Aquatic Warbler in Pomerania: habitat requirements and management recommendations

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DBU

Aquatic Warblers in Pomerania

Differences to core population

- genetic (Giessing 2002) - ???
- wintering area (Pain et al. 2004) - ???
- song (ongoing PhD J. Glapan, Poznan) - ???

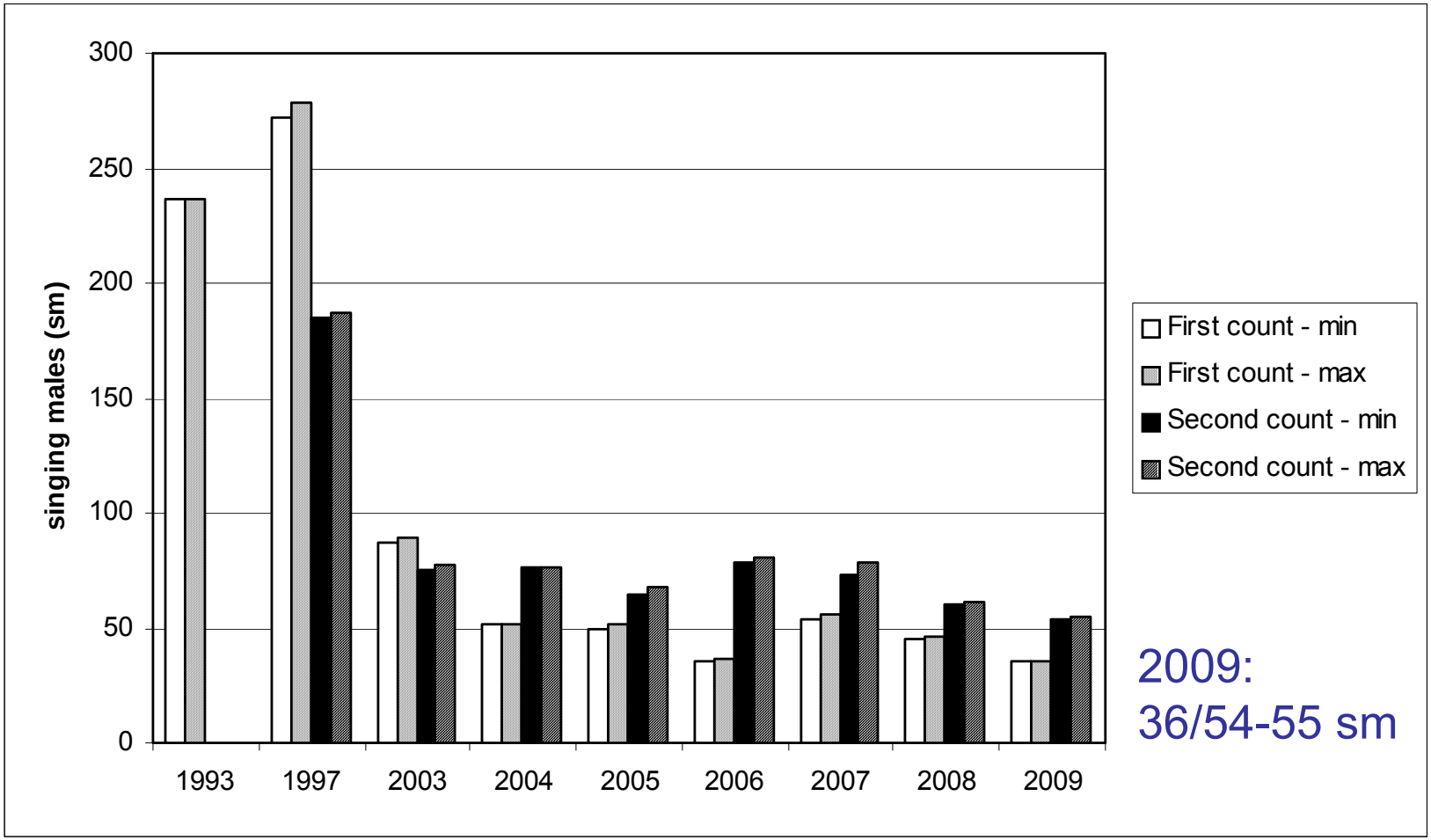
→ doubtful

This is NOT doubtful

- strongly decreasing
- remnant of large population
- now: western margin of breeding area

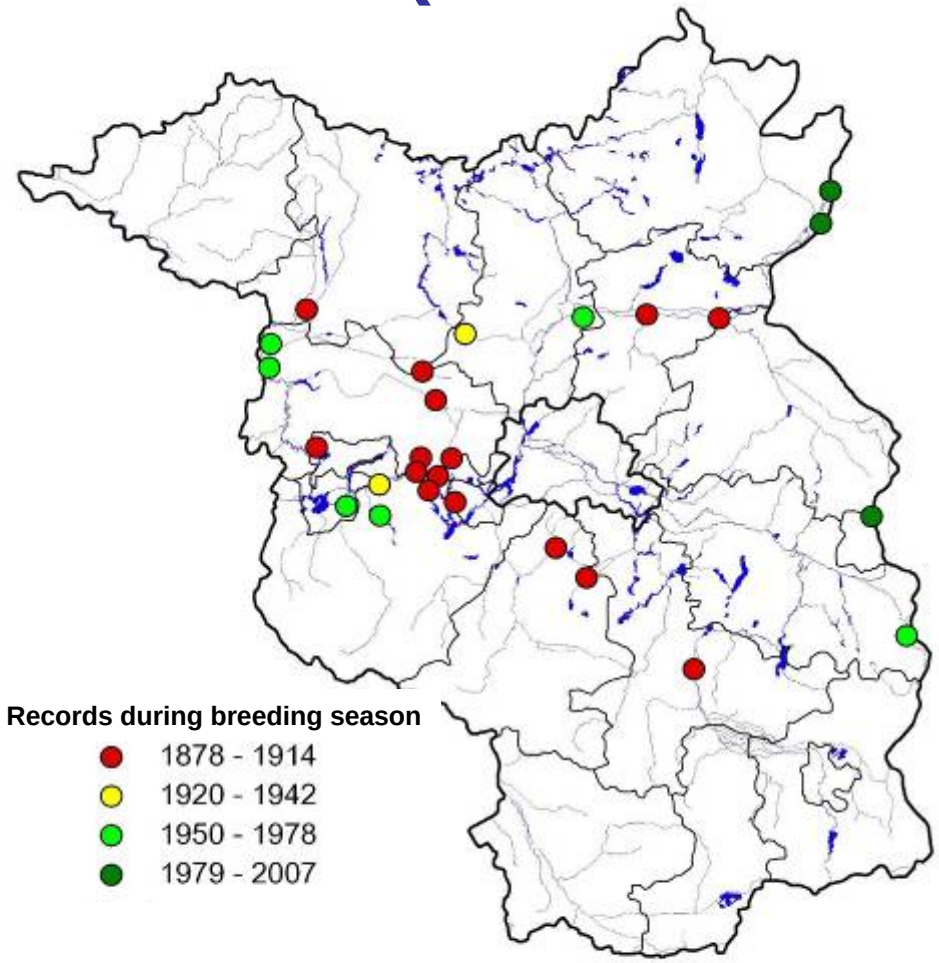
Picture: Wolin National Park, M. Radziszewski 2007

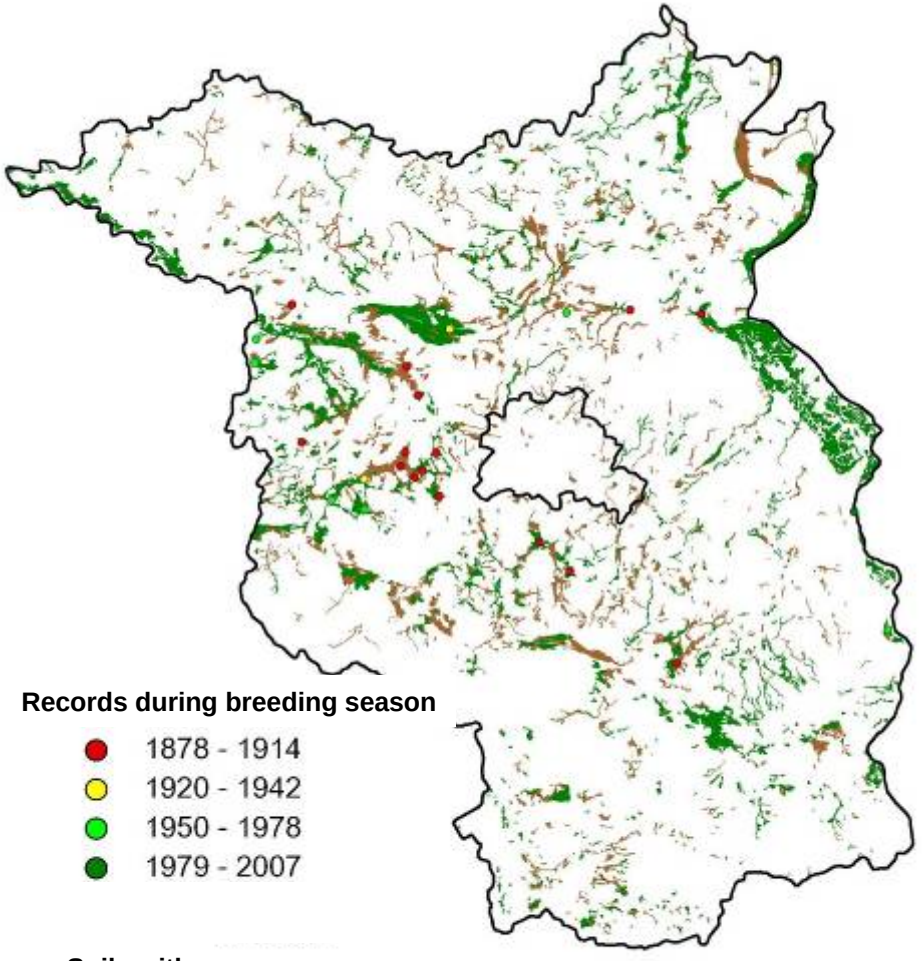
Aquatic Warblers in Pomerania 1993-2009



AW Pomerania Access database prepared within AW LIFE project

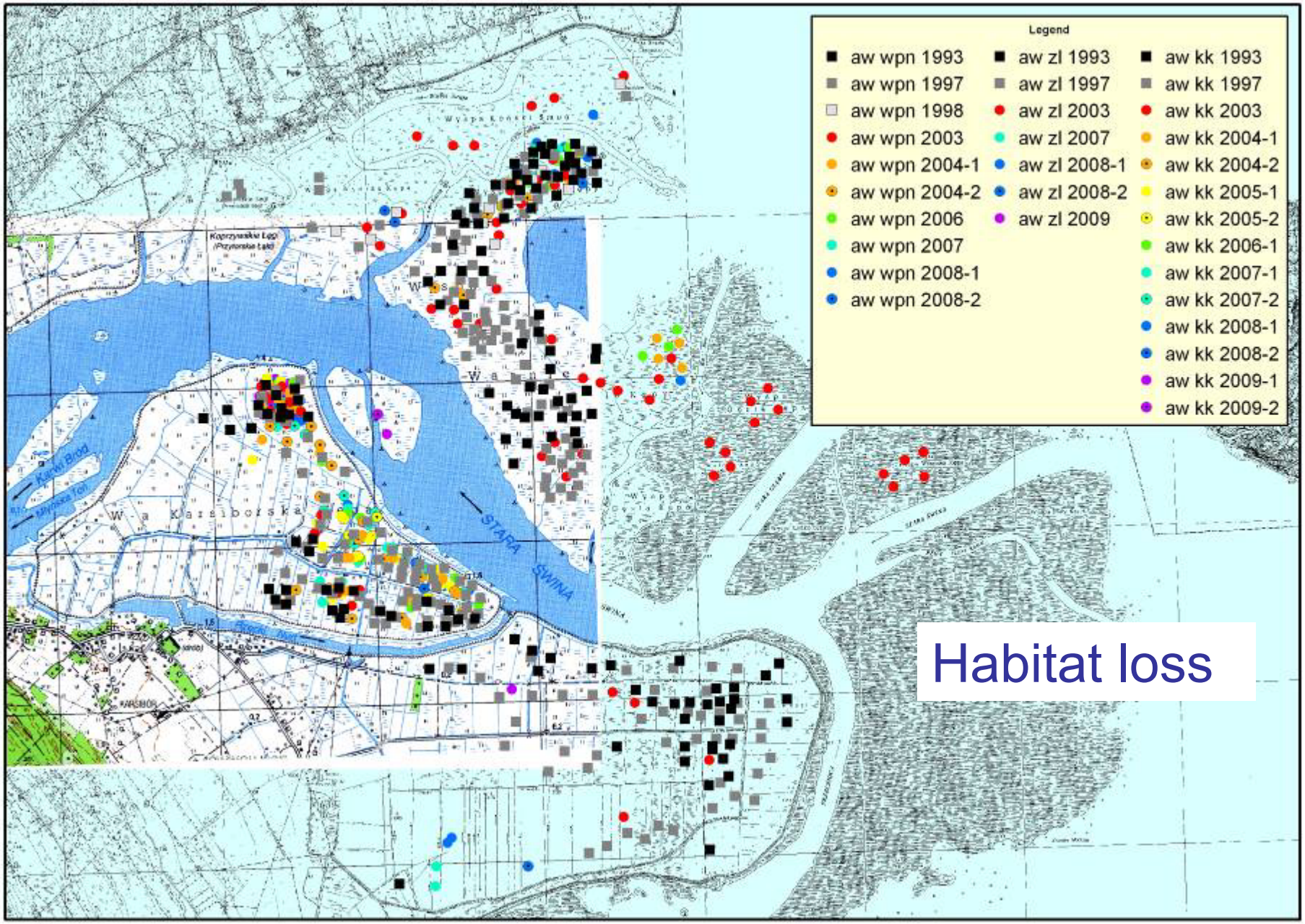
Historic records from Germany (federal state Brandenburg)





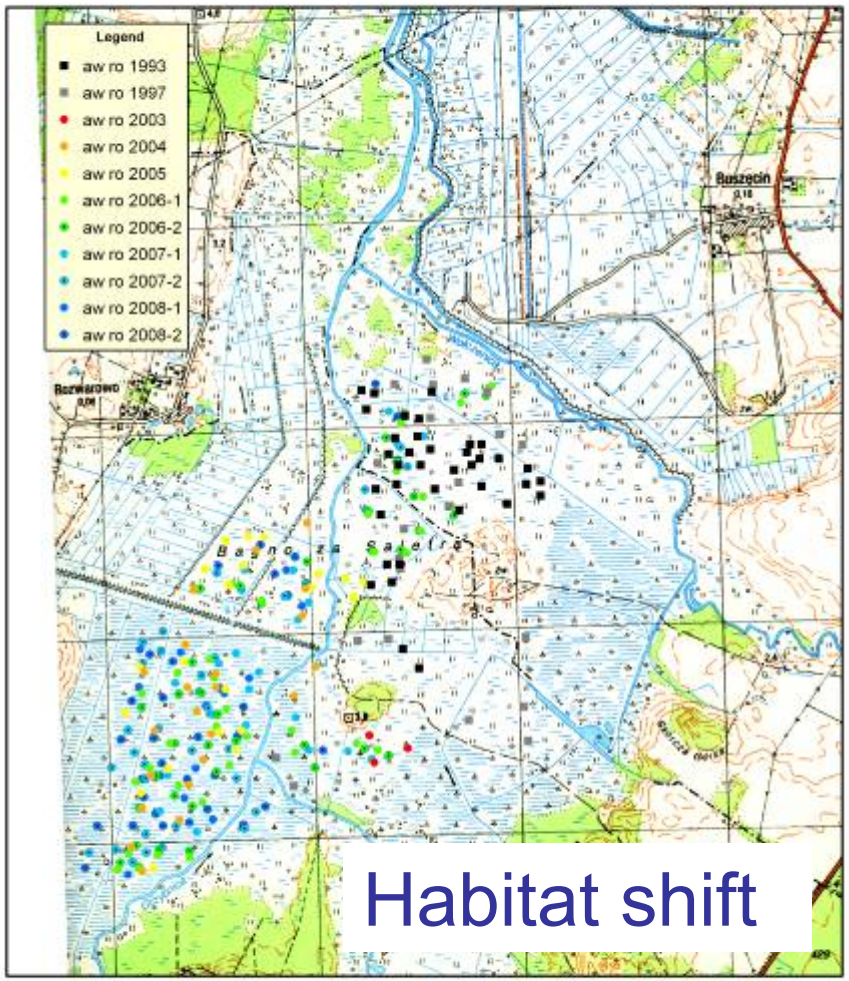
Tanneberger & Bellebaum in prep.

Wolin National Park, Karsiborska Kepa, and Zajecze Legi s.l.

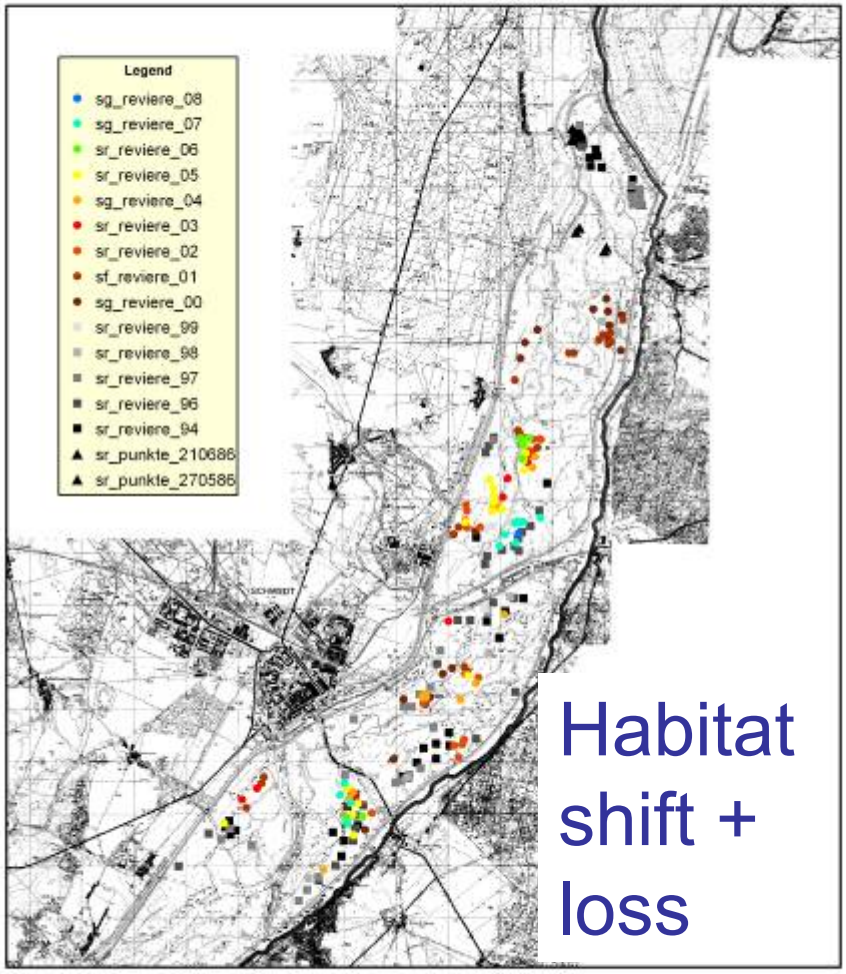


Habitat loss

Rozwarowo Marshes



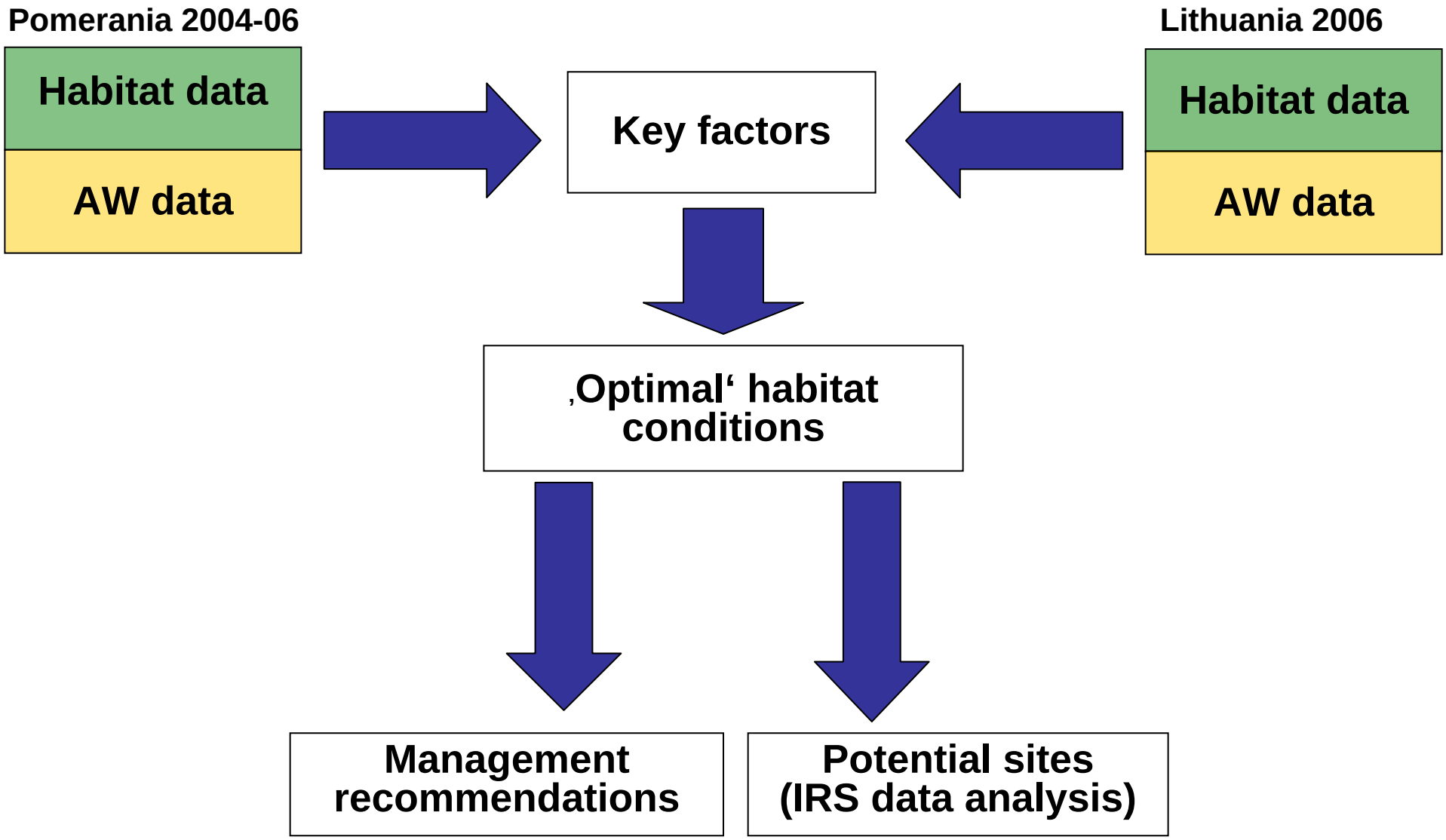
National Park Lower Oder Valley

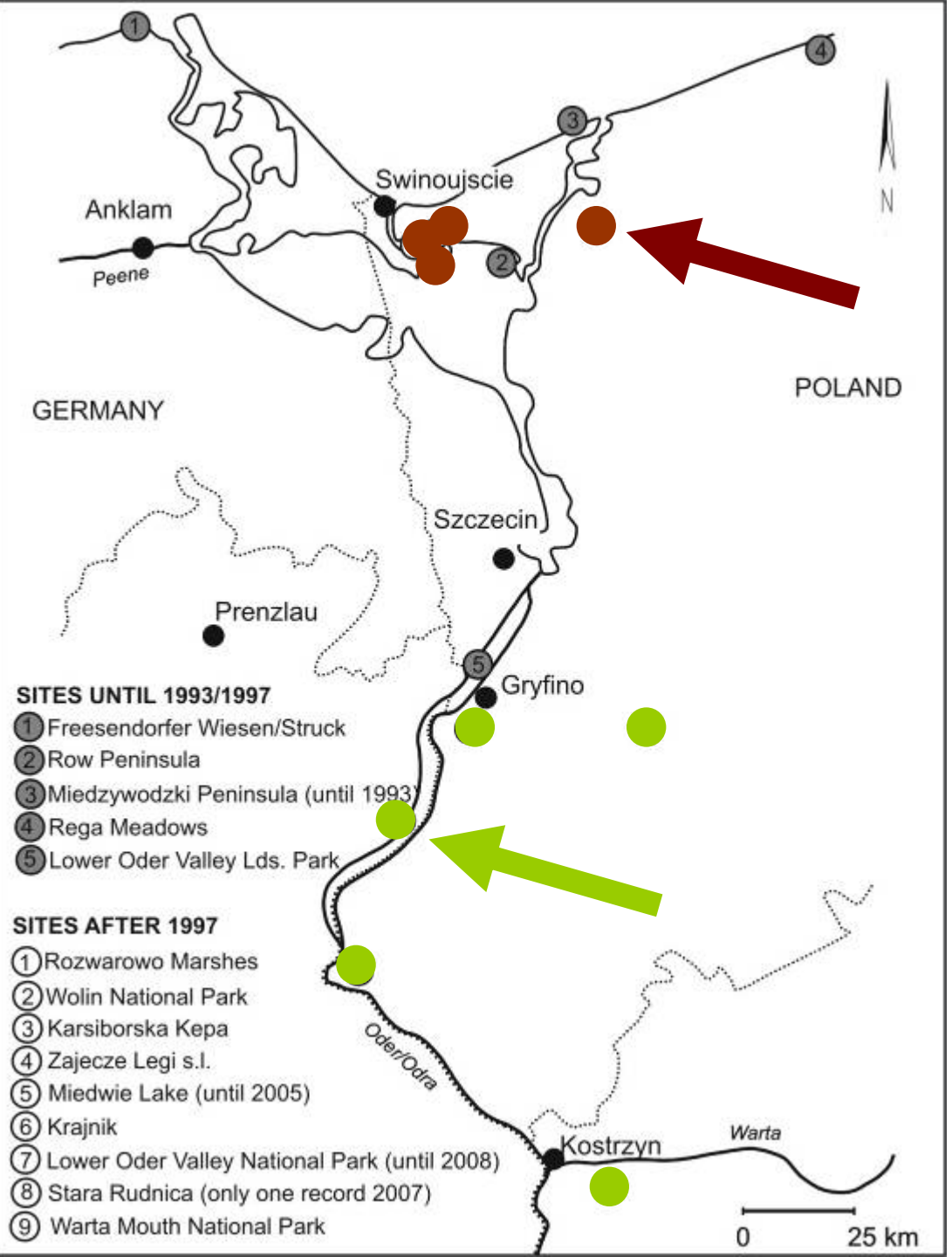


Data 2004-2006 (2009)

- Sites: in all 9 current/recently abandoned breeding regions
- AW data:
  - singing males all years (incl. song records)
  - 9 nests (2006)
  - food of Sedge Warbler (surrogate species; 2005)
- Habitat data: water/soil conditions, vegetation structure, potential prey composition and biomass, habitat heterogeneity
- Land use: direct observation or interviews
- Sampling time:
  - at the time of arrival (late April/early May)
  - at the peak of the 1st brood (late May/early June)
  - at the peak of the 2nd brood (late June/early July)

Research approach





Coastal and small river valley sites

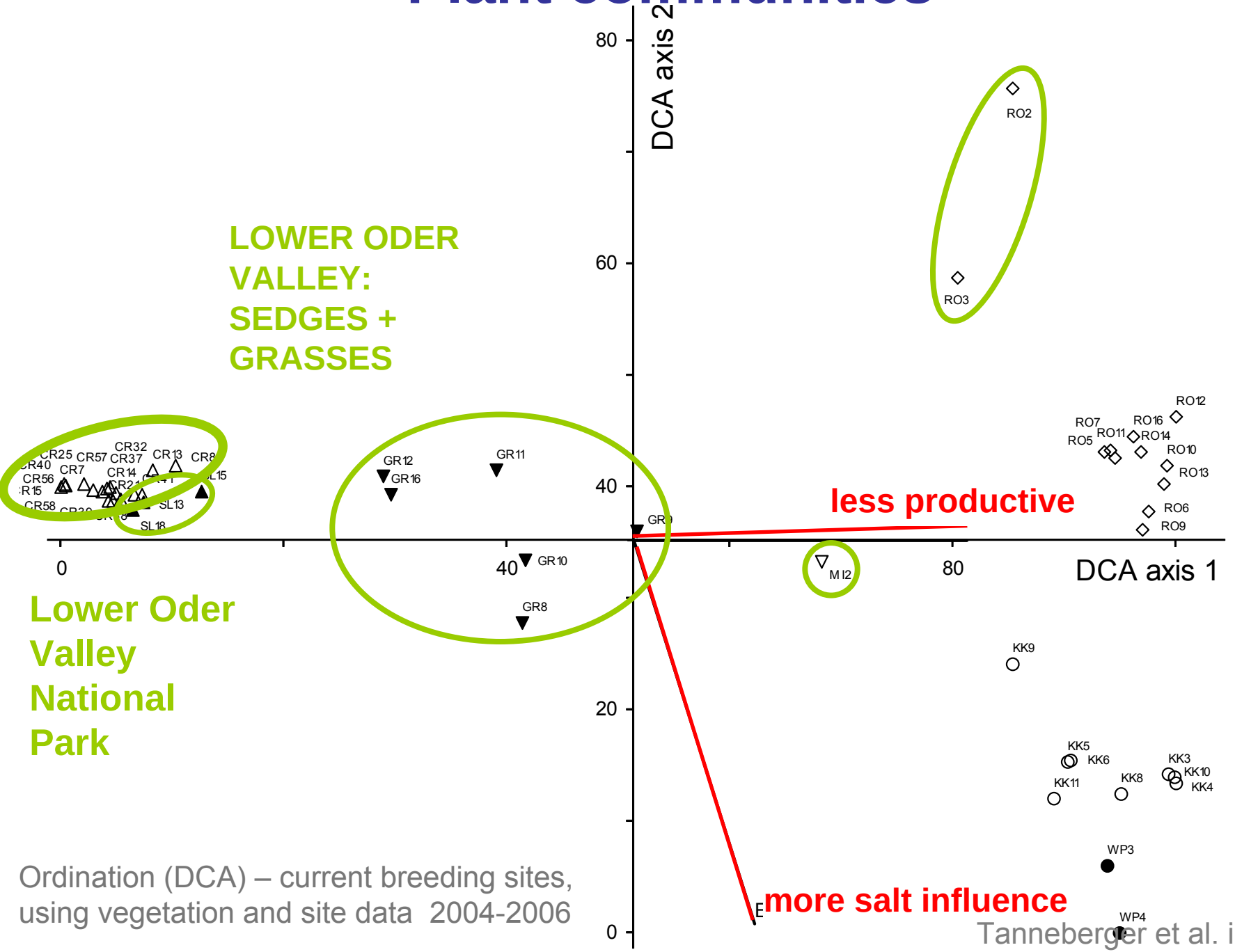
slightly eutrophic (soil C/N 15-19)

Lower Oder valley sites

strongly eutrophic (soil C/N 10-13)

Tanneberger et al. in print

Plant communities



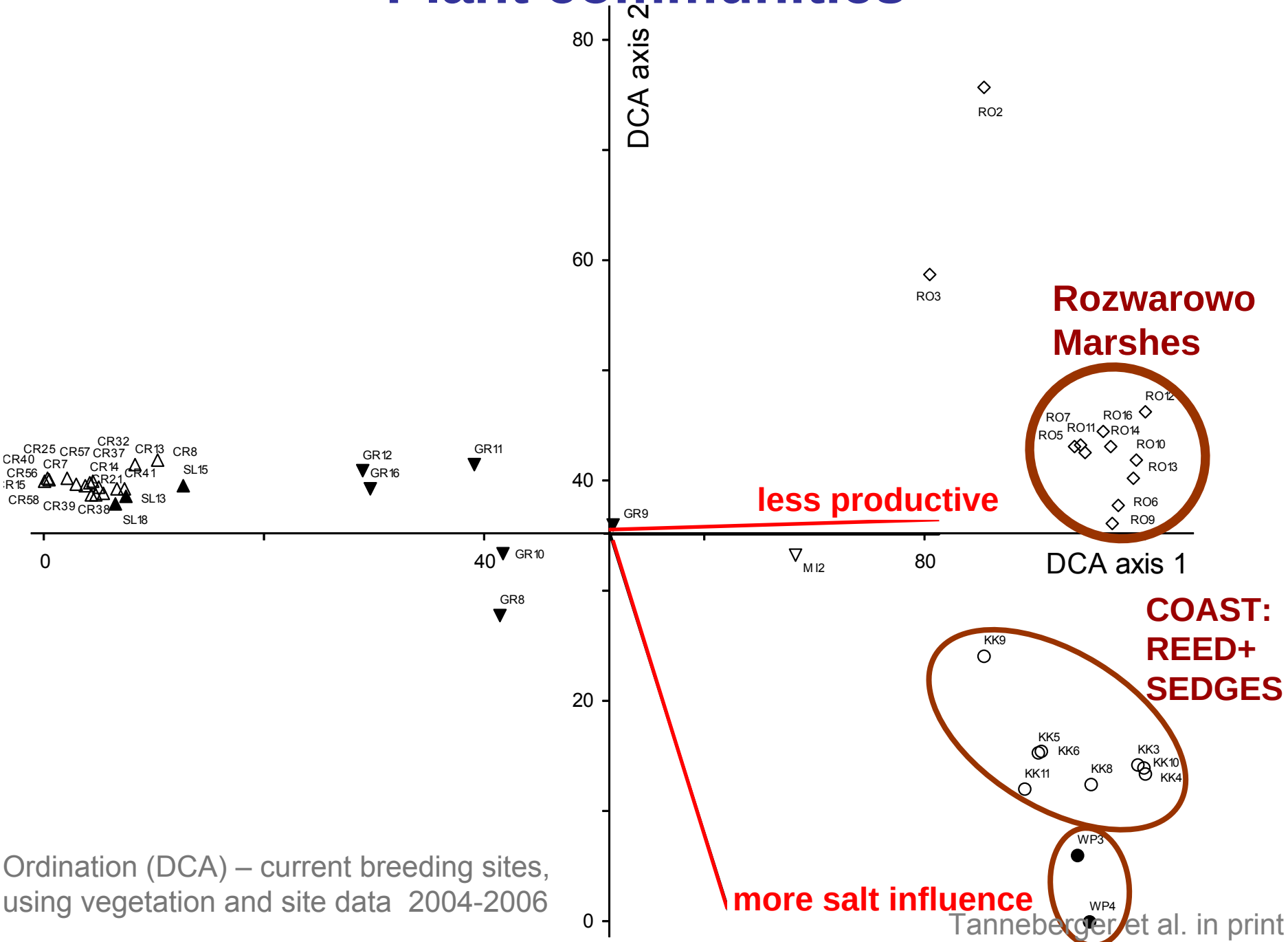
Ordination (DCA) – current breeding sites, using vegetation and site data 2004-2006

Tanneberger et al. in print

Lower Oder Valley National Park

the last breeding site in Germany

Plant communities



Ordination (DCA) – current breeding sites, using vegetation and site data 2004-2006

Tanneberger et al. in print

Rozwarowo Marshes

different species/communities → similar structure!

the largest Pomeranian breeding site

Vegetation structure

NP Lower Oder Valley

Early May	current	abandoned	test	p
Number of plots	12	15		
Mean vegetation height (cm)	65 ± 7	86 ± 8	t = 6.905	0.005
Cover of herb layer (%)	14.8 ± 10.2	2.6 ± 3.6	t = -3.969	0.005
Thickness of litter layer (cm)	4.4 ± 6.6	10.3 ± 7.3	t = 2.224	0.035

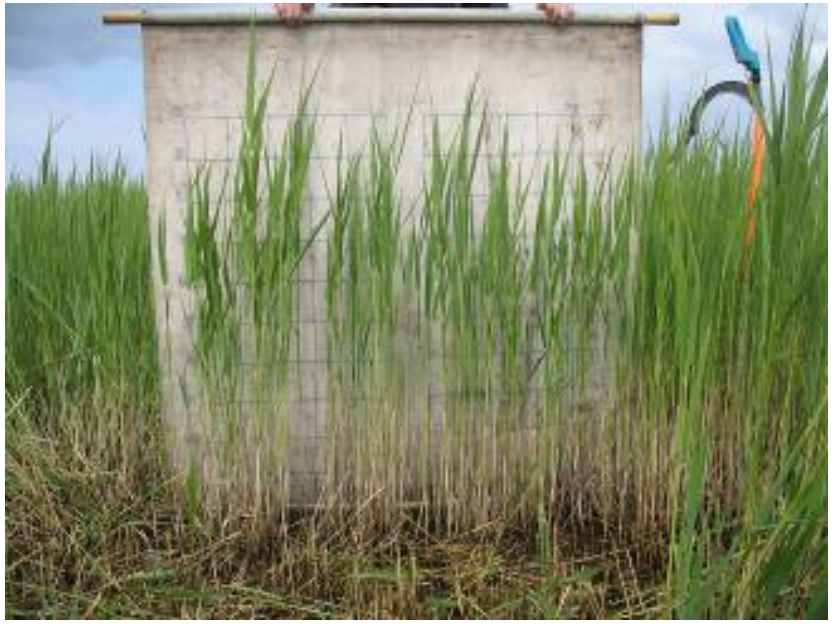
t-test Holm corrected, N=27, 2004-2006

Tanneberger et al. J. Orn 2008

Vegetation structure

Rozwarowo Marshes

Early May	current	abandoned	test	p
Number of plots	21	20		
Mean vegetation height (cm)	64 ± 5	110 ± 8	t = 6.905	0.005
Cover of herb layer (%)	26.2 ±13.5	9 ±6.5	t = -3.969	0.005



t-test Holm corrected, N=41, 2005

Tanneberger et al. Biodiv Cons 2009

Parameters in habitat modelling

Abbreviation	Parameter	Unit/category
DISTAW	Distance to nearest other AW	m
AREA	Area of this habitat type	ha
WATHEIGHT	Water level	cm
SOILMOIS	Soil moisture	3=moist 4=moist to wet 5=wet 6=open water
CN_SO	Nutrient availability measured in soil samples	-
VEGHEIGHT	Vegetation height	cm
PREY	Potential prey biomass	mg per 100 sweeps
USE-1	Land use in preceding year	0 = no land use 1 = any land use
PROPEAR-1	Proportion of early used area in preceding year	-
SPNUM	Plant species number per 25 m^2	-
COVHERB1	Cover of the lower herb layer (< 30 cm)	%
COVHERB2	Cover of the upper herb layer (< 30 cm)	%
LITTMEAN	Thickness of the litter layer	cm
T_HET	Habitat heterogeneity	0 = lowest; 0.81 = highest

→ known from studies in core population (Leisler 1981, Schulze-Hagen 1991, Dyrcz & Zdunek 1993, Kozulin & Flade 1999)

→ related to land use (Jensen & Schrautzer 1999, Pfadenhauer et al. 2001, Hodgson et al. 2005)

→ additionally developed

→ parameter reduction (pairwise correlation, importance in univariate models)

Tanneberger et al. in revision

Results of habitat modelling I

Model		Maximum dataset for each model (various *N*)					Maximum full dataset (*N*=56)			
		Predictor	Coeffcient	Standard error	P		**Predictor**	Coeffcient	Standard error	P
Land use model (1)	a	Intercept	5.477	1.913	0.004	b	Intercept	5.056	2.128	0.017
		COVHERB1	-0.051	0.037	0.117		COVHERB1	-0.066	0.051	0.198
		DISTAW	-0.001	<0.001	0.003		DISTAW	-0.001	<0.001	0.033
		PROPEAR-1	3.493	1.053	0.001		**PROPEAR-1**	4.248	1.614	0.009
		VEG	3.229	0.961	0.001		VEG	3.439	1.353	0.011
		VEGHEIGHT	-0.070	0.023	0.002		VEGHEIGHT	-0.062	0.025	0.013
		N	R^2_N	AUC			R^2_N	AUC	AIC_c	w_i
		98	0.574	0.902			0.480	0.877	55.63	0.682
Food resource model (2)	a	Intercept	-0.744	2.145	0.729	b	Intercept	0.751	2.393	0.754
		DISTAW	-0.001	<0.001	0.007		DISTAW	-0.001	<0.001	0.028
		PREY	0.020	0.008	0.014		**PREY**	0.012	0.009	0.187
		PROPEAR-1	[illegible]	[illegible]	[illegible]		PROPEAR-1	2.699	1.707	0.114
		VEG	2.746	0.851	0.001		VEG	2.357	0.956	0.014
		VEGHEIGHT	0.003	0.025	0.897		VEGHEIGHT	-0.012	0.028	0.647
		VEGHEIGHT***PREY**	[illegible]	[illegible]	[illegible]		VEGHEIGHT***PREY**	-0.001	<0.001	0.228
		N	R^2_N	AUC			R^2_N	AUC	AIC_c	w_i
		98	0.592	0.908			0.444	0.864	57.51	0.267
Productivity model (3)	a	Intercept	[illegible]	[illegible]	[illegible]	b	Intercept	2.578	1.982	0.193
		CN_SO	[illegible]	0.122	0.133		**CN_SO**	-0.170	0.125	0.174
		DISTAW	[illegible]	[illegible]	[illegible]		DISTAW	-0.001	<0.001	0.023
		PROPEAR-1	3.852	1.283	0.003		PROPEAR-1	3.815	1.393	0.006
		VEG	-6.867	4.558	0.132		VEG	-6.265	4.635	0.177
		VEG***CN_SO**	[illegible]	[illegible]	[illegible]		[illegible]	0.449	0.263	0.088
		N	R^2_N	AUC			R^2_N	AUC	AIC_c	w_i
		70	0.486	0.866			0.406	0.843	61.03	0.046
Heterogenity model (4)	a	Intercept	0.092	0.039	0.019	b	Intercept	8.713	4.048	0.031
		COVHERB2	-0.131	0.057	0.022		COVHERB2	-0.115	0.059	0.056
		DISTAW	-0.001	<0.001	0.013		DISTAW	0.001	<0.001	0.03
		PROPEAR-1	2.024	1.107	0.067		PROPEAR-1	3.489	1.494	0.02
		T_HET	-0.219	0.121	0.068		**T_HET**	-19.336	11.881	0.104
		COVHERB2***T_HET**	0.353	0.188	0.061		COVHERB2***T_HET**	0.261	0.192	0.175
		N	R^2_N	AUC			R^2_N	AUC	AIC_c	w_i
		87	0.310	0.780			0.290	0.818	65.37	0.005

→ small number of presences (23)

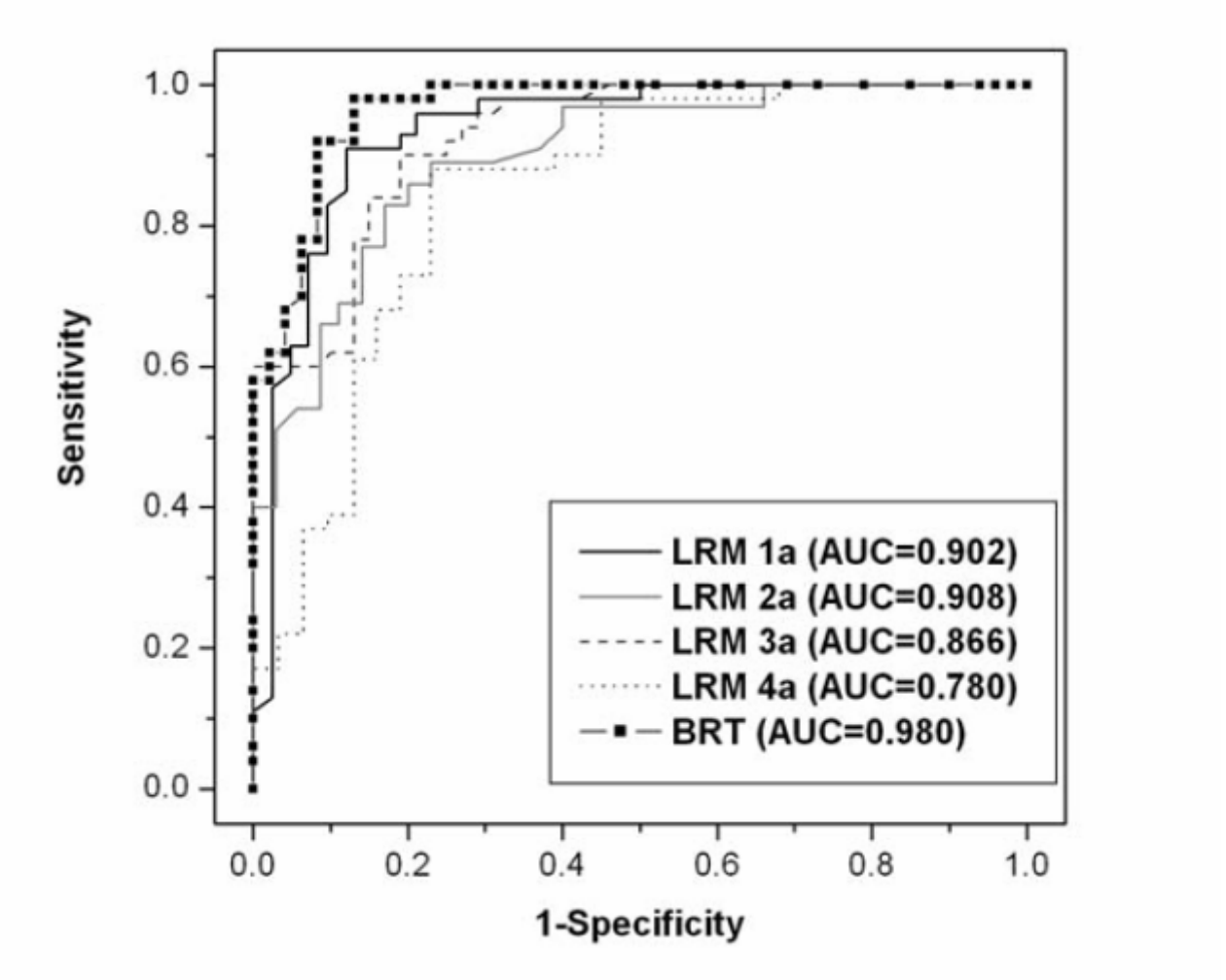
→ four equally good logistic regression models (LRM) = set of key habitat parameters

→ no autocorrelation in residuals

LRM, all sites (N=98), 2006

Tanneberger et al. in revision

Results of habitat modelling II



LRM and BRT, all sites (N=98), 2006

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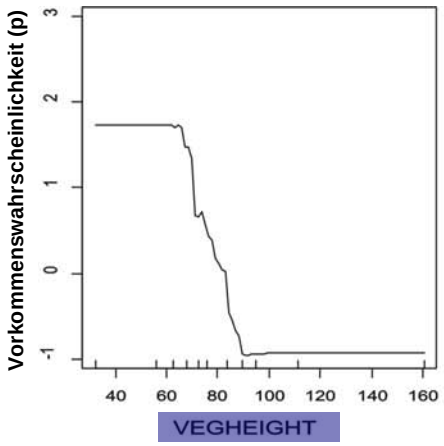
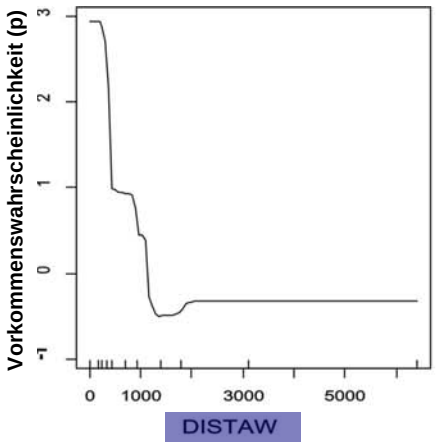
Results of habitat modelling III



low



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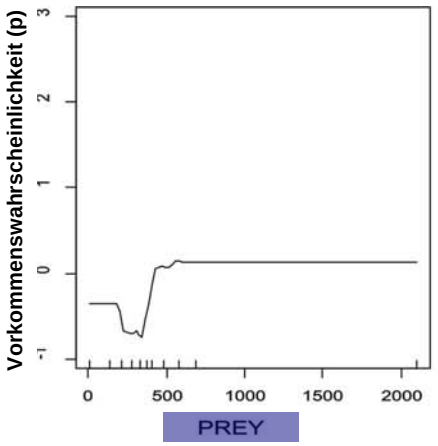
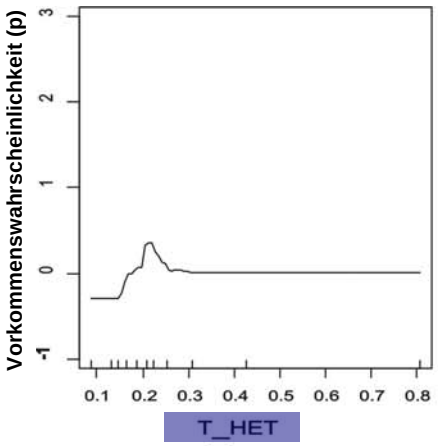
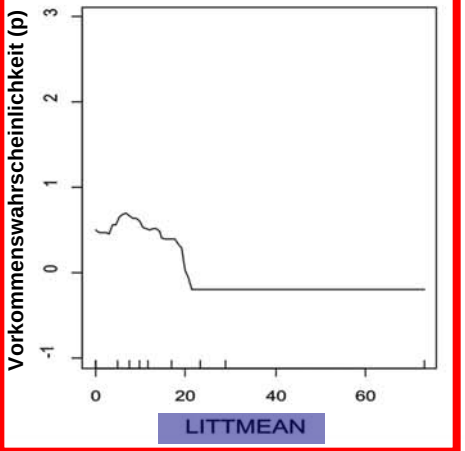


high



medium

Difference to core population



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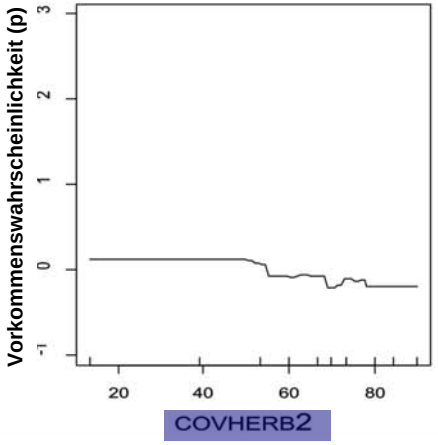

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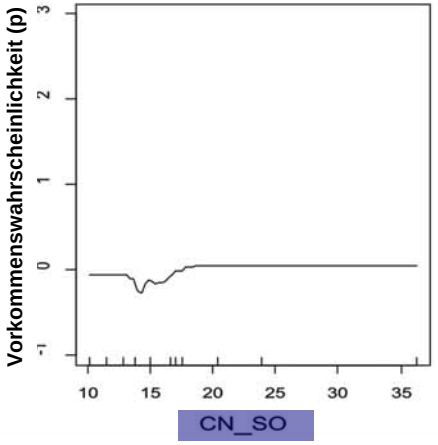

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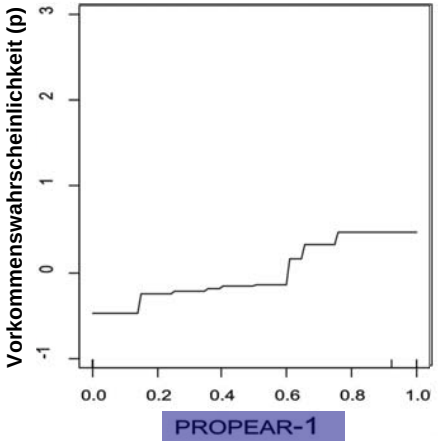

high

BRT with 700 trees, tree complexity 3, learning rate 0.005; AUC=0.98, all sites (N=98), 2006

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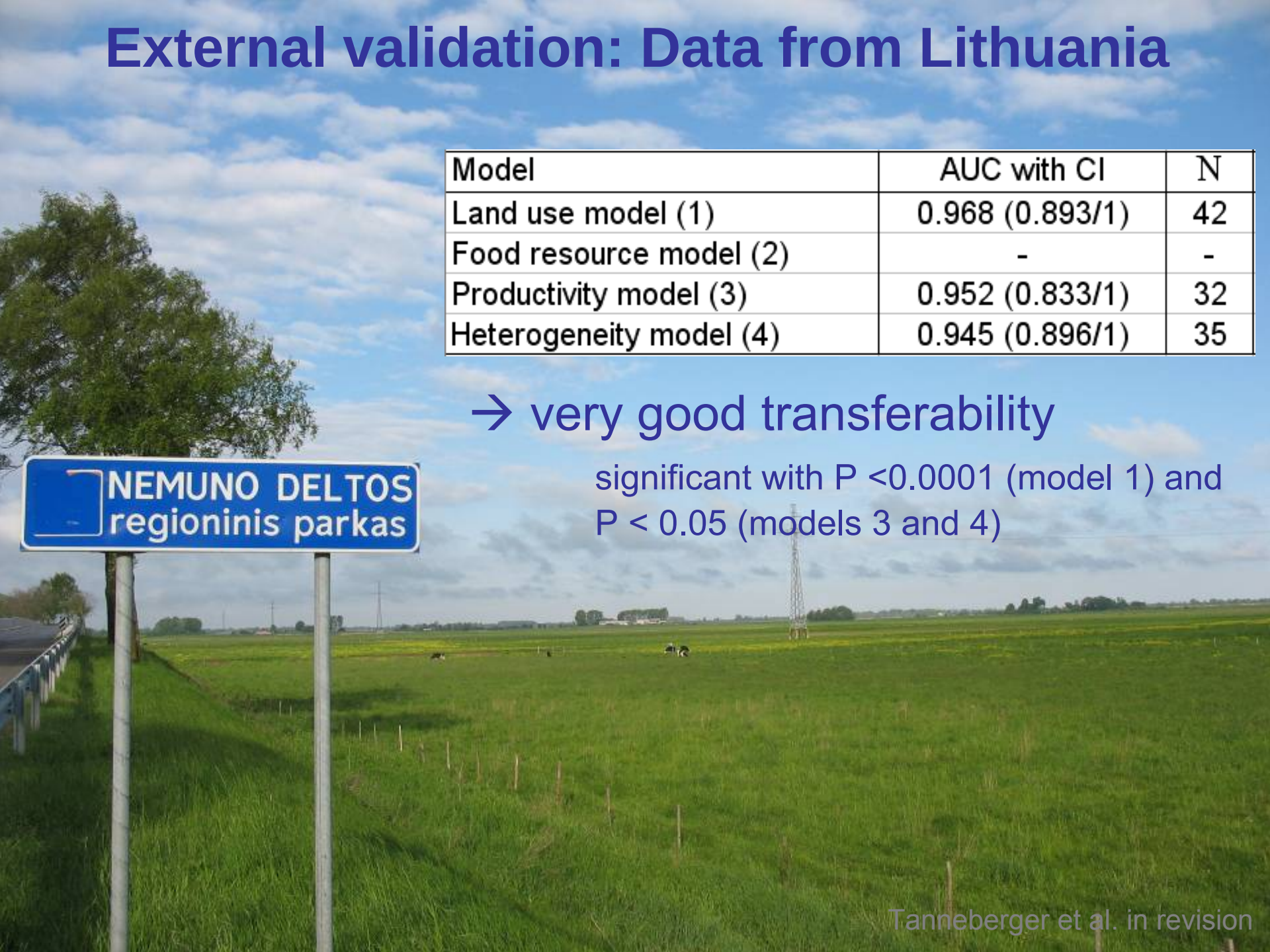
External validation: Data from Lithuania

Model	AUC with CI	N
Land use model (1)	0.968 (0.893/1)	42
Food resource model (2)	-	-
Productivity model (3)	0.952 (0.833/1)	32
Heterogeneity model (4)	0.945 (0.896/1)	35

→ very good transferability

significant with P <0.0001 (model 1) and P < 0.05 (models 3 and 4)



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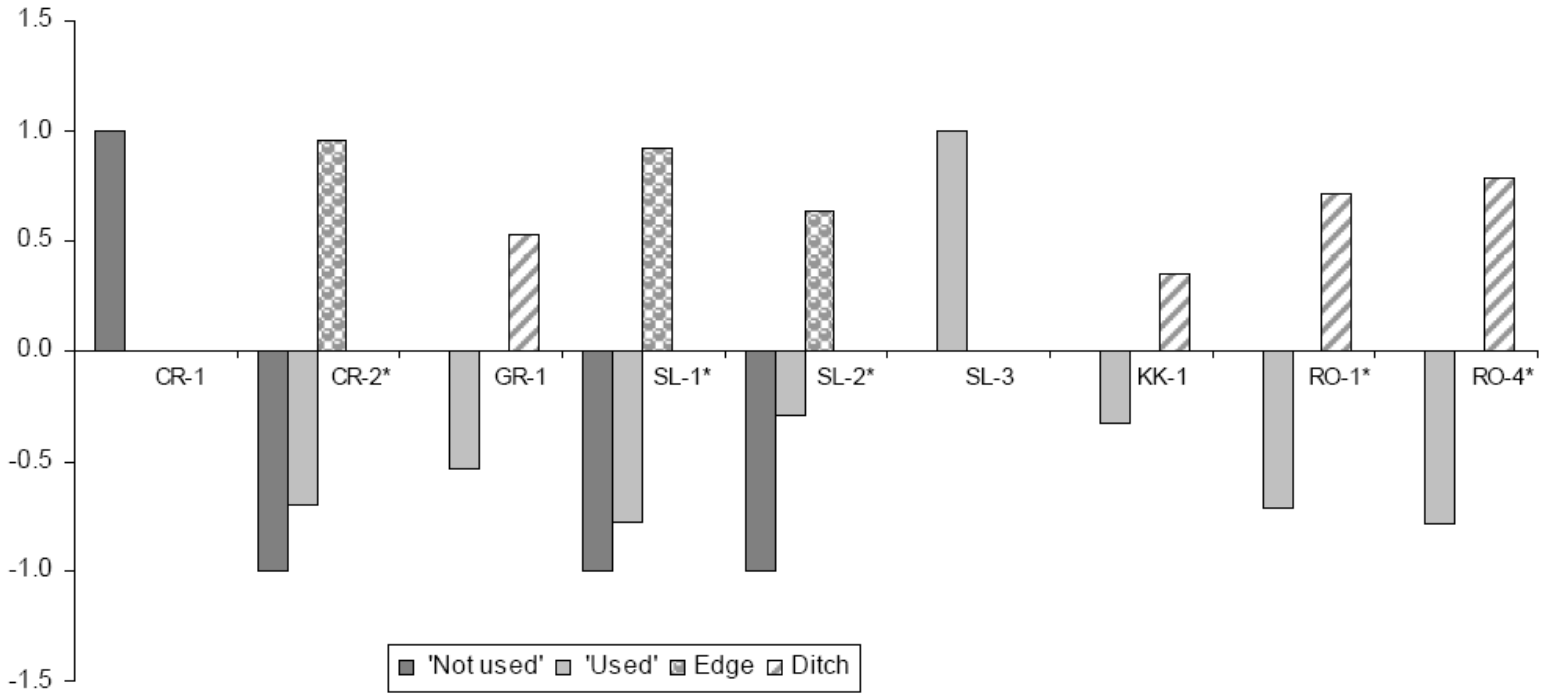
Food supply – limited?

Reference	Area	Nests	Mean/Median (m)	Preference
Dyrcz & Zdunek (1993)	Biebrza	8	31.7	no
Schulze-Hagen et al. (1989)	Biebrza	17	18	no
A. Kozulin in prep.	Belarus	12	25.5	no
this study	**Pomerania**	**9**	**60**	**ja**

→ AW in Pomerania fly longer and more selective



Jacobs Index D with x^2-test (*=significant difference), 246 flights from 9 nests, 2006

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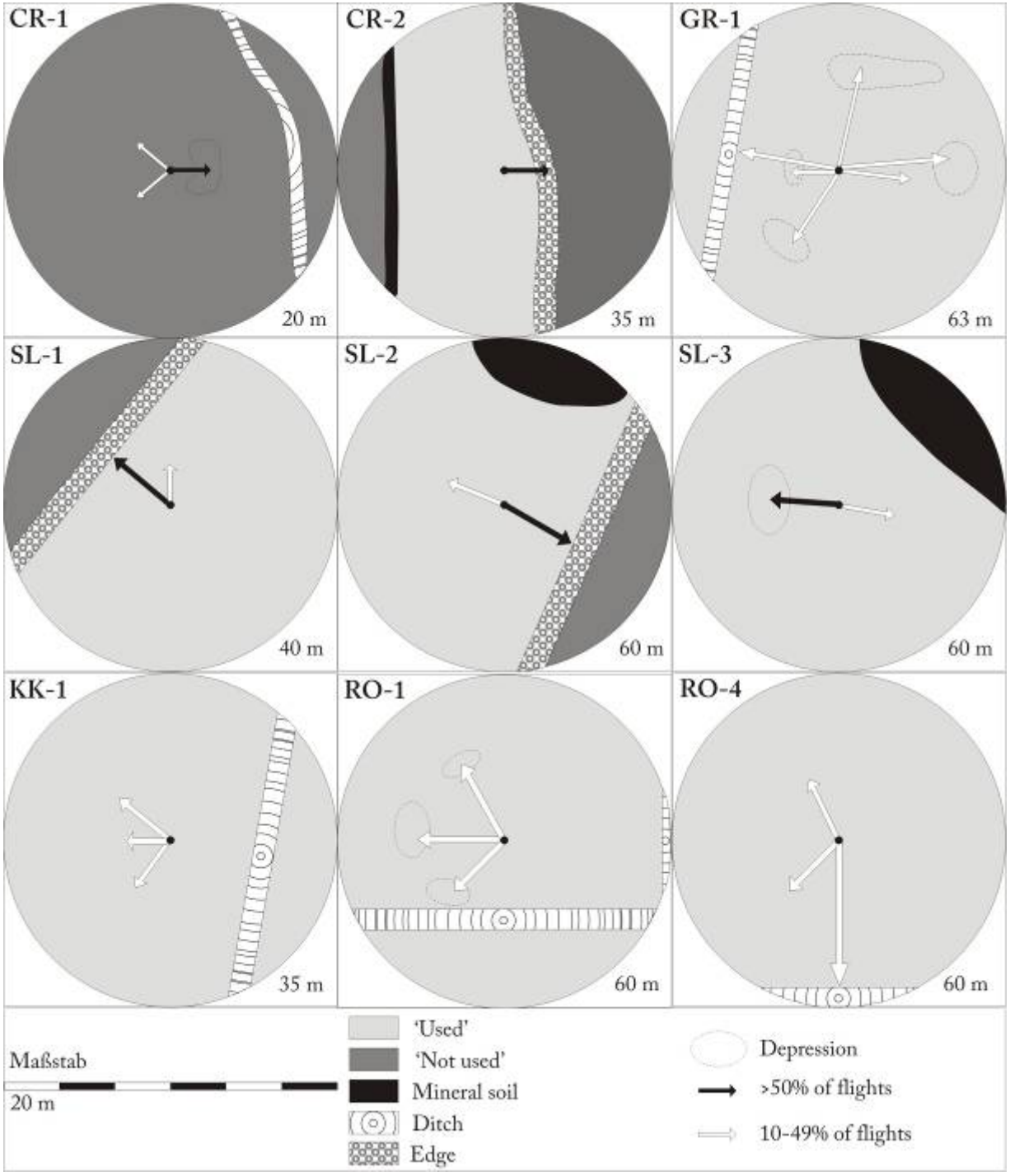


'used' = mown/grazed before 31.7. in more eutrophic sites and mown in winter in less eutrophic sites, with sufficient biomass removal

'not used' = no land use at all or mown/grazed in late summer in more eutrophic sites

Tanneberger et al. in prep.

Food supply – limited?

	Pomerania	Belarus
Nests	4	13
Samples	165	145
Prey items	622	908
Weight of prey items (mg)	2.5 (1.8-3.0)	1.0 (1.0-2.6)
Weight of prey bales (mg)	12.5 (11.8-13.6)	13.5 (11.0-22.3)
Prey delivery rate (mg min^{-1} $nestling^{-1}$)	0.5 (0.4-0.5)	0.4 (0.2-0.6)

→ Sedge Warbler: no difference in prey delivery rate between Pomerania and Belarus

→ Aquatic Warbler in Pomerania: successful broods (juveniles observed outside nest) - 7/9 in 2006

Median and quartiles per nest, linear mixed effects models (LMM), collar neck samples 2002-2006

Tanneberger et al. in prep.

Influence of vegetation structure on potential food supply?

Parameter	Level	Estimate ±1SE	P
Intercept		5.723 ±0.089	<0.001
Vegetation	Sedge	0	
	Reed	-1.624 ±0.337	<0.001
Land use	'Not used'	0	
	'Used'	0.461 ±0.117	<0.001
Vegetation * Land use	Reed * 'Used'	1.163 ±0.368	0.002

→ sedge better than reed, ‚used' better than ‚not used'

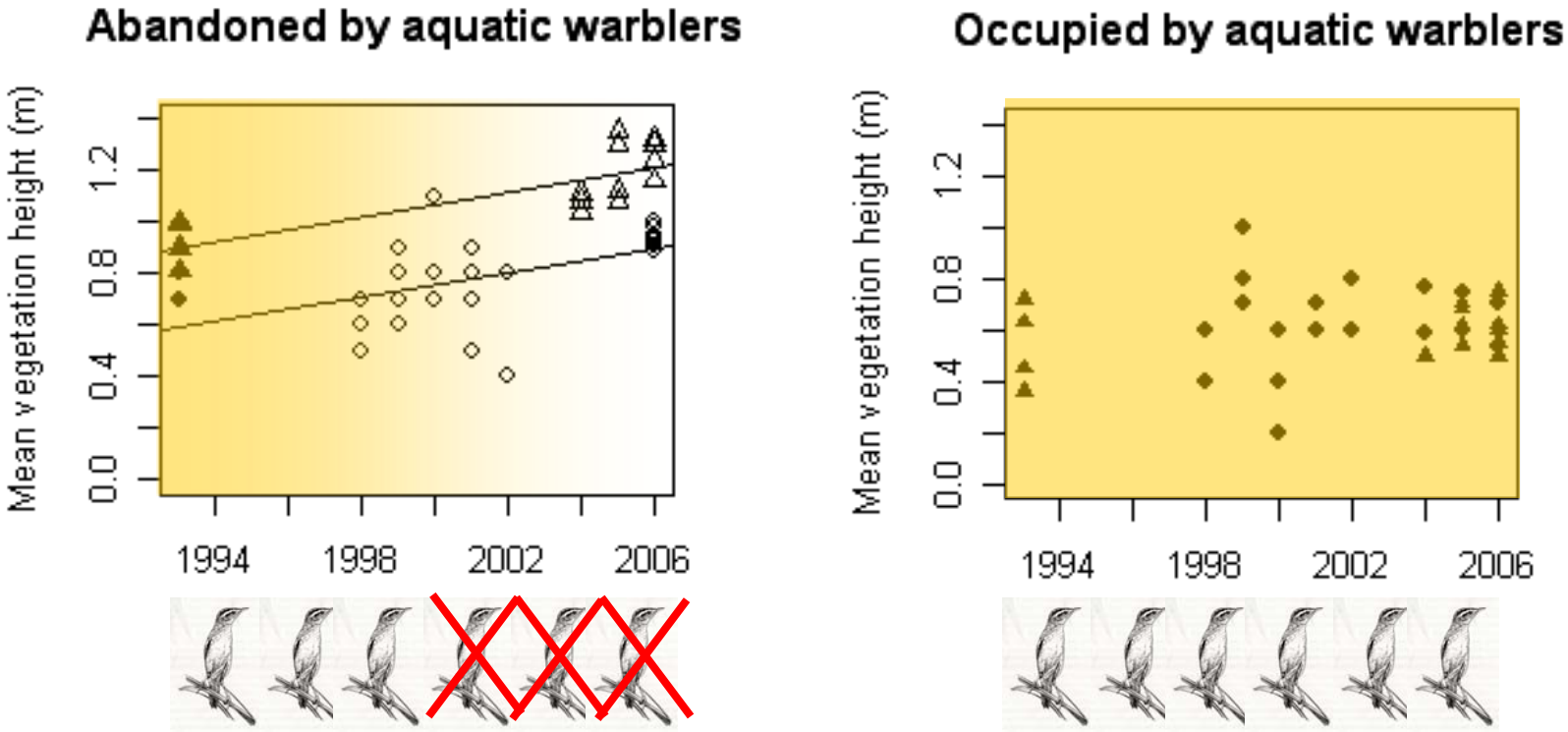
→ best: ‚used' sedge vegetation

Generalised linear mixed effects models (GLMM) for sweep net results, N=121, 2006, region and sample as random effect

Tanneberger et al. in prep.

Influence of land use
strongly eutrophic sites

intensity of mowing/grazing

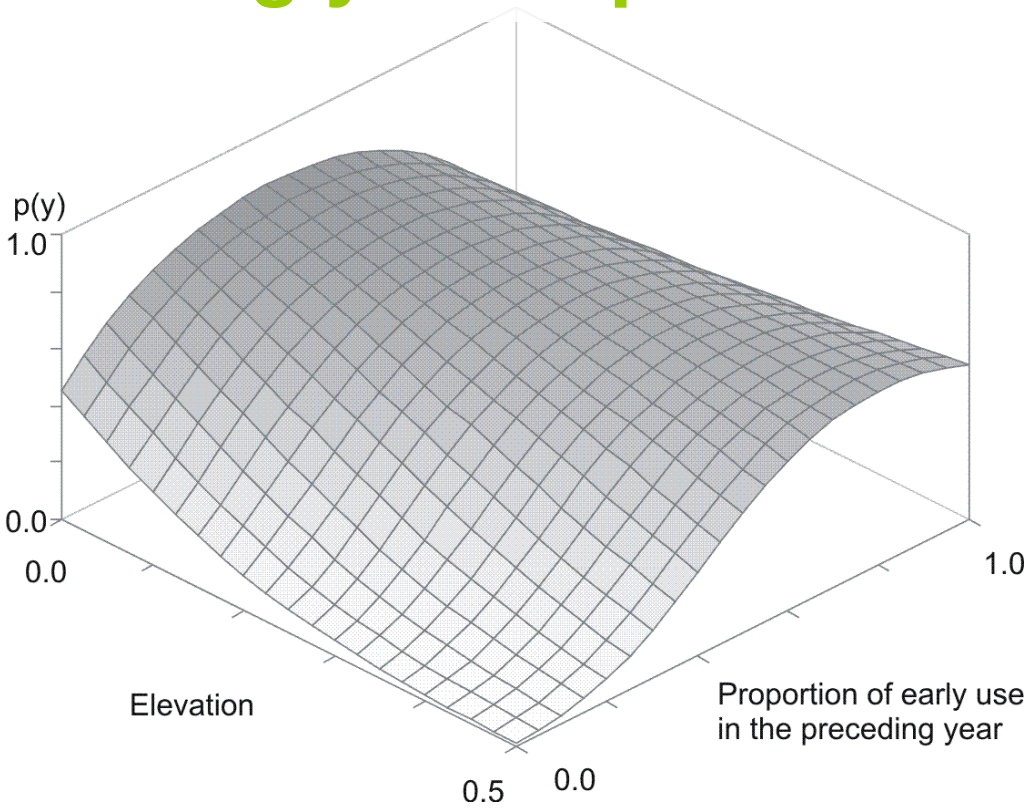


→ vegetation height increases in periods of late summer mowing (after breeding season)

NP Lower Oder Valley, o plot centre, Δ plot margin

Tanneberger et al. J. Orn. 2008

Influence of land use
strongly eutrophic sites



→ especially on higher elevated (=drier) sites
early land use in the preceding year is important

NP Lower Oder Valley 1998-2007, DGM (5x5 m);
GLM mit AUC = 0.73, R^2_N = 0.228

Tanneberger et al. J. Orn. 2008

Management recommendations

strongly eutrophic sites

Alternating early and late land use

Year 1 (3,5,...)

Nest protection; delayed land use (after 30.8.)

Vegetation high & dense

Year 2 (4,6,...)

Land use in June/July

Vegetation suitable

Management recommendations
slightly eutrophic sites

Late summer or winter land use

→ with stripes unmown (nest building material, wintering of prey); prevent (further) eutrophication

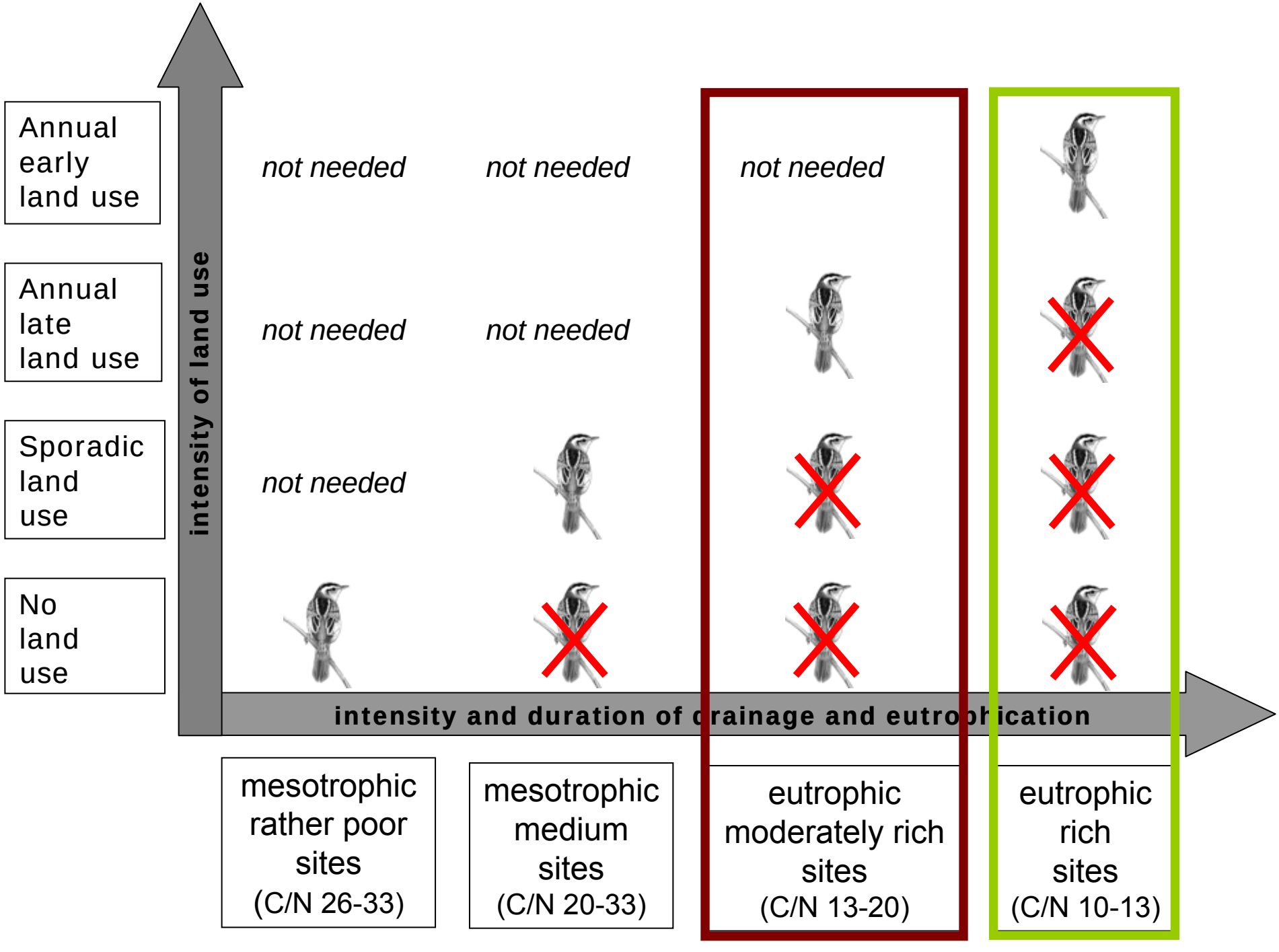
Management recommendations

strongly eutrophic sites with AW = habitat maintenance	early summer land use with nest protection (search for females necessary!) → mosaic, alternating land use
strongly eutrophic sites without AW = habitat restoration	early summer land use
slightly eutrophic sites with AW (habitat maintenance)	late (winter) land use, monitoring of potential vegetation succession!
slightly eutrophic sites without AW (habitat restoration)	late (winter); in case of reed overgrowth: early summer

→ all sites: very good AW monitoring

→ all sites: biomass removal

→ all sites: prevention of further eutrophication


Annual early land use
Annual late land use
Sporadic land use
No land use
intensity of land use
not needed
not needed
not needed
not needed
not needed
intensity and duration of drainage and eutrophication
mesotrophic rather poor sites (C/N 26-33)
mesotrophic medium sites (C/N 20-33)
eutrophic moderately rich sites (C/N 13-20)
eutrophic rich sites (C/N 10-13)

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