Bundesministerium für Bildung und Forschung

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TERRESTRIAL ENVIRONMENTAL OBSERVATORIES

Trait-dependent responses of bee communities to land-use and weather

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Starting points

- Declining biodiversity in **agricultural landscapes** (intensification, crops grown)
- Global decline of **pollinators**: Important pollinator group ⇨ wild bees decline with land-use intensity
- Pollination is affected by **species traits**. Land use may filter for specific traits in bee communities
- Biodiversity monitoring within the **long-term** project TERENO ⇨ investigation of local bee communities in “normal“(= agricultural) landscapes

... still analysis in progress

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What we wanted to know

Q1: What are the **main drivers** for bee occurrence? Weather conditions or land use intensity?

Q2: Do **intensively used areas** have fewer bees (species; individuals)?

Q3: Do responses of bees to land use depend on **bee traits** (e.g. body size, nesting behaviour, sociality)?

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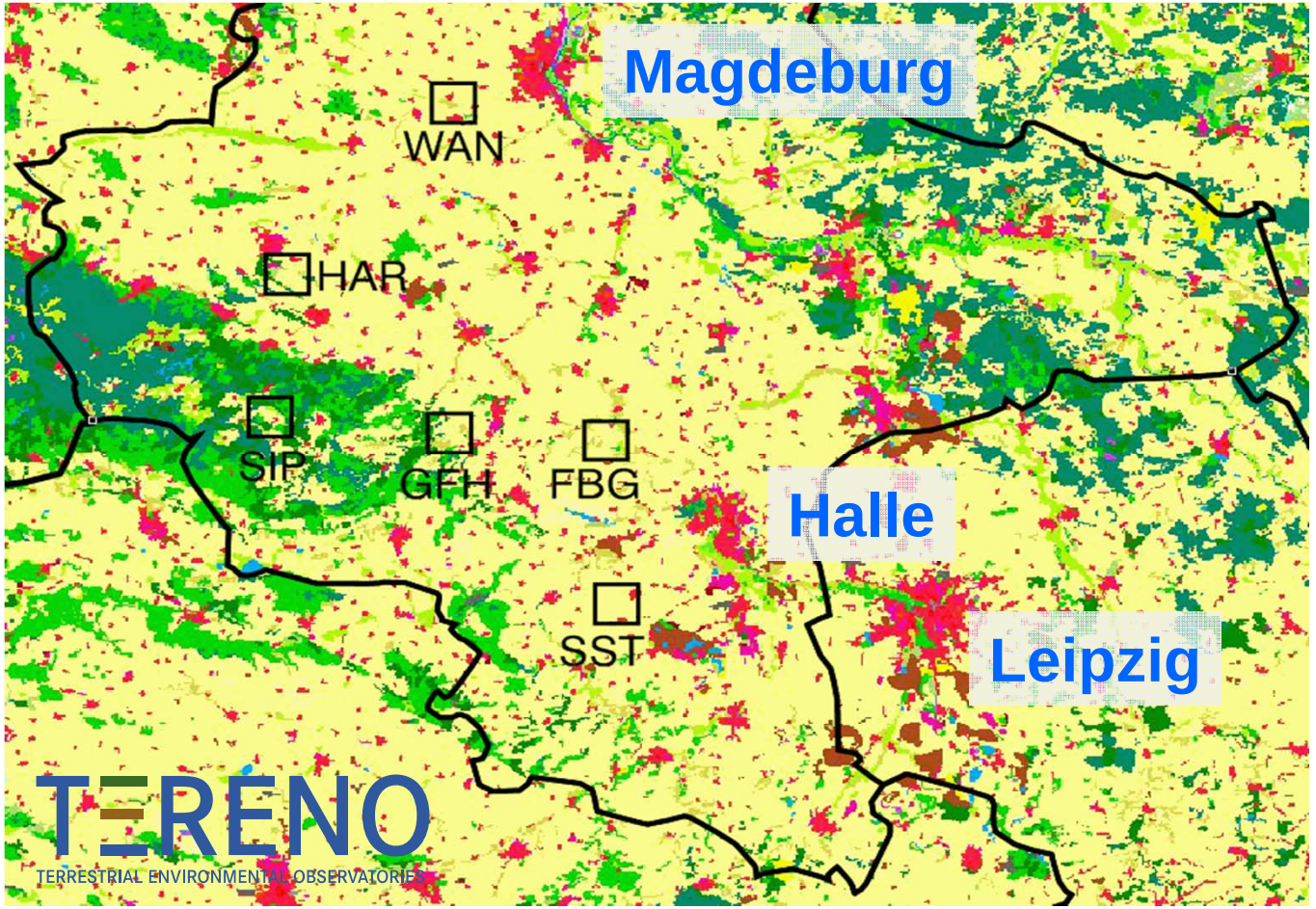
Site locations in Saxony-Anhalt



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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Bee sampling and additional data

SAMPLES

- yellow flight interception traps
- 2010, 2011, 2012 (ongoing)
- Collection: 3x spring, 3x summer
- 6 sites (4x4 km)
  - 16 traps per site (Σ 96 traps)
  - Σ 576 samples per year

ADDITIONAL DATA

- Bee trait database (STEP, University of Reading)
- local land use (200 m radius)
- regional weather (DWD, daily)

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Bee numbers & proportions (without honey bees)

	All	WAN	HAR	SIP	GFH	FBG	SST
Individuals	28528	4163	(4669)	**(2348)**	2635	**8482**	6231
Richness	254	148	**179**	**103**	152	175	140
Diversity (H')	3.94	3.48	3.75	3.55	**3.97**	3.70	3.34
% Small bees	41	36	35	32	34	**56**	36
% Eusocial	42	42	**54**	38	43	49	**20**

Central Germany: Hot spot for species richness of bees!

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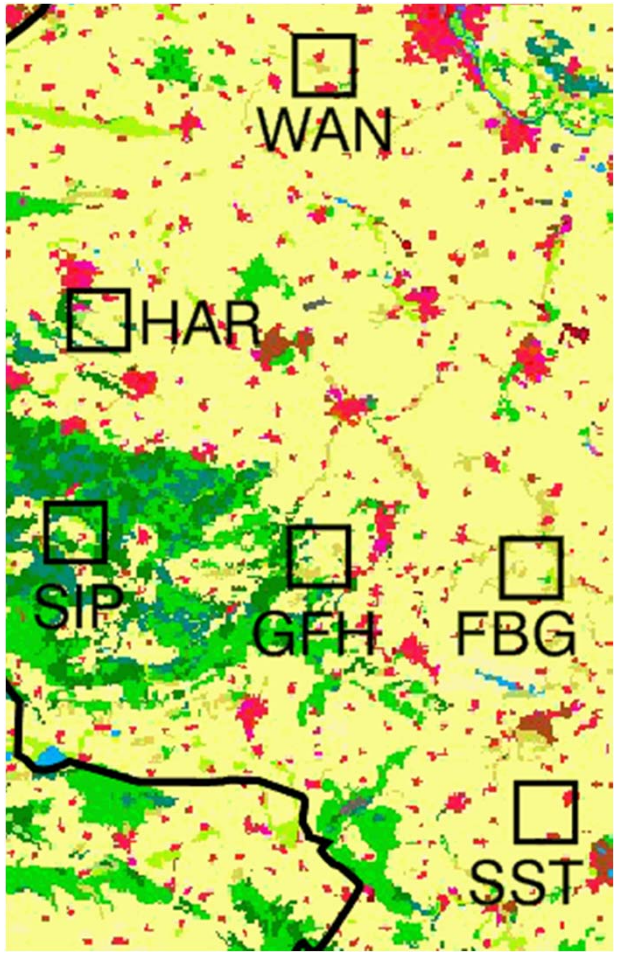
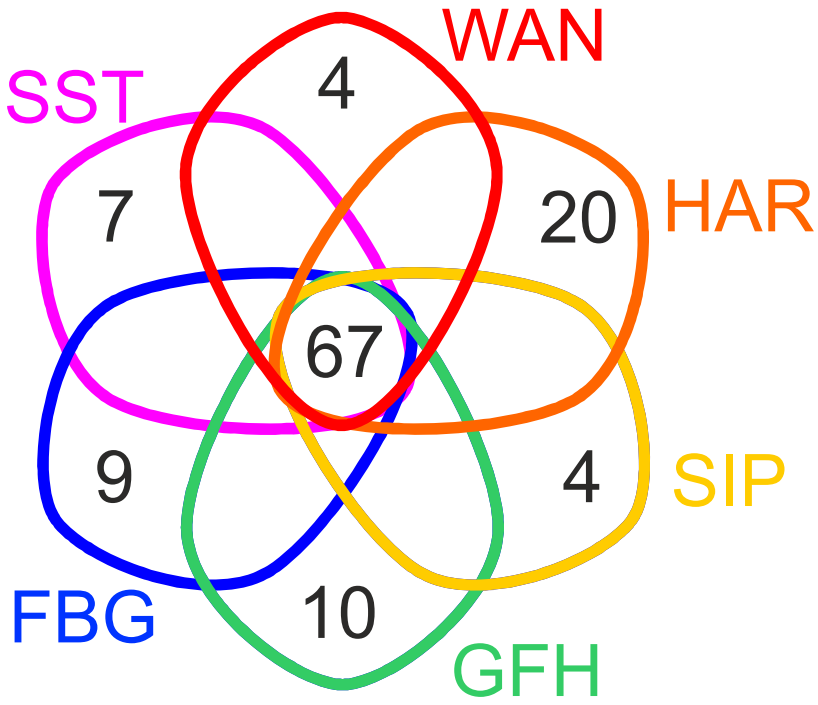
Sites: Shared and unique species





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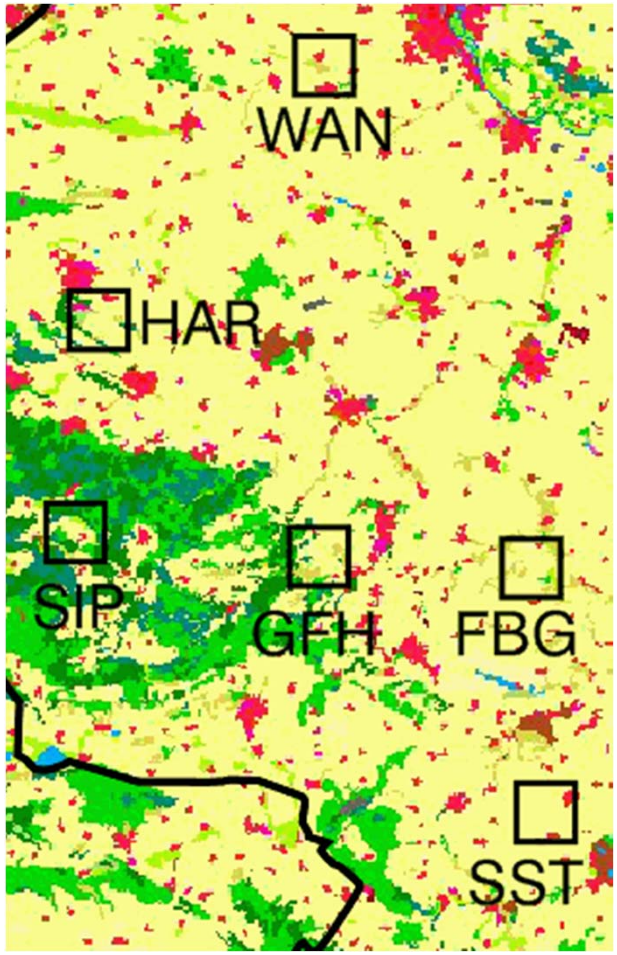
Seasons: Shared and unique species



	Spring	shared	Summer
WAN	77	54	18
HAR	85	68	27
SIP	47	40	17
GFH	70	60	23
FBG	83	77	16
SST	78	53	10

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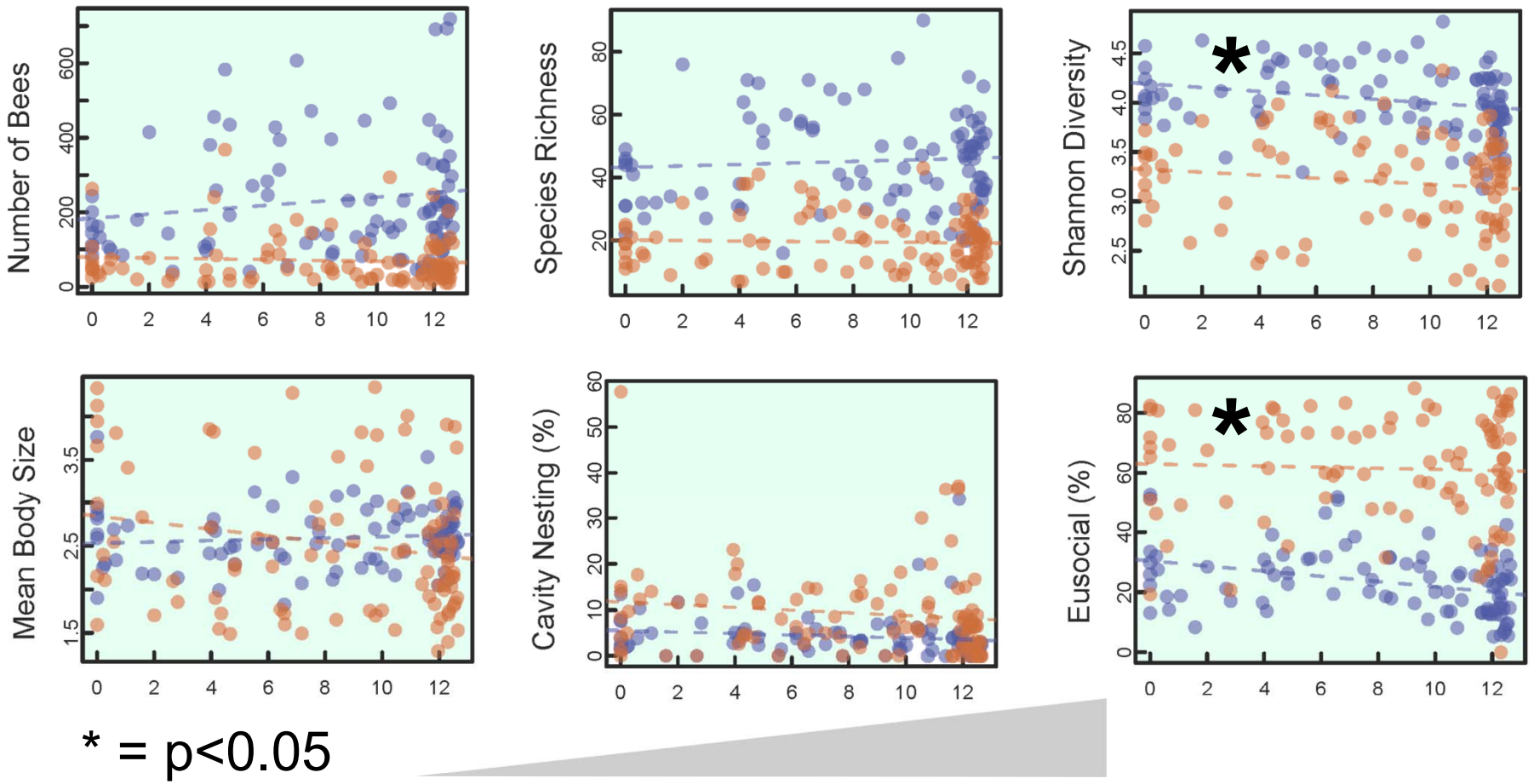
Bee community response to arable land size



* = p<0.05

■ Spring and ■ Summer communities

Local scale (200 m radius)

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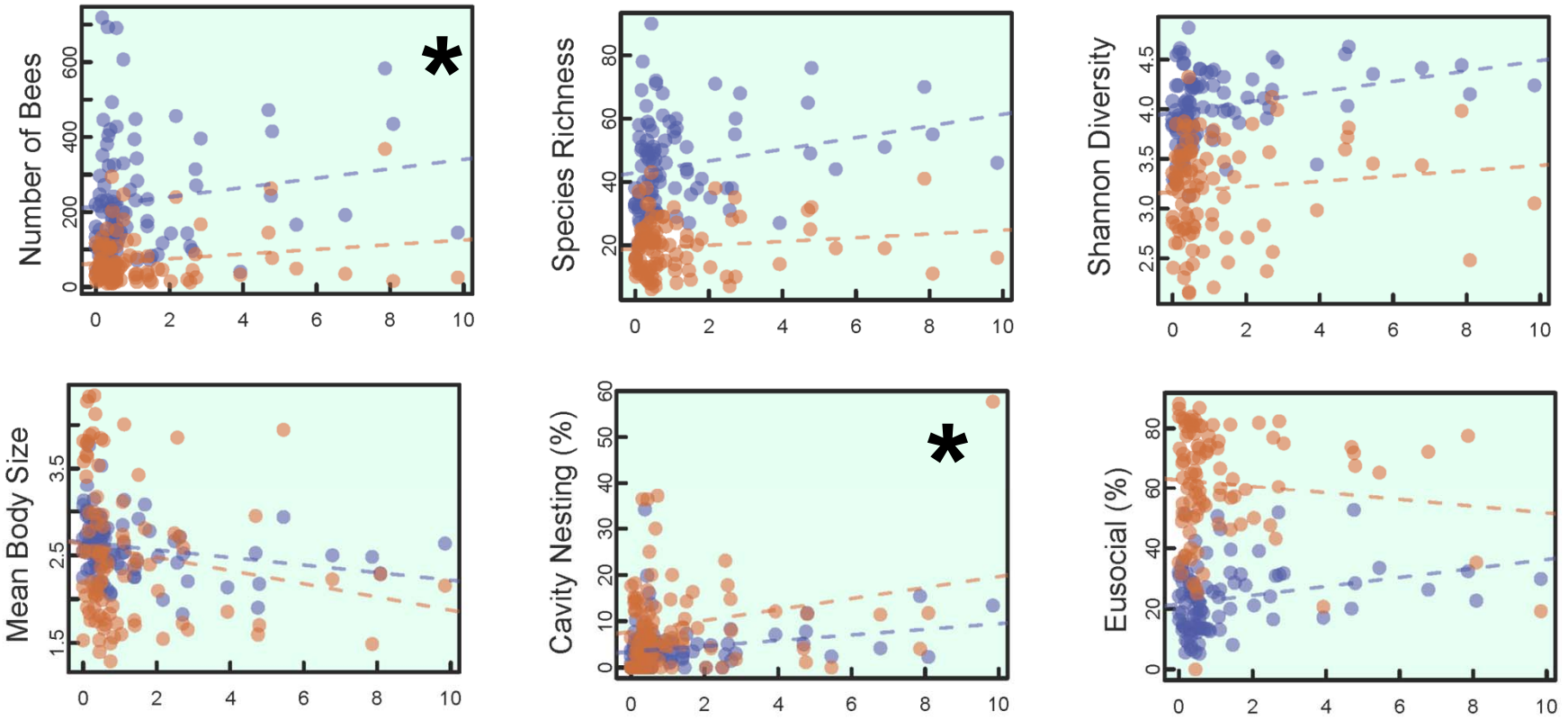
Bee community response to semi-natural habitat size



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■ Spring and ■ Summer communities

Local scale (200 m radius)

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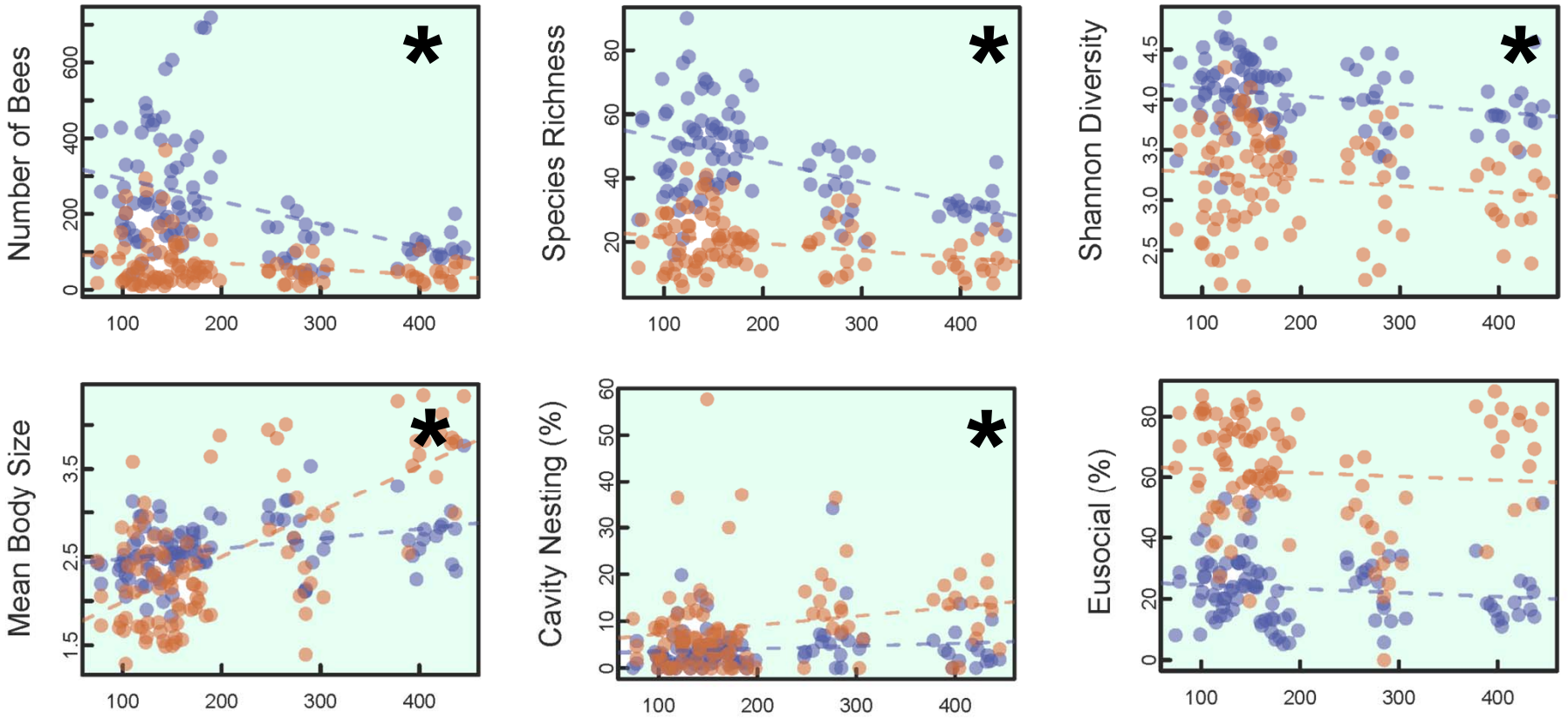
Bee community response to elevation



* = p<0.05

■ Spring and ■ Summer communities

Local scale (200 m radius)

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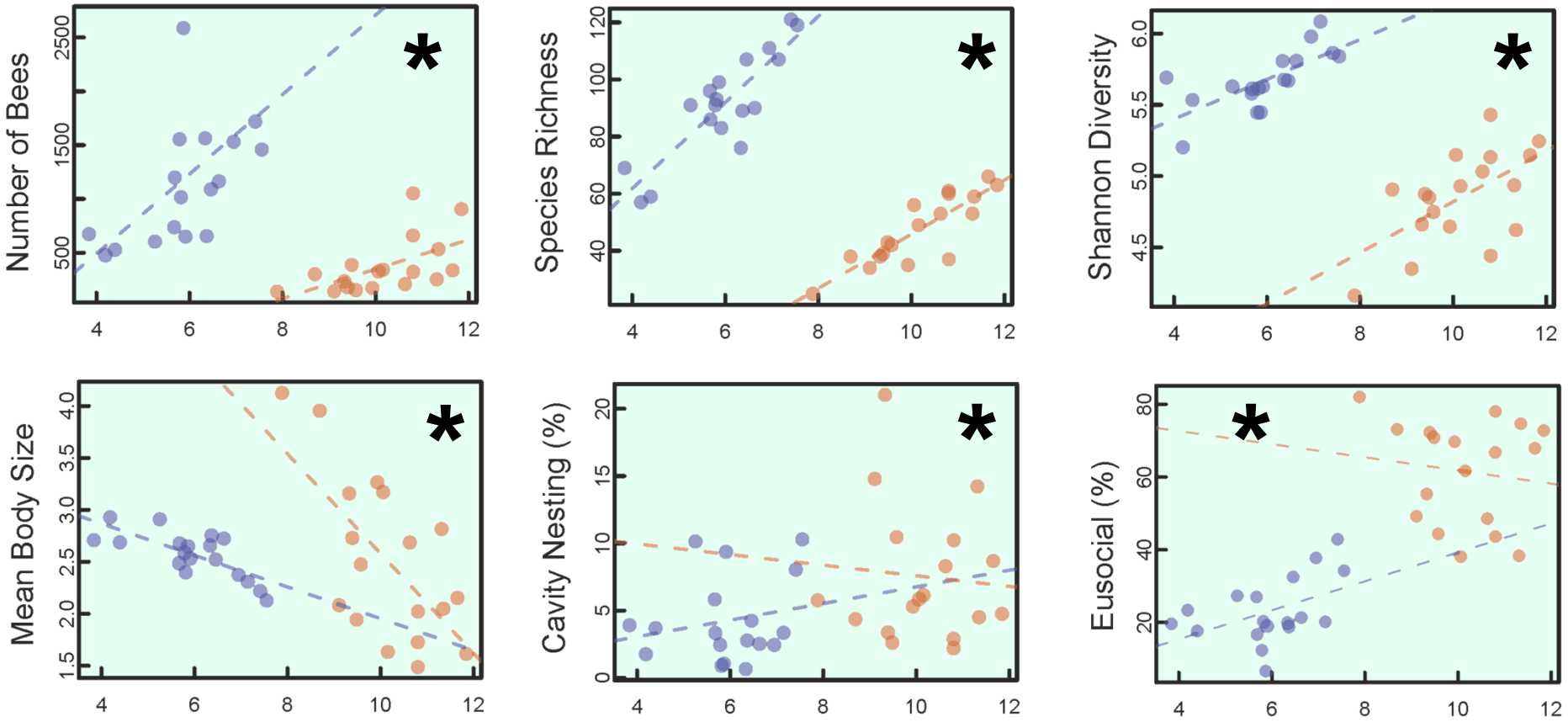
Bee community response to ground temperature



* = p<0.05

■ Spring and ■ Summer communities

Regional scale (4x4 km)

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Answers to questions

- Q1: What are the **main drivers** for bee occurrence? Weather conditions or land use intensity?
  - Abiotic conditions produce more significant patterns
- Q2: Do **intensively used areas** have fewer bees (species; individuals)?
  - No significant patterns in local communities
- Q3: Do responses of bees to land use depend on **bee traits** (e.g. body size, nesting behaviour, sociality)?
  - Only the traits **cavity nesting** (⇨ semi-natural habitats) and **eusociality** (⇨ arable land) responded significantly

Conclusions

- Data at local (200 m radius) and regional (4x4 km) scale are surprising: even **high intensively used agricultural landscapes** (97% crop fields) **host diverse bee communities**!
- **Spring** (more species & individuals) and **summer** (less species and individuals) bee **communities are clearly separated** ⇨ difference in pollination services
- **Weather conditions** seem to be the most important driver shaping bee communities
- **Responses to land use** seem to be complex … still some work to do!

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Acknowledgements

- **Frank Creutzburg** (Jena) – Determination of bees
- **STEP Project** - Status and trends of European pollinators; http://www.step-project.net; Bee Trait Database compiled by University of Reading, Stuart Roberts & Simon Potts

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