



Fließgewässer-Renaturierungen:
EG WRRL, multiple Stressoren und menschliche
Wahrnehmung

EU Water Framework Directive

- Demands a „good ecological status“ of all water bodies
- Ecological status in rivers:
benthic invertebrates,
fish, macrophytes



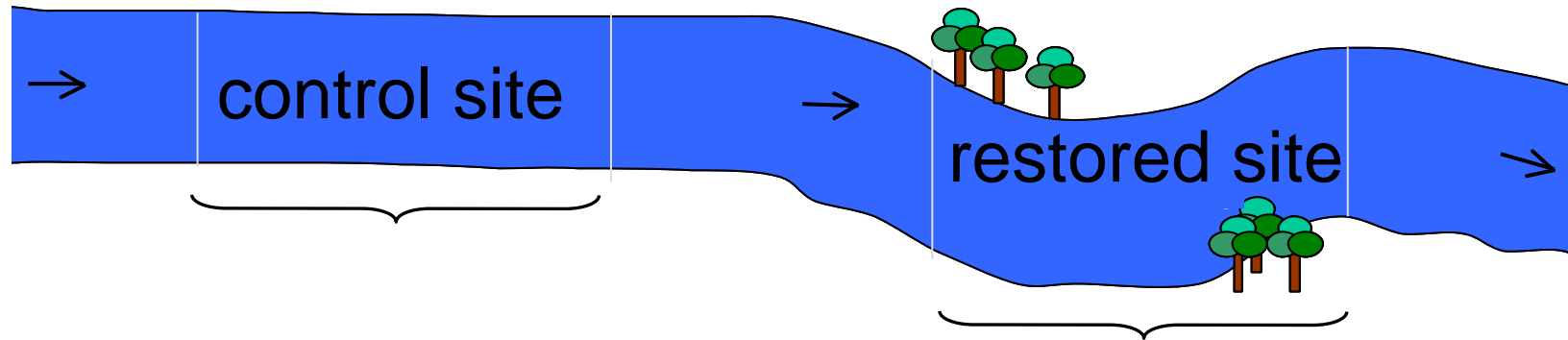
Current status of European rivers

- 60% of European rivers fail good ecological status
- 40% in Eastern Europe; 90% in Central Europe

Improvement by restoration



Study design

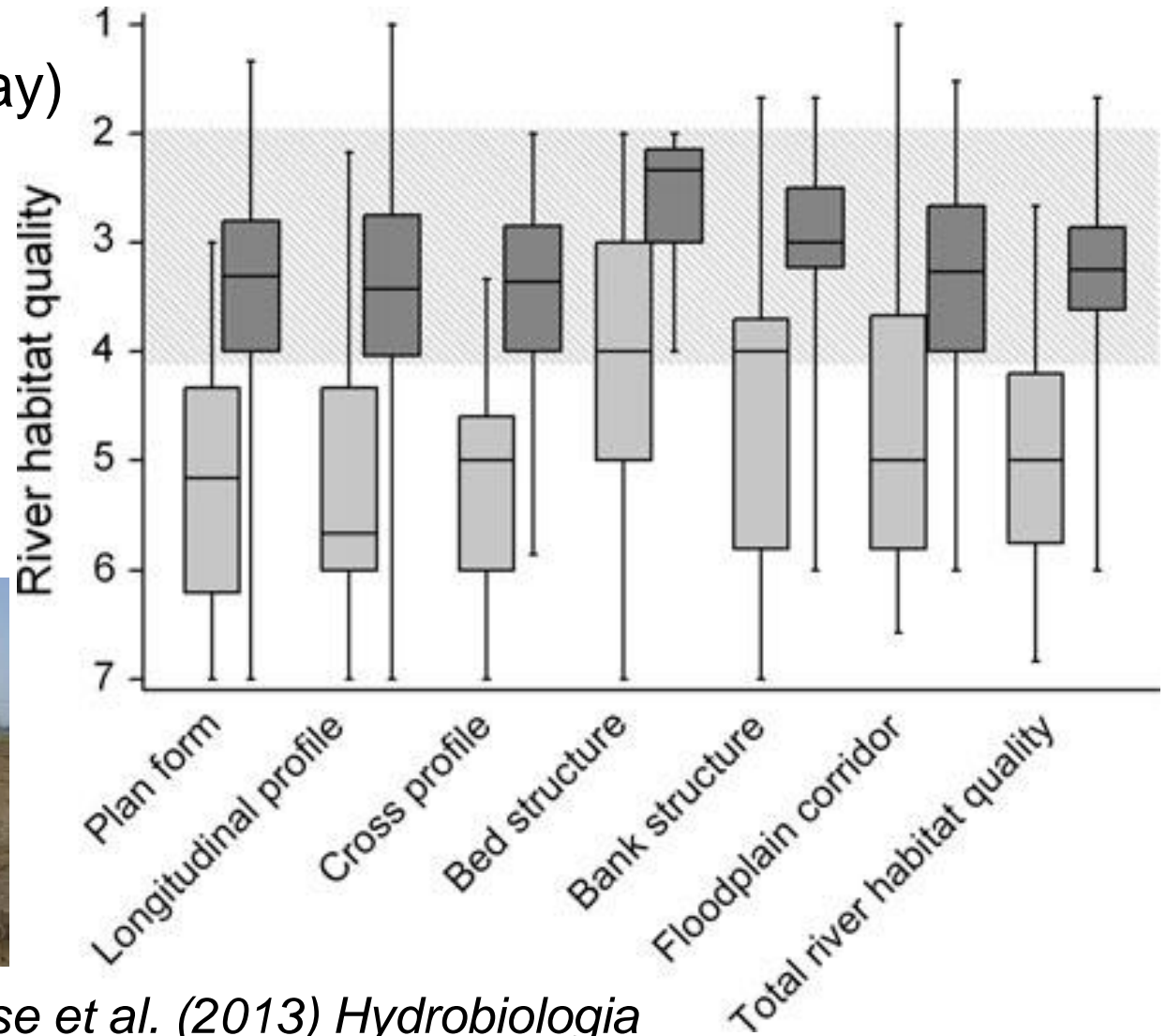


Hydromorphology
Benthic invertebrates
Fish
Macrophytes
Carabids
Floodplain vegetation

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River Habitat Survey

unrestored (light gray)
 restored (dark gray)
 1 = undisturbed
 7 = totally disturbed



River restoration effects on EQC

	Higher	Lower	No change
Invertebrates	5	5	14
Fish	11	3	10
Macrophytes		2	7
Overall EQC	7	1	16

No. of good or high EQC at restored sites: 0

Temporal changes in restoration success

Benthic invertebrates

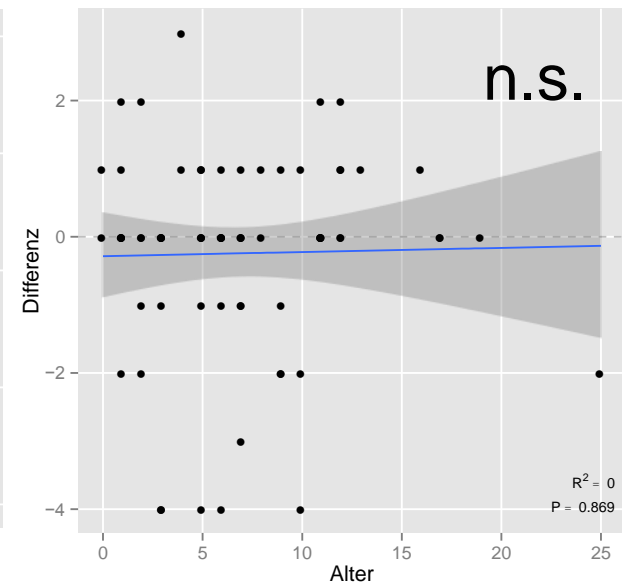
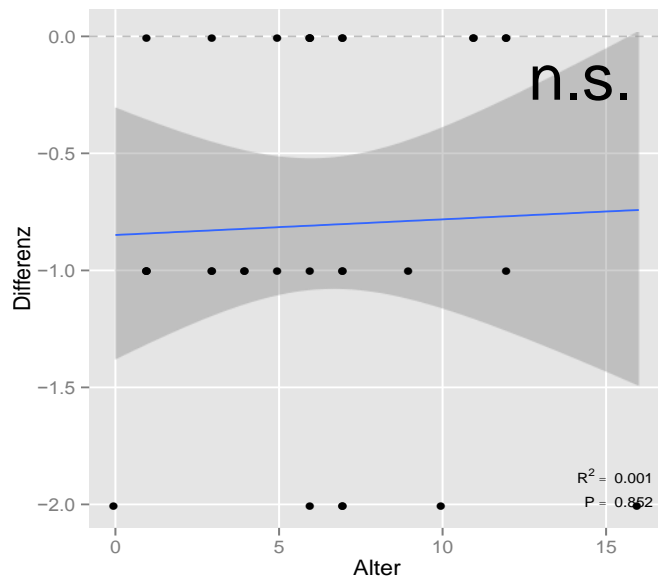
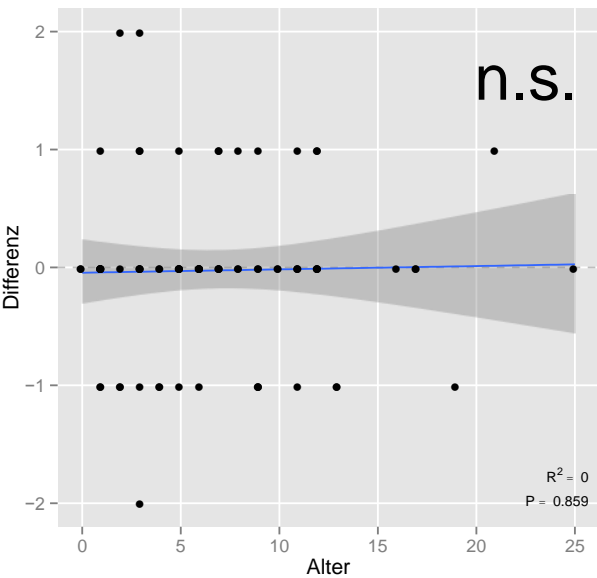
Fish

Macrophytes

ÖZK

ÖZK

ÖZK



Time is no healer

Kurt Lange Stiftung



STIFTUNG
HESSISCHER
NATURSCHUTZ



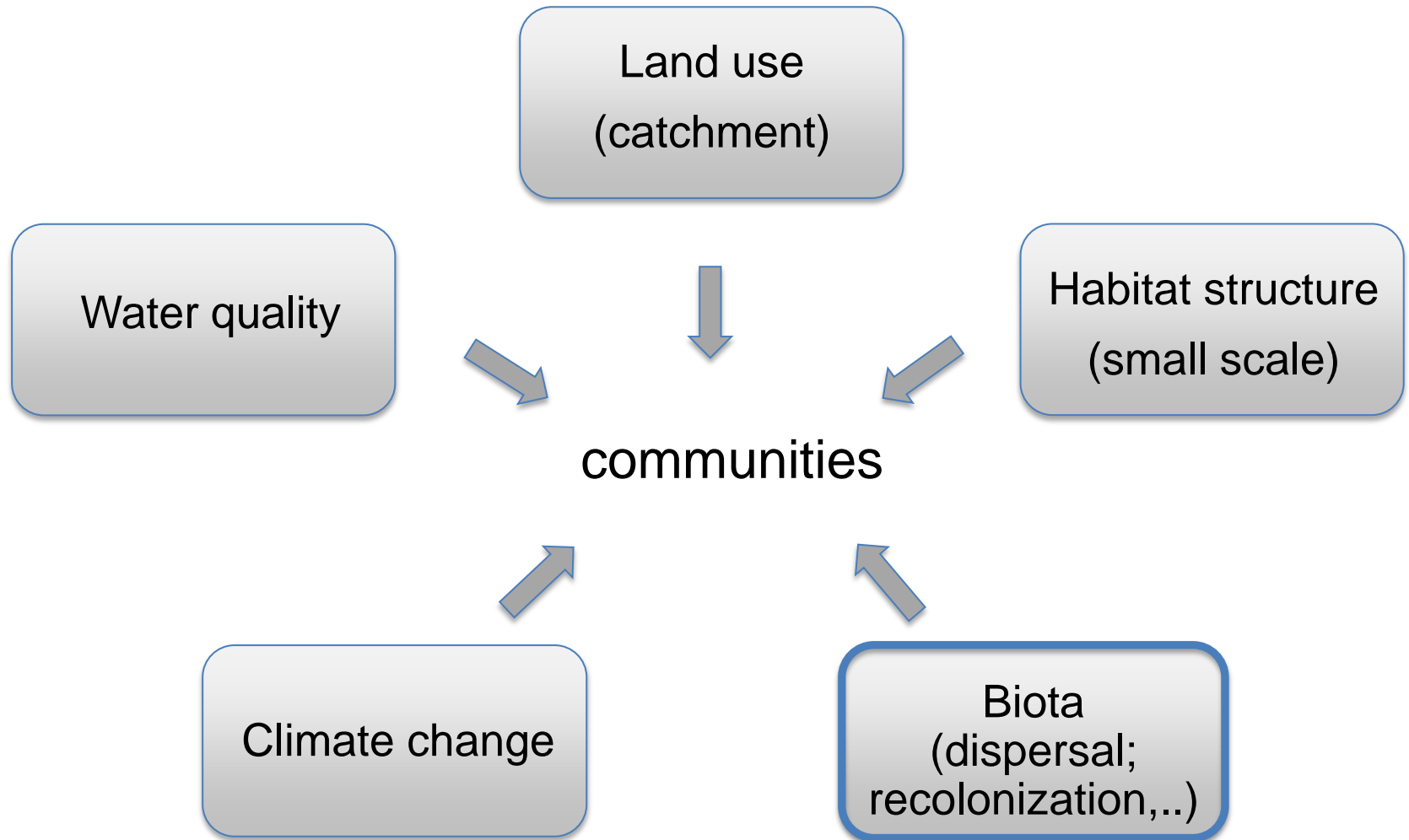
Stiftung der
Kreissparkasse
Gelnhausen



gefördert durch

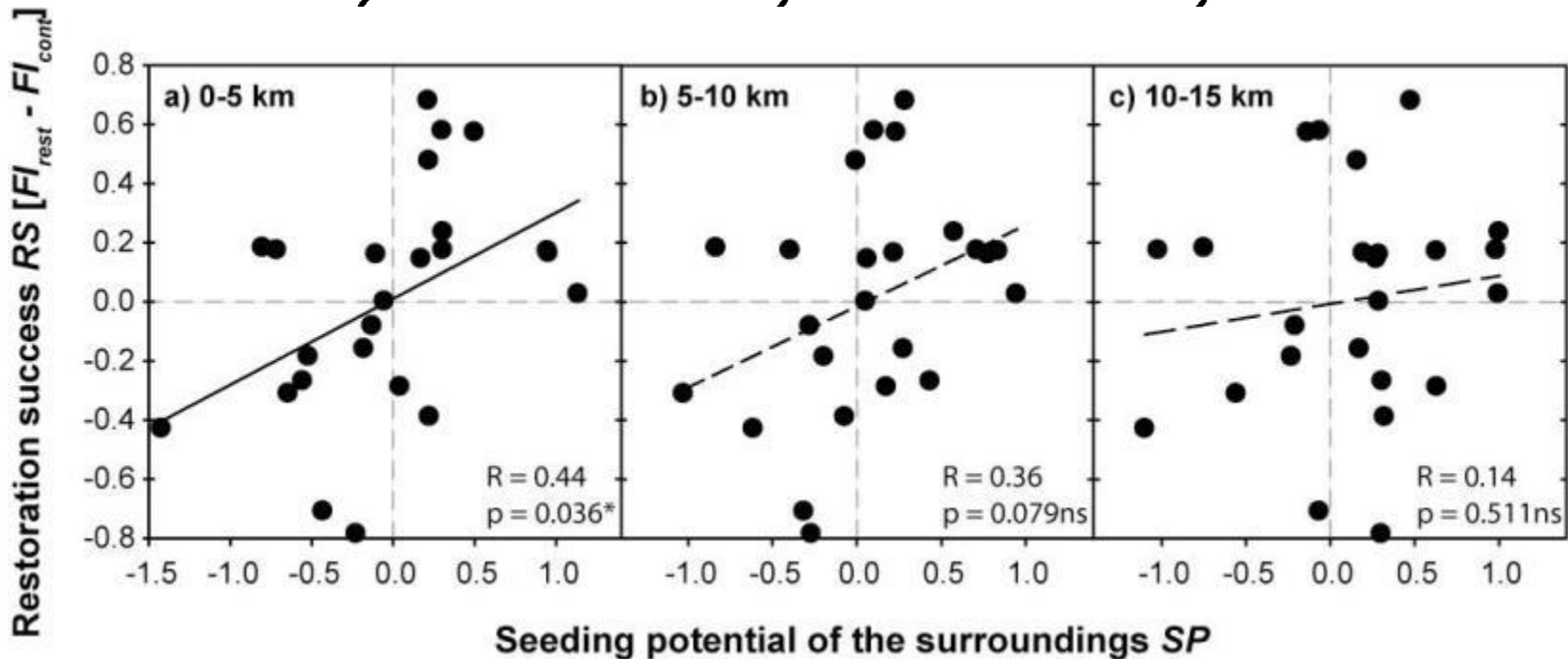
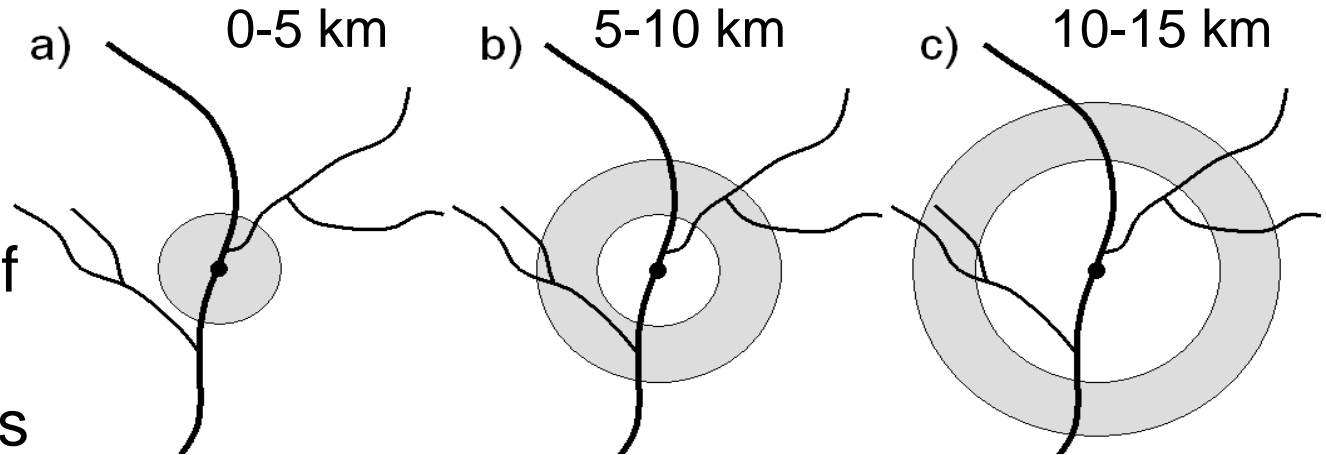


Factors shaping freshwater communities



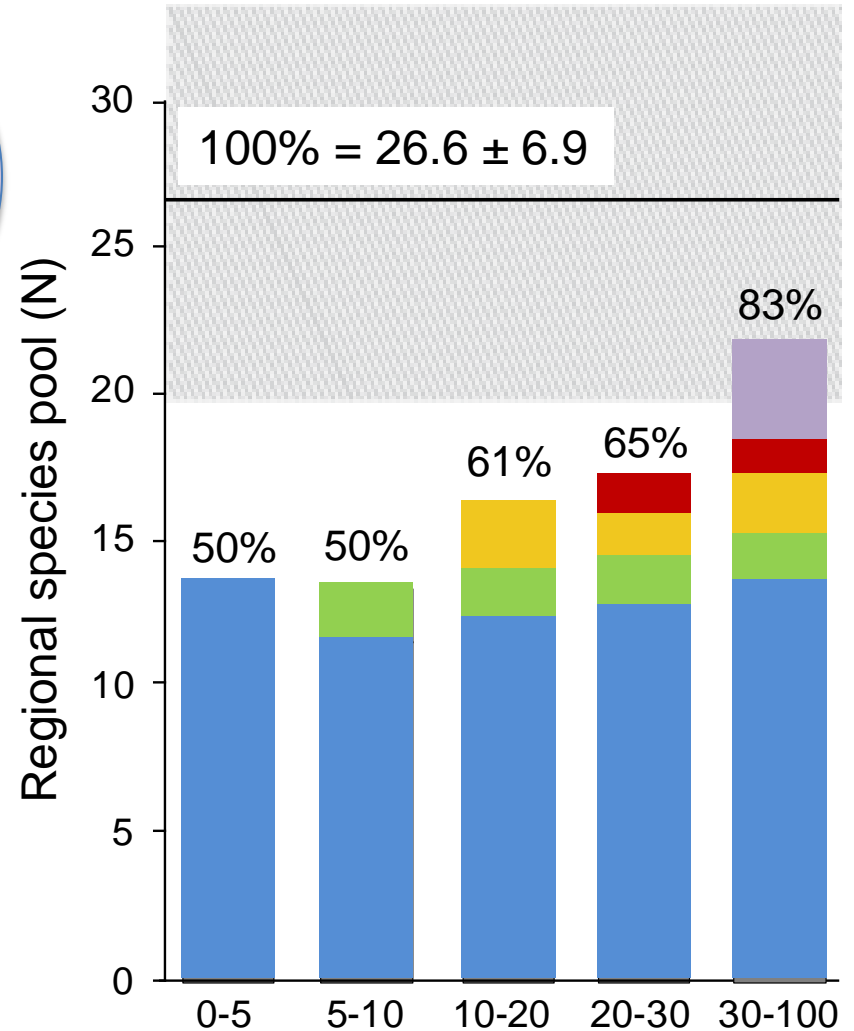
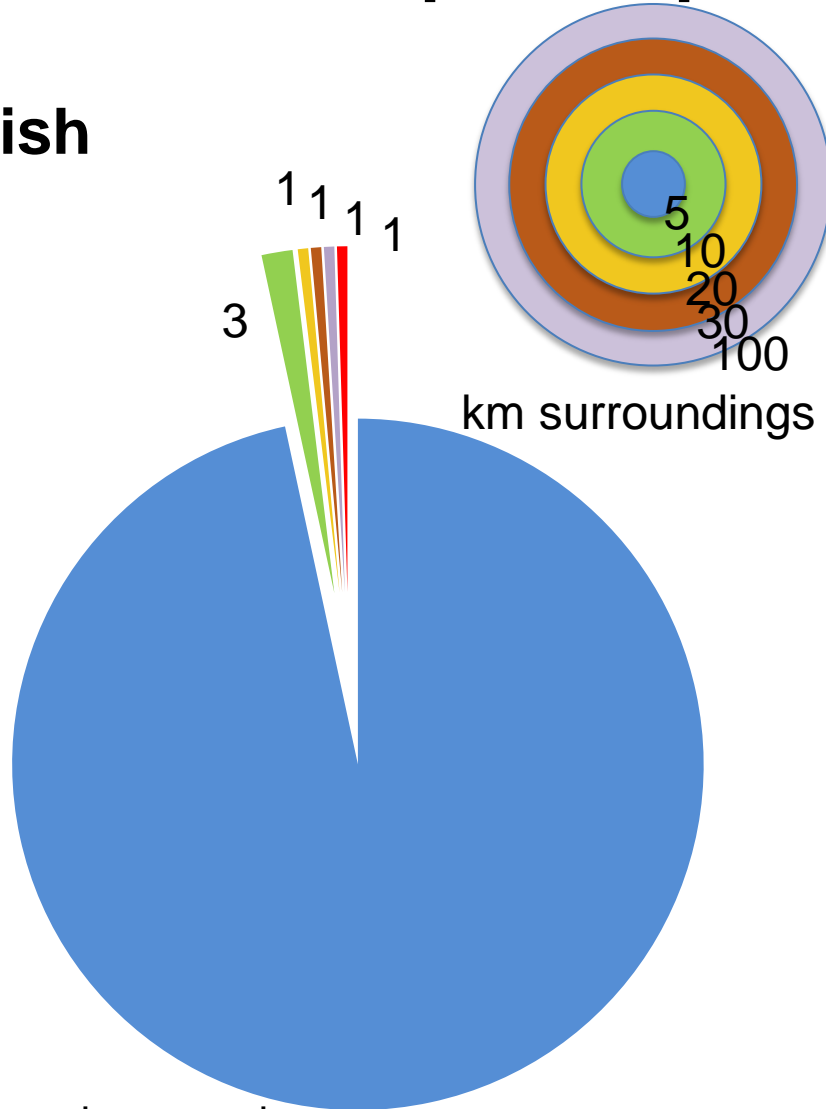
Recolonization potential in surroundings

1,231 benthic invertebrate samples from surroundings of 25 river restoration sites



Are the species pools impoverished?

Fish



N = 207 species records

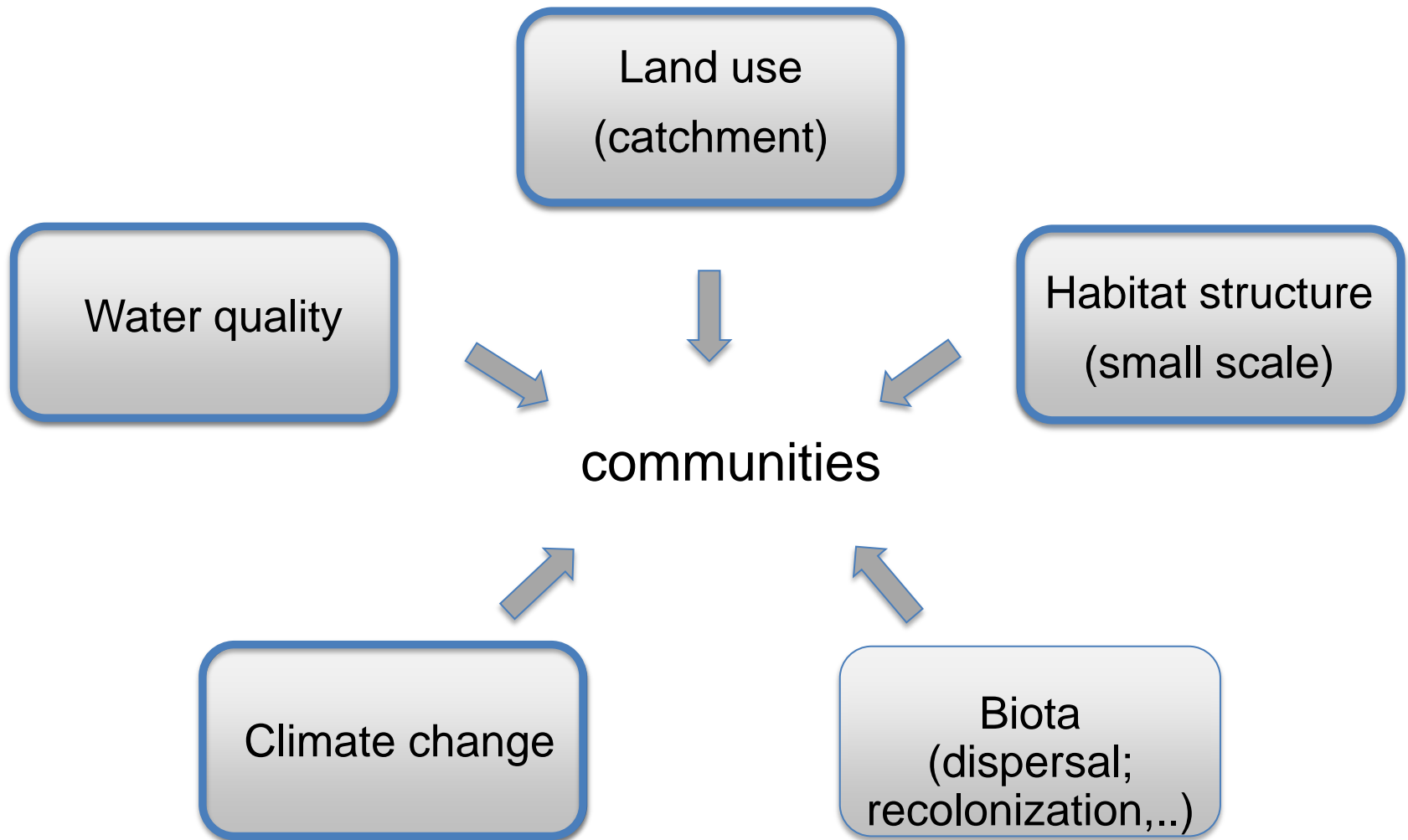
Distance from restored reach (km)

Summary 1

- Limitations in dispersal
- Relevant species pool < 5 km
- These species pools were severely impoverished
- Assisted migration



Factors shaping freshwater communities



Multiple stressor analysis

- 1009 sites across Germany
- Lowland & highland, streams & rivers
- Data: 21 variables
 - Water quality
 - Land use in the catchment (Corine data)
 - Habitat structure (small scale)
 - Climate change (temperature)
- Benthic invertebrates (20 metrics)



Multiple Generalized Linear Regression

			Water quality							Land use						
Small mountain streams			Electric conductivity	Ammonium	Nitrate	Nitrite	o-Phosphate	Dissolved oxygen	TOC	Water temperature	Artificial surfaces	Arable land	Pastures	Regional LUI Buffer	Buffer width × length (in km)	Hydromorphology
Metric	%DevExpl	p														
%EPT	45.4	***	16.7	1.9	0.4		6.7	31.2		11.1	1.7			8.1	0.5 × 0.5	7.4
%Shredderers	8.60	***		0.9	1.3			0.7		0.6	0.1	2		0.4	0.25 × 5	
#EPT	49.8	***	22.6		3	16.6	10.5	22.3	14.6				10.4	20.9	0.5 × 5	
#EPTCBO	40.9	***	16.7		4	18.2	11.1	11	12.1			14.8	11.7	21.3	0.5 × 5	
#Taxa	30.5	***	10.7	7.4		12.2			6.9			9.2	14.3	15	0.25 × 5	5.1
Shannon	17.8	***	6.5			5.2	1.2	4.7			5.7		4.8	10.5	0.1 × 5	
BMWP	40.7	***		7.5		15.2			12.2	1	7.7	21.9	16.1	27.1	0.5 × 5	
MMI	43.6	***	24.2	4.4	4.4	16.2	17.1			6.2	4.4			24	0.5 × 5	8.9

Multiple Generalized Linear Regression

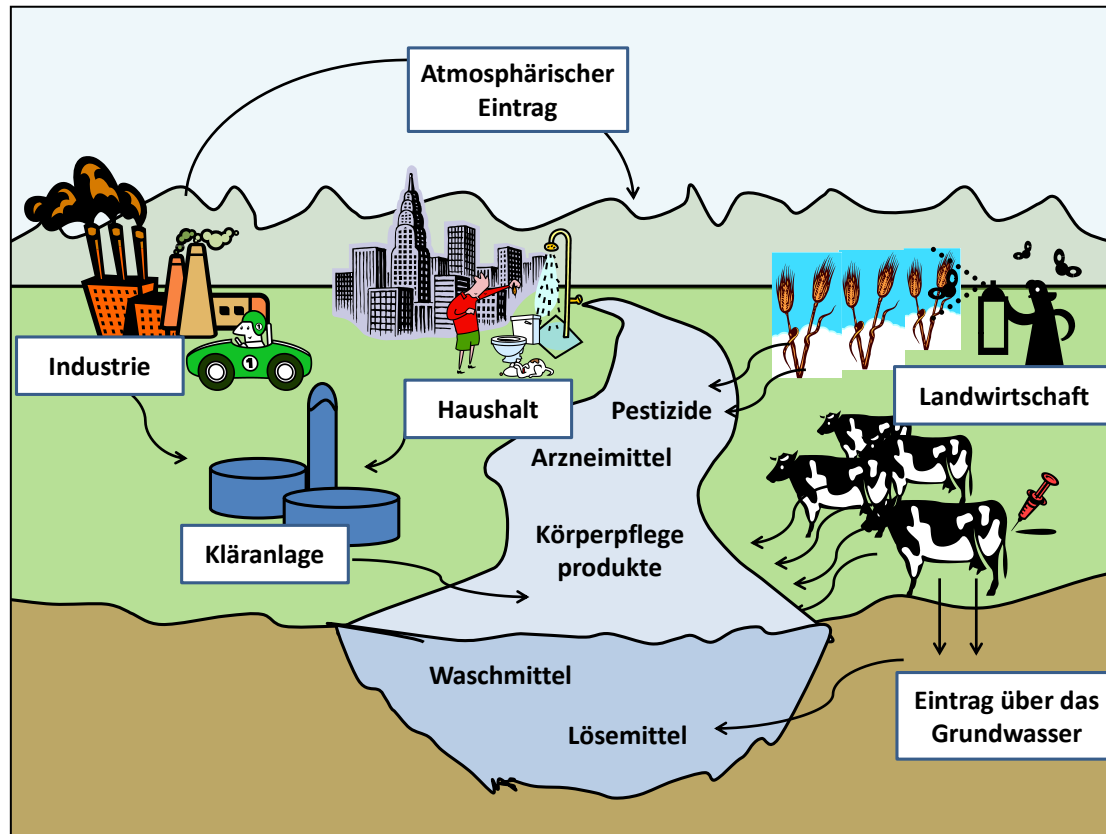
			Water quality							Land use						
Large mountain streams Reduced models			Electric conductivity	Ammonium	Nitrate	Nitrite	o-Phosphate	Dissolved oxygen	TOC	Water temperature	Artificial surfaces	Arable land	Pastures	Regional LUI Buffer	Buffer width × length (in km)	Hydromorphology
Metric	%DevExpl	p														
%EPT	44.9	***	20.7				15.4	17.7		15.4						
%Shredderers	1.3	n.s.														
#EPT	42.5	***	17.7		0.2		13.9	20.8		11.1		6.6			4.3	
#EPTCBO	33.7	***	14	11.7			12.4	10		11.2		6.6	4.6	(0.5 × 0.5)		
#Taxa	23.6	***	12.3	8.9						9.8					4.1	
Shannon	25.1	***	13.7							10.2	5.8		3.8	< 0.1	(0.1 × 1)	
BMWP	33.1	***	9.4	15.8			10.4			11.6		7.9			8	
MMI	38.6	***	9.7		0.4	19.9			6.2	12.7	5.7	7.5				

Summary 2

- Important: - water quality + climate (rivers)
- water quality + land use (streams)
- Less important: local habitat structure



Chemicals



- 100,000 chemicals registered in EU
- 1 sample may contain 1,000 chemicals
- 45 substances used to calculate chemical status (WFD)

WFD → “good” chemical status ≠ “good” ecological status

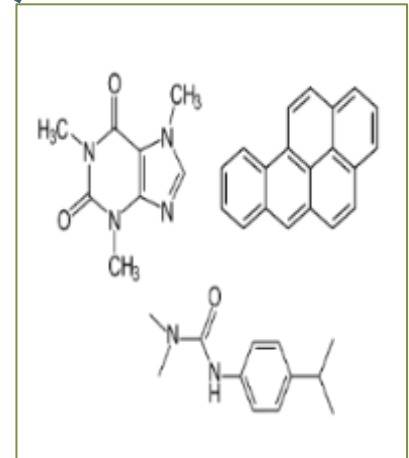
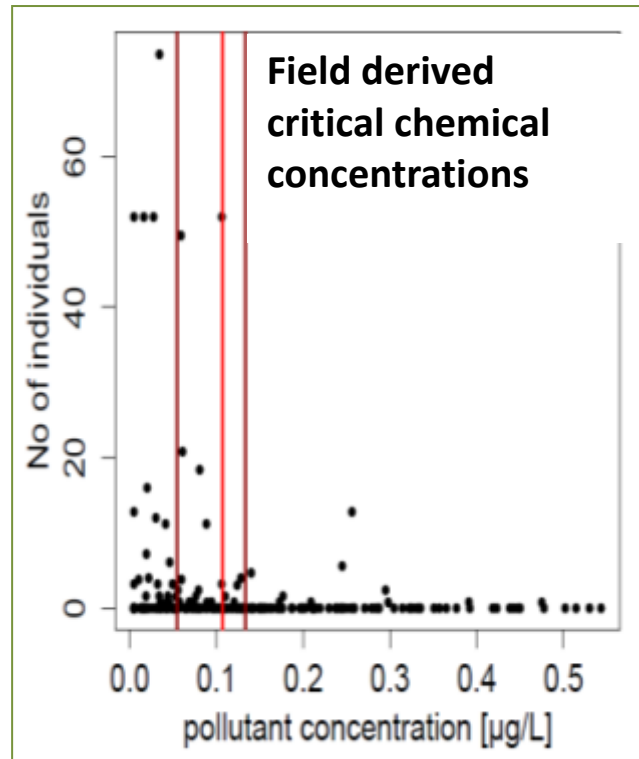
Chemicals

- Standardized lab experiments important, but ...

Lab	Field
1 animal + 1 chemical	Entire communities + multiple stressors
3 invertebrates	> 1000 Taxa
Test: days/weeks	Permanent exposure

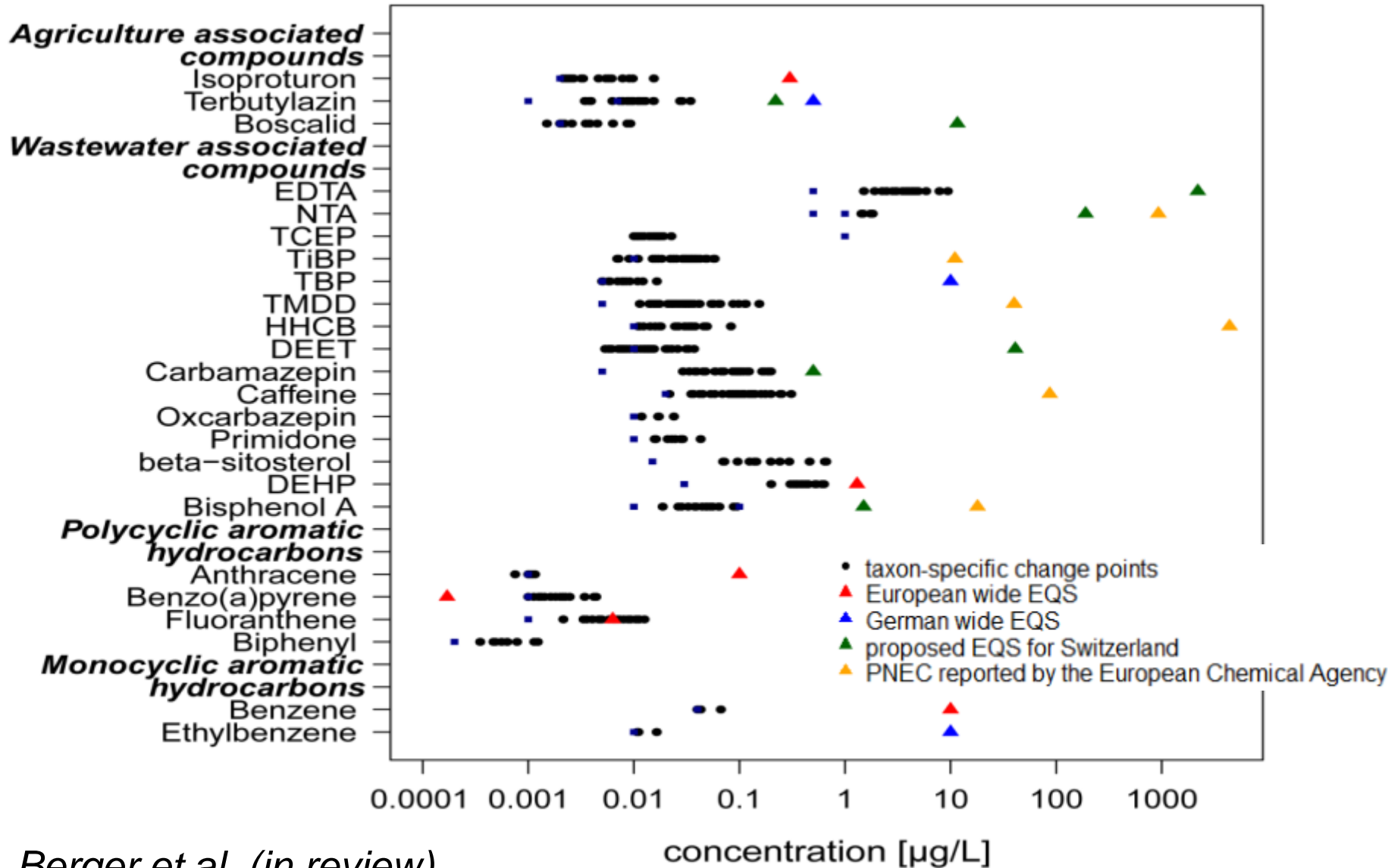
- Chemical Monitoring
 - Point measurements (temporal & spacial)
 - Sometimes “predicted no effect concentrations” < technical detection limit

Field studies



- Critical concentrations for 25 chemicals + 365 Taxa using field data (399 sites, 4 federal states)

Effects on benthic invertebrates



Human dimension often missing

- Restoration studies focus on biotic and abiotic changes
- River restoration projects are important for humans too, e.g., recreation
- Assessments of these aspects are scarce

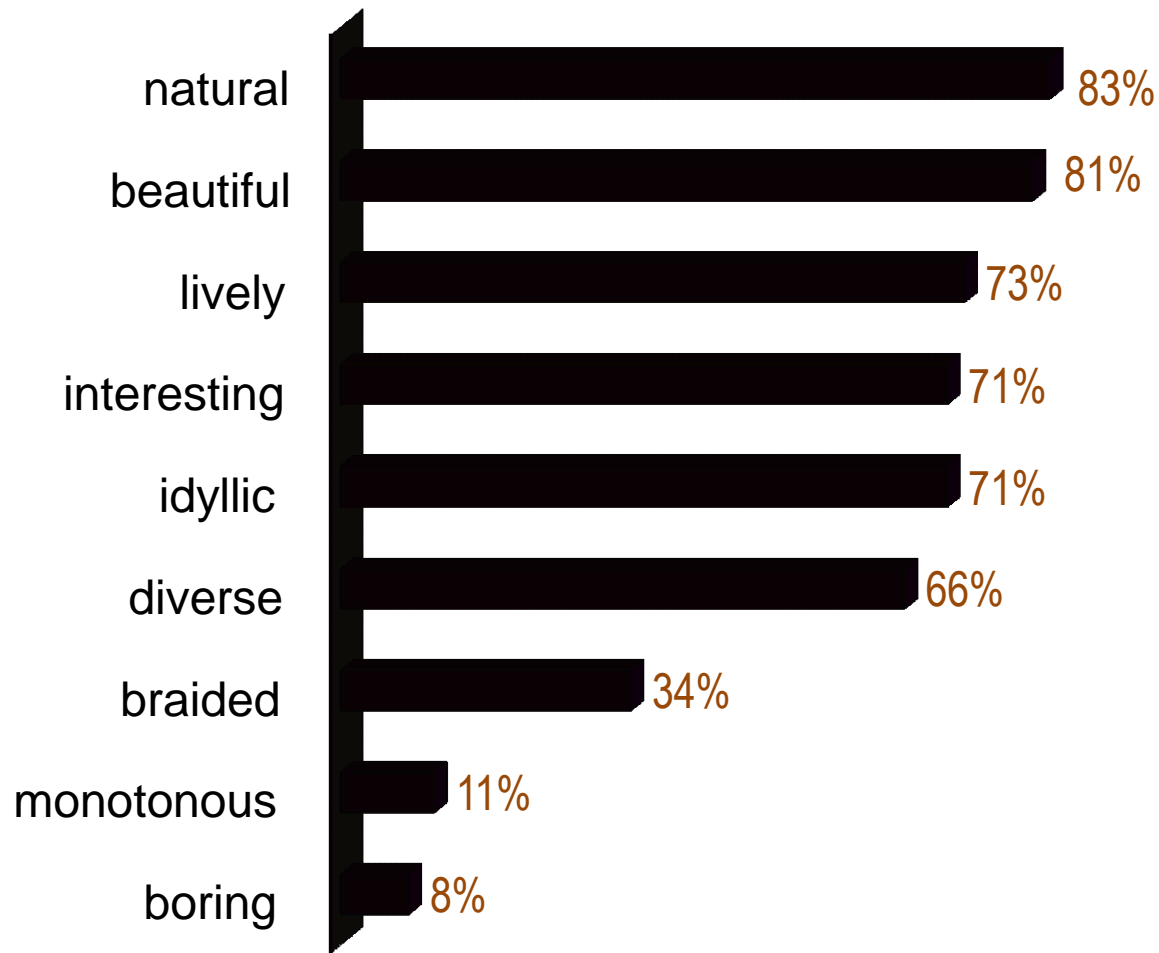


Study design

- Perception of people living in the surroundings
- 10 river restoration projects
- Guided interviews: 75 - 79 people per project (n = 760)
- In total 16 questions
- 4 examples:

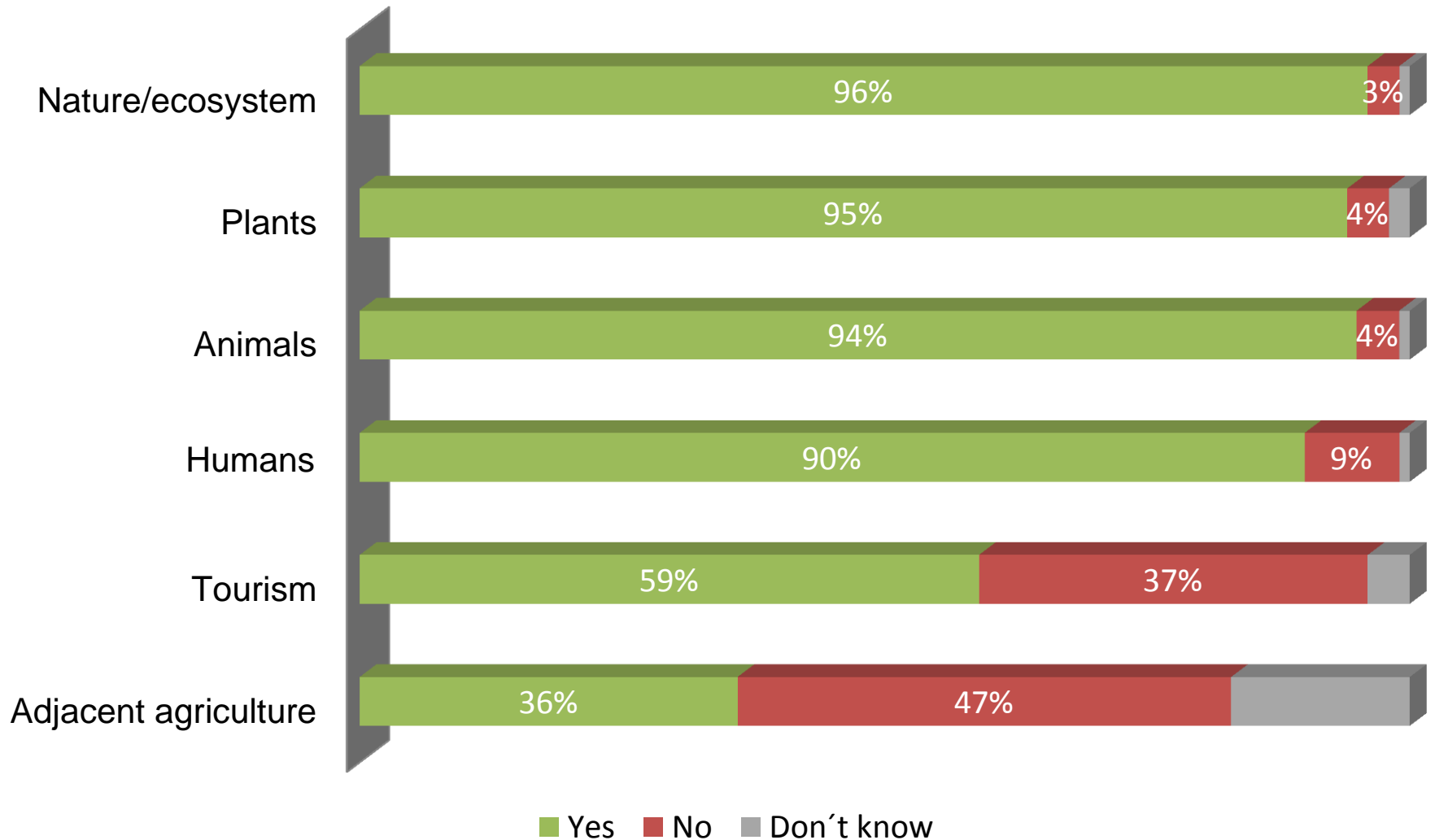


How would you describe the restored section?



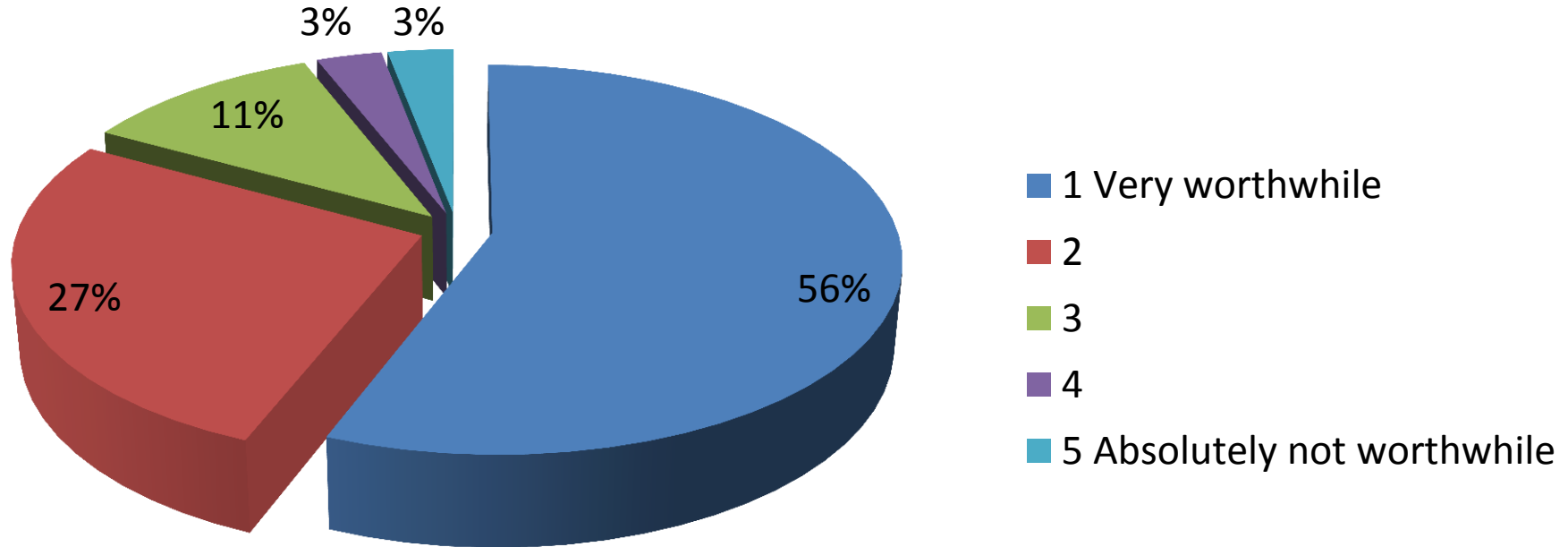
Deffner et al. (in prep.)

Who profits from restoration?

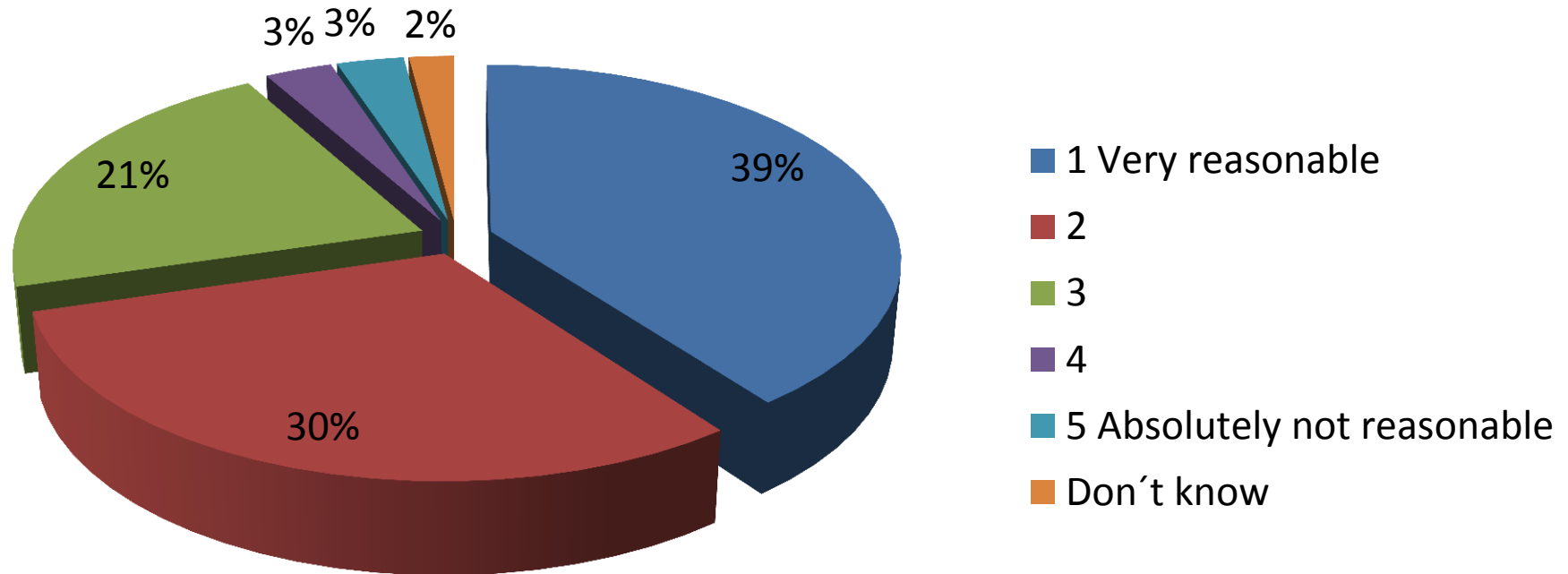


Deffner et al. (in prep.)

Overall: How worthwhile do you rate this restoration project?



Given average costs of 200,000 Euros per 500 m for a restoration project, how reasonable are further restoration projects?



Conclusions

- Restorations improve local habitats
- Rivers are affected by multiple stressors
- New approaches on catchment scale required
- Additional impact: climate change
- Long-term biodiversity monitoring required (restoration & climate change)
- Human recognition positive



Herzlichen Dank!



- UBA, HLUG für Datenbereitstellungen
- Kollegen/innen der Uni Duisburg-Essen & ISOE
- Sami Domisch, Sonja Jähmig, Fengqing Li, Stefan Stoll, Andrea Sundermann, Jonathan Tonkin