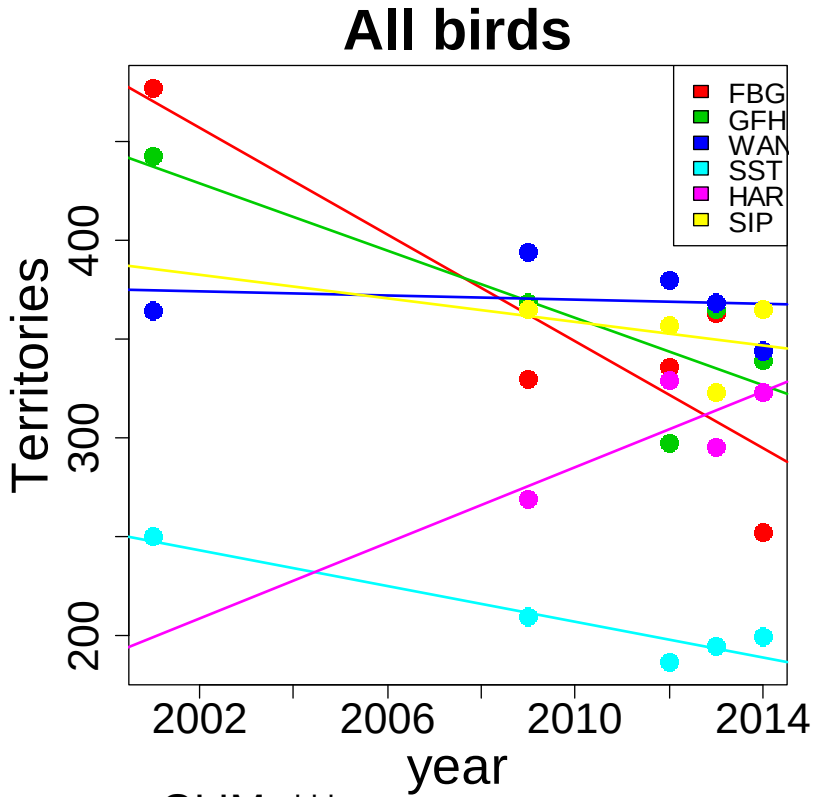
All species: number of territories per year and site



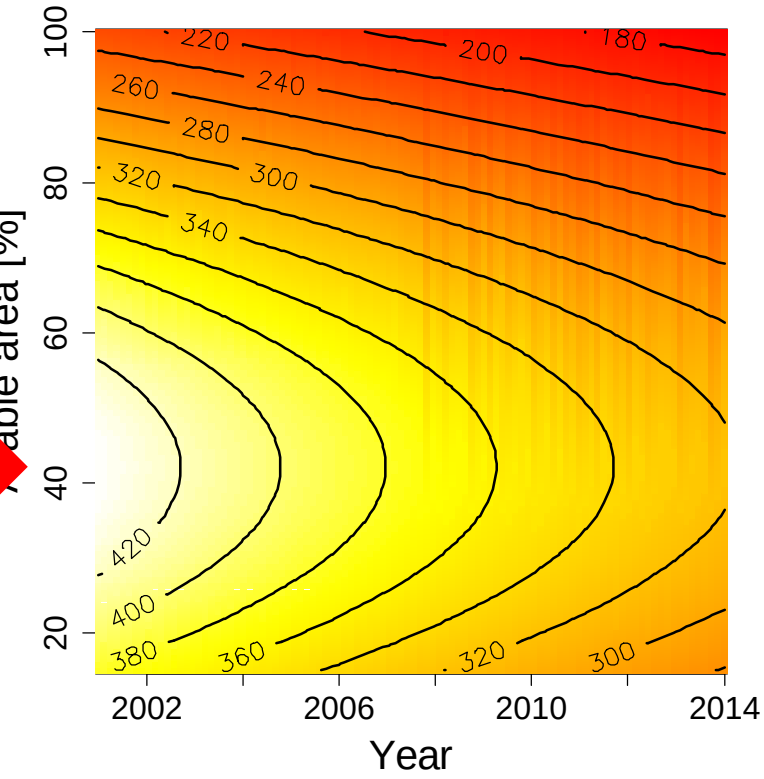
GLIM: ***

FBG GFH
WAN SST
HAR SIP

Model: most changes happen at about

40 % arable land cover

NEGATIVE TREND



Modelled territory numbers: time related to arable land proportion

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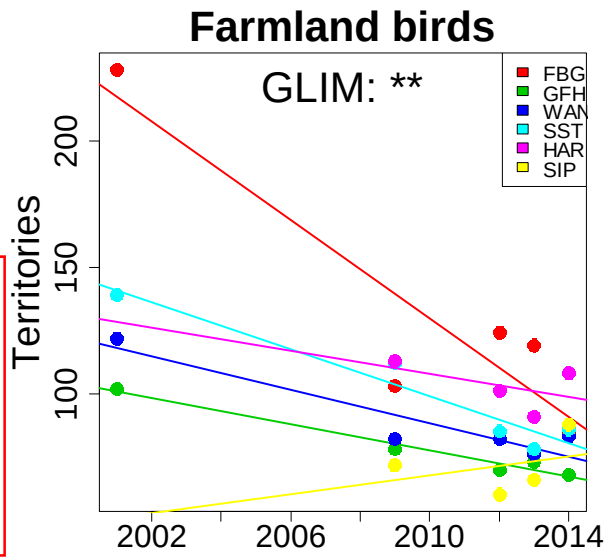
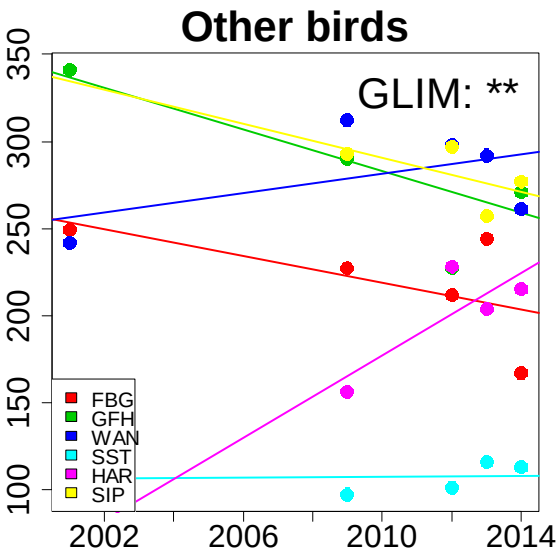
Territories of Farmland (special.) *vs*. Other birds (general.)

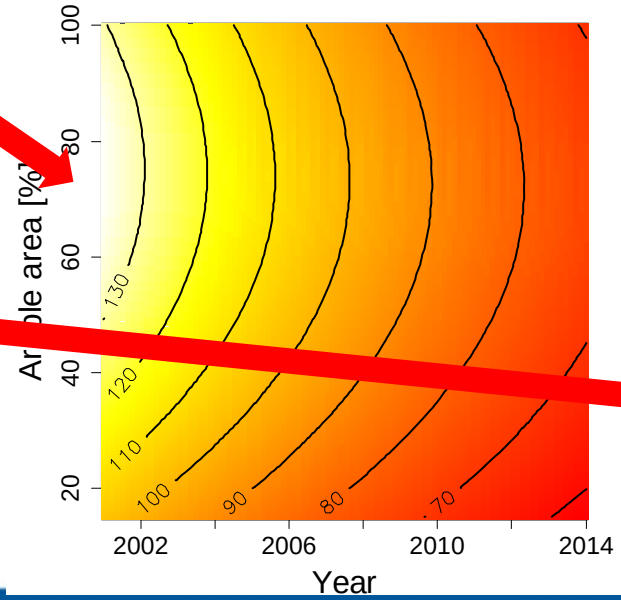
Significant difference Farmland birds vs. Other species: GLIM: ***

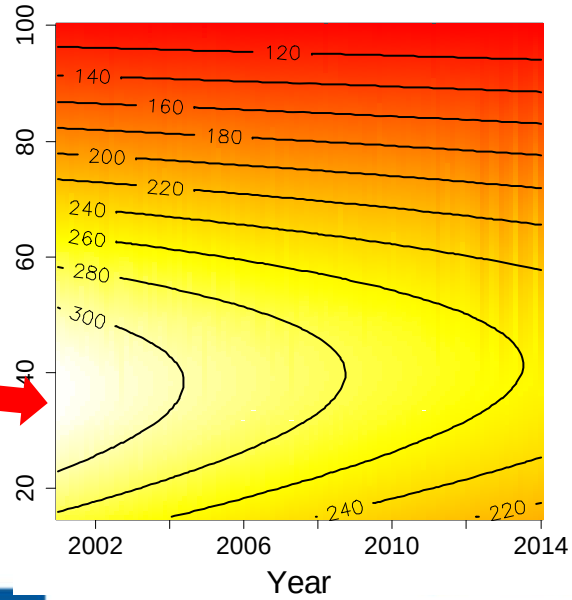
Farmland birds territories
Model: most changes happen at about
70 % arable land cover
STEEP NEGATIVE TREND

Other birds territories
Model: most changes happen at around
40 % arable land cover
SLIGHT NEGATIVE TREND







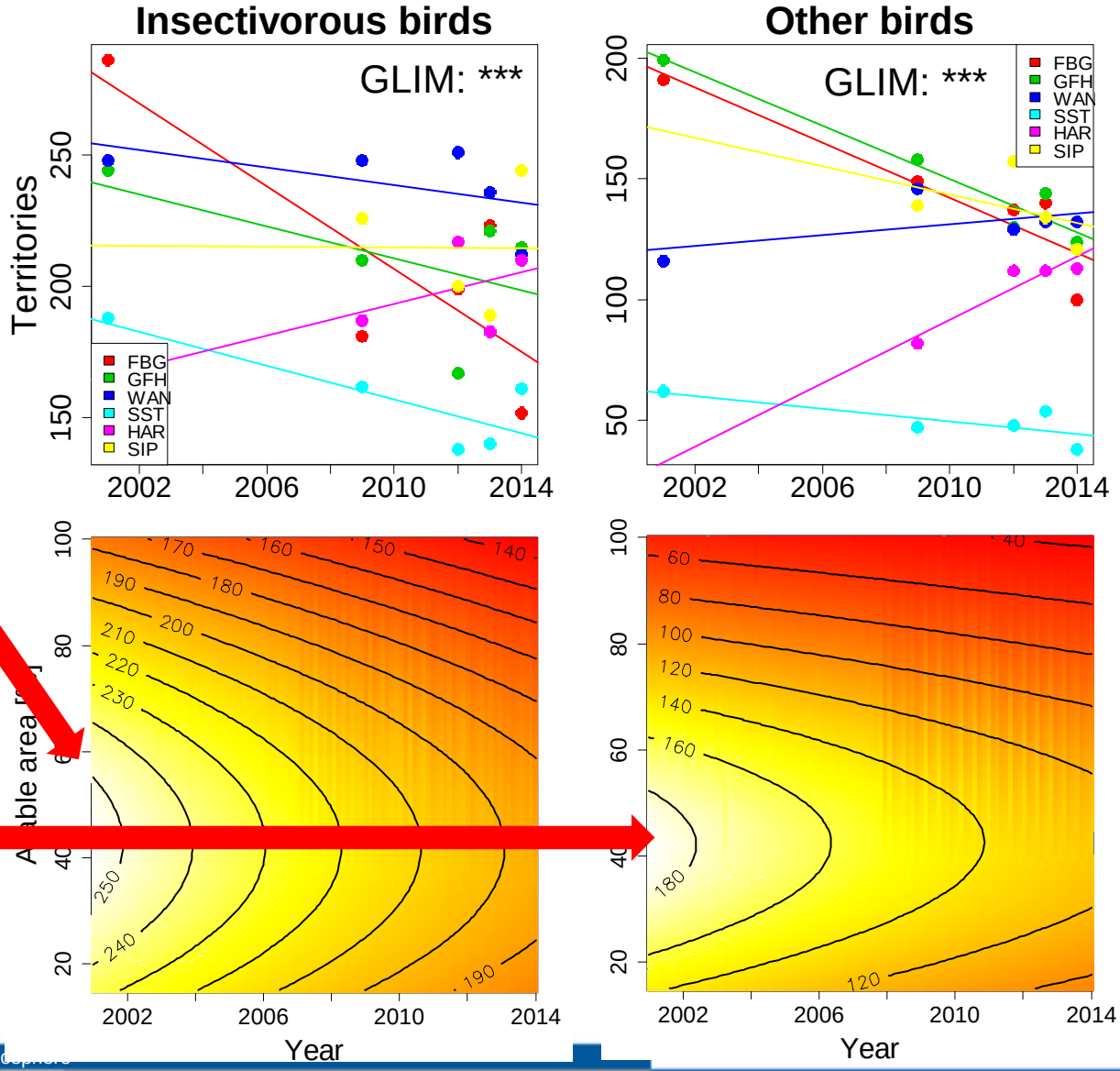


Territories of mainly insect feeders (special.) *vs*. all others

Significant difference Insect feeders vs. Other species: GLIM: ***

Insect feeder territories
Model: most changes happen at about
50 % arable land cover
STEEP NEGATIVE TREND

Other birds territories
Model: most changes happen at arabout
45 % arable land cover
SLIGHT NEGATIVE TREND



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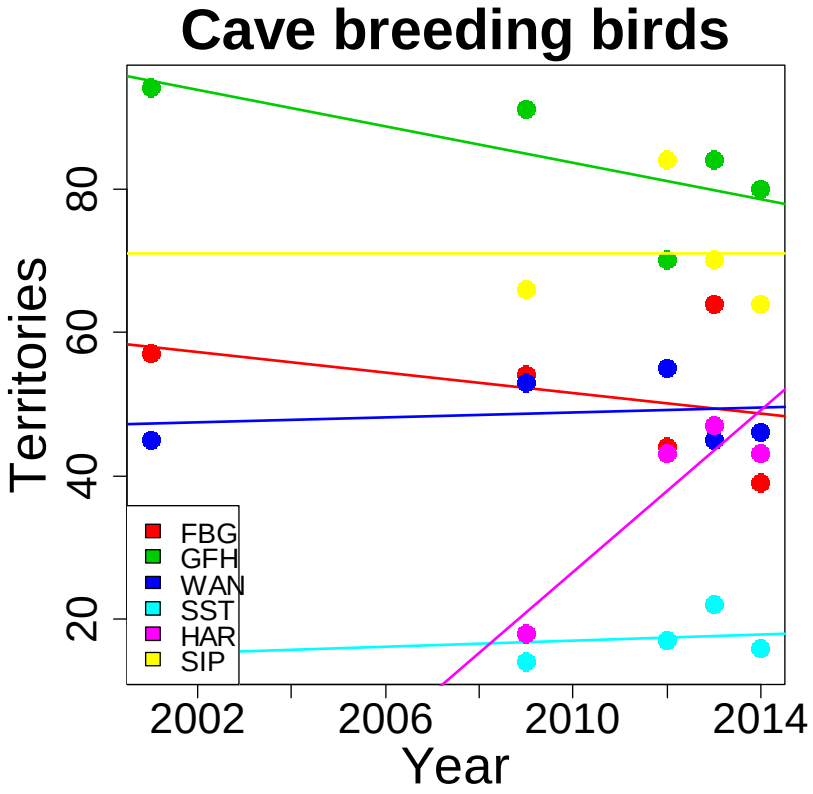
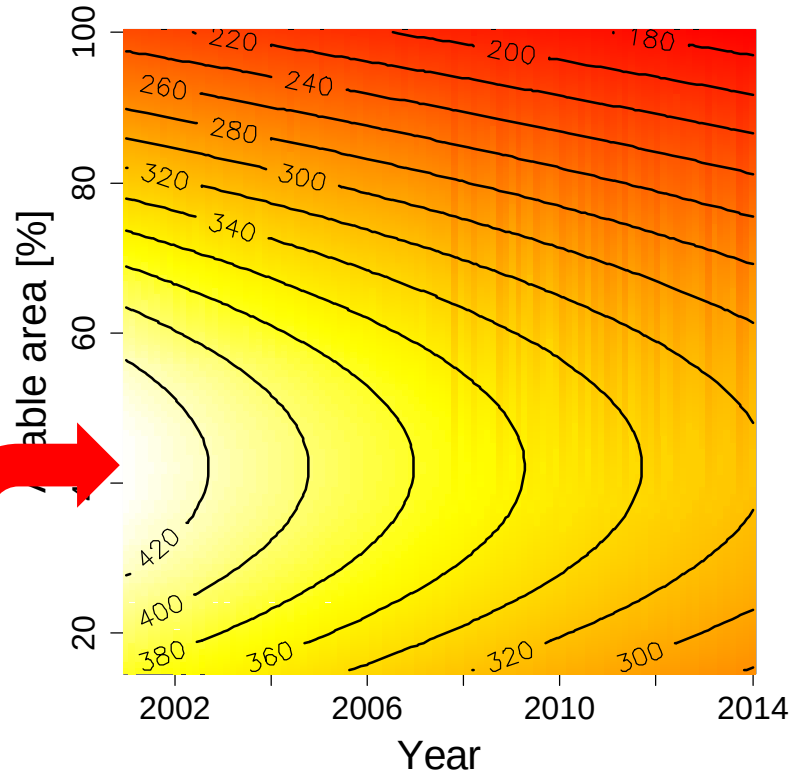
Territories of cave breeding birds (specialists)





GLIM: ***

Model: most changes happen at about

40 % arable land cover

NEGATIVE TREND

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Answers to questions

How does the proportion of arable fields in a landscape affect…

Q1: …bird **occurrence**?

- Good news: positive trend in species richness if arable land coverage is intermediate

Q2: …number of **territories**?

- Bad news: overall decrease in territories, especially at intermdiate levels of arable land coverage

Q3: …**specialist** (farmland birds) and **generalist** (all other) species?

- Bad news: compared to territory numbers of generalists, all specialist categories (farmland birds, mainly insect feeders, cave breeders) decrease even more.

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Conclusions

- The overall **European trend** in a decrease of farmland bird populations is supported by our data
- Regional and local trends may be different. **Site-specific drivers** and community shifts need to be identified.
- Most changes at “intermediate“ arable land cover
- The majority of bad news (decreasing territories) may be related to
  - agricultural **intensification** (pesticide use)
  - **homogenisation** of crops grown (e.g. energy plants)
  - **habitat loss**
- The need for **long-term observations** is emphasized by trends becoming obvious after at least a decade

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- **René Höhne** (Halle) – Field ornithologist & bird ecology expert
- **Authors** of the trait data base **BioBase** (Register biodiversiteit; Centraal Bureau voor de Statistiek, NL, 1997)

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