IAVS

eDGG Grassland research and conservation

GrassPlot

Zurich University of Applied Sciences

zhaw Life Sciences and Facility Management

Institute of Natural Resource Sciences

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Species-area relationships in continuous vegetation: evidence from Palaearctic grasslands

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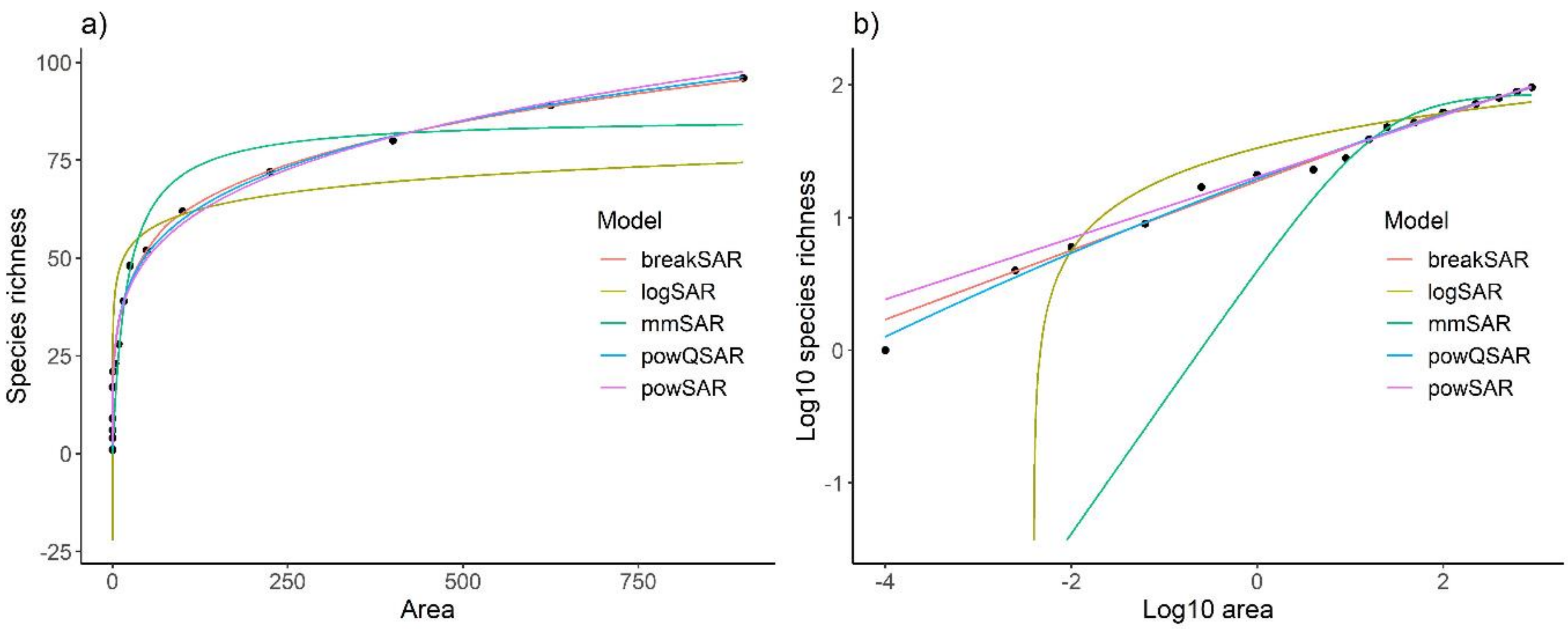
Species-area relationships (SARs)

- Numerous function types proposed for SARs
  (e.g. Tjørve 2003, *J. Biogeogr.* 30: 827-835; Dengler 2009, *J. Biogeogr.* 36: 728-744)

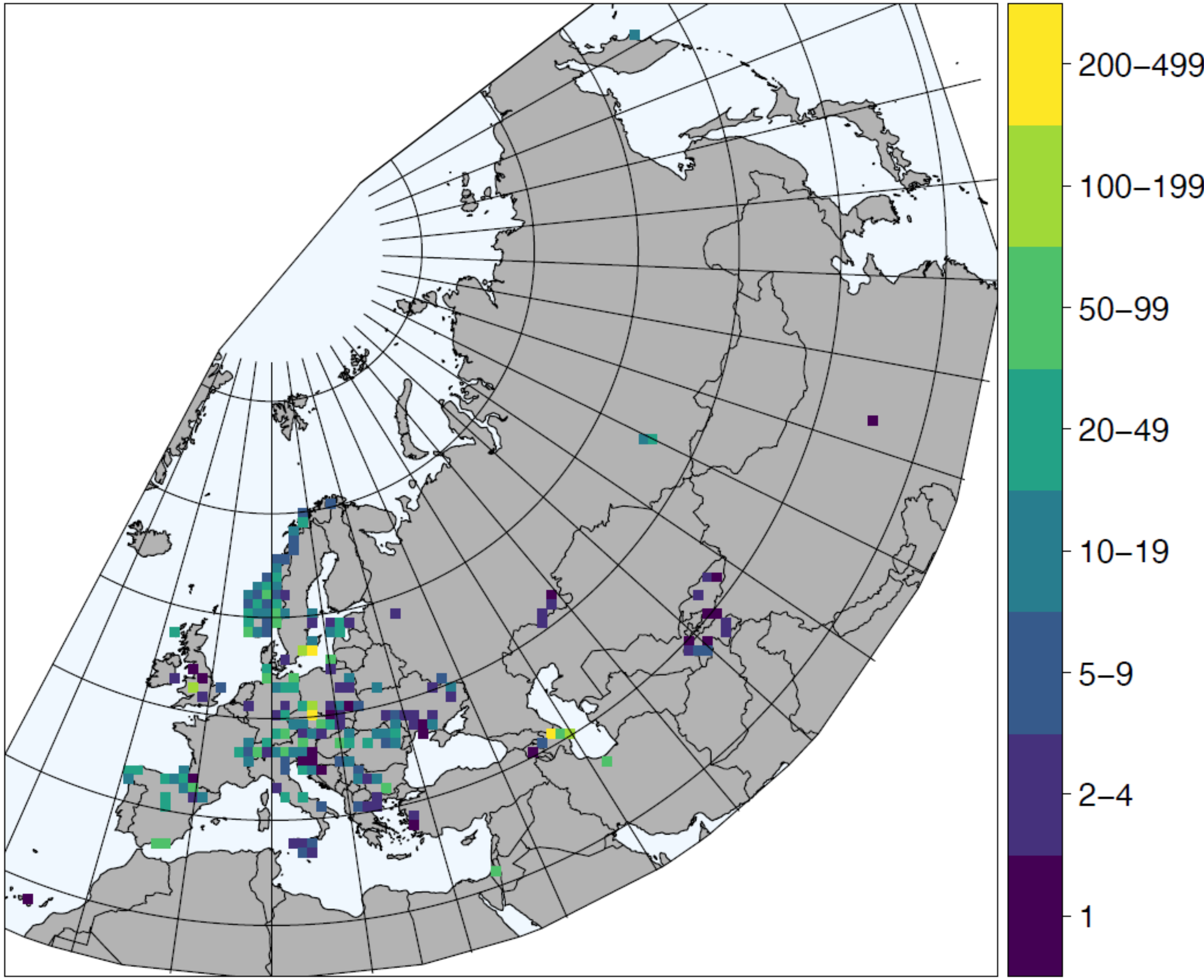
- At coarse grain sizes the power function overall performs best
  (e.g. Triantis et al. 2012, *J. Biogeogr.* 39: 215-239)

➢ For fine grain sizes, the situation, however, was disputed



Data

- GrassPlot database
  Dengler et al. 2018, *Phytocoenologia* 48, 331-347.
- 2057 nested-plot series with ≥ 7 grain sizes
- Many series also with bryophyte and lichen records
- Extensive environmental and structural data from the plots



Annual EDGG Field Workshops

Dengler et al. 2016, *Bull. Eurasian Dry Grassland Group* 31: 12-26.

Analyses

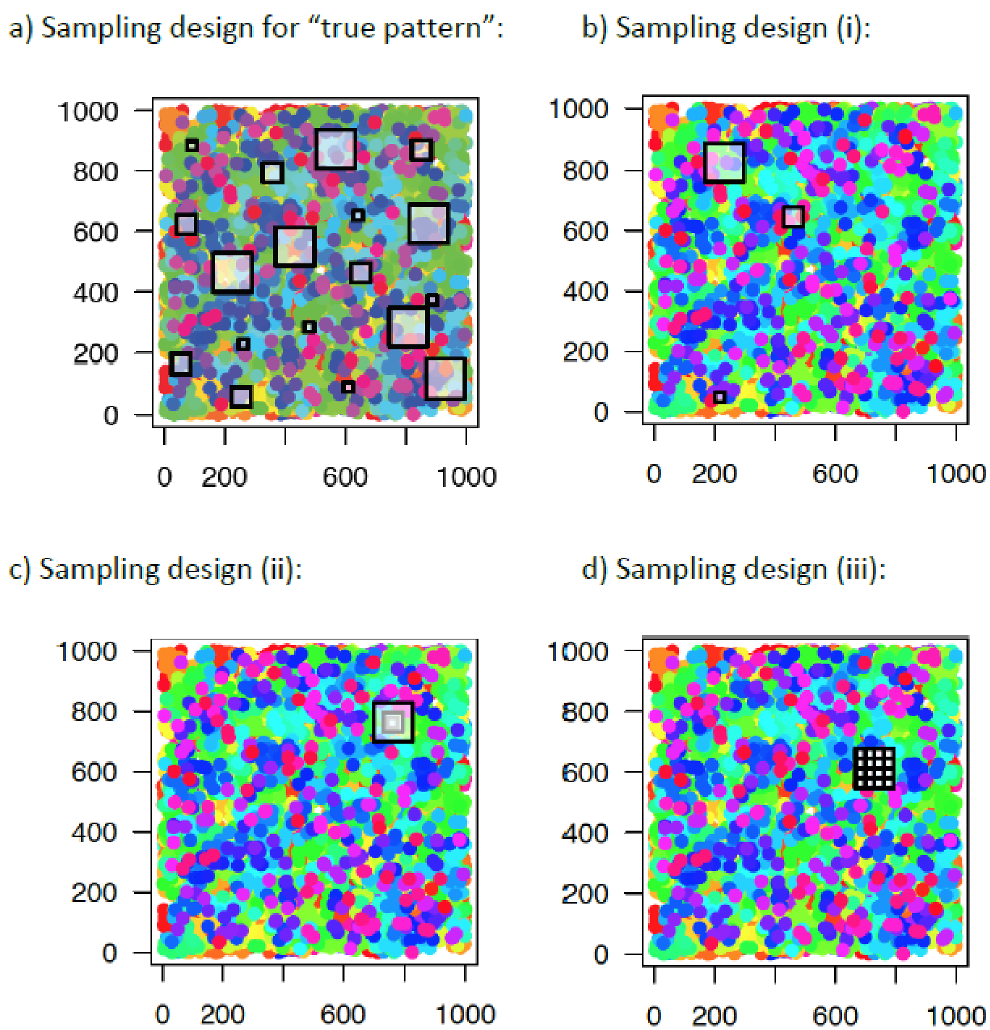
- Five representative functions in comparison

Function name	Akronym	*k*	Formula in *S*-space
Power	powSAR	2	$S = c A^z$
Power quadratic	powQSAR	3	$S = 10^(\log c + z_1 \log A + z_2 (\log A)^2)$
Power breakpoint	breakSAR	4	$S = 10^[\log c + (\log A < \log T) (z_1 \log A) + (\log A \geq \log T) (z_1 \log T + z_2 (\log A - \log T))]$
Logarithmic	logSAR	2	$S = b_0 + b_1 \log A$
Michaelis-Menten	mmSAR	2	$S = b_0 A / (b_1 + A)$

- Fitting in *S*-space and in log *S*-space
- Non-linear regression with a wide range of starting values to assure convergence
- Model comparison via AICc (mean Akaike weights, fraction of best fits), BIC and $R^2_{adj.}$

Are nested plots a methdological problem?

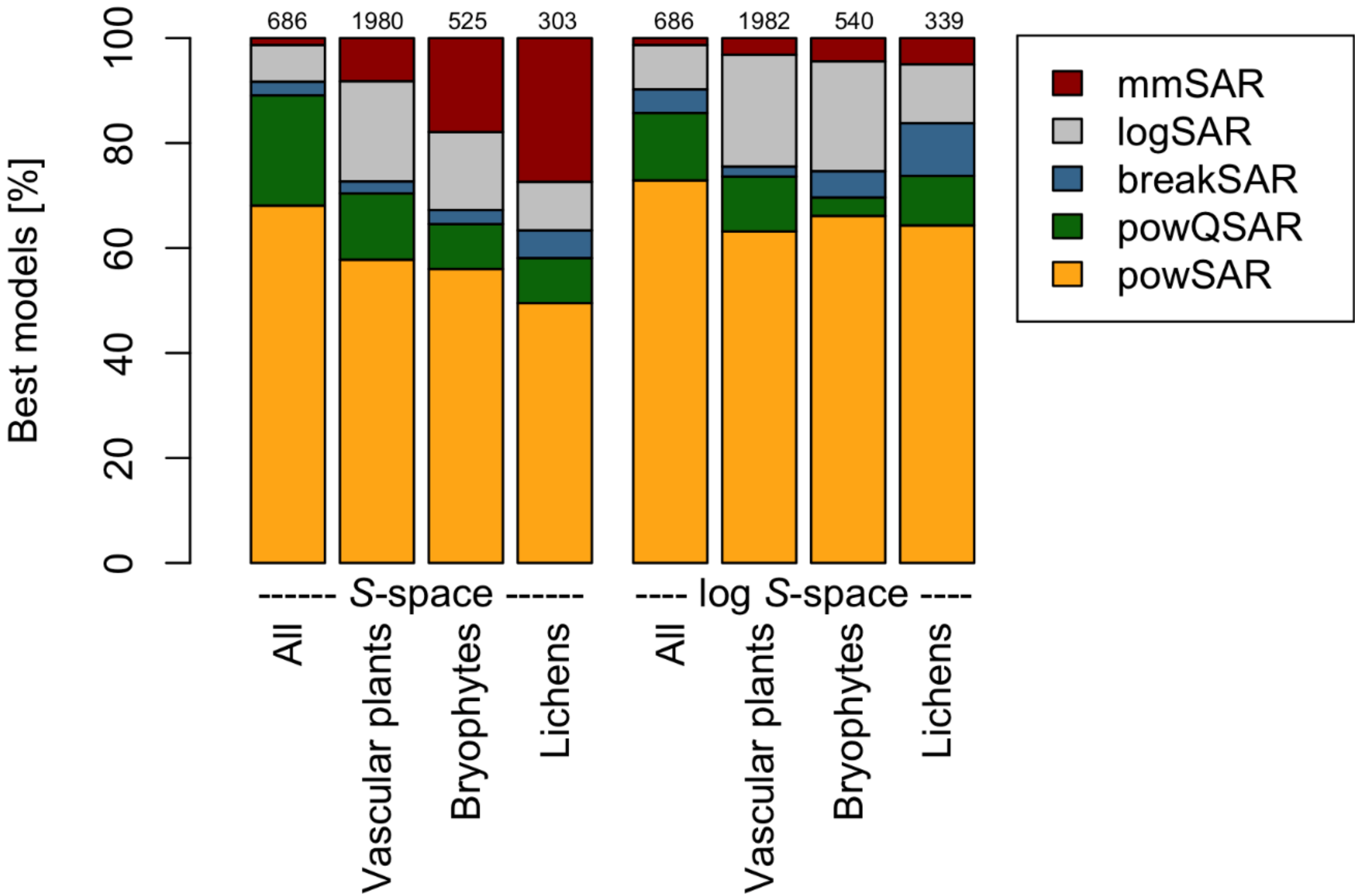
Accuracy of model selection based on simulation (with R package mobsim)



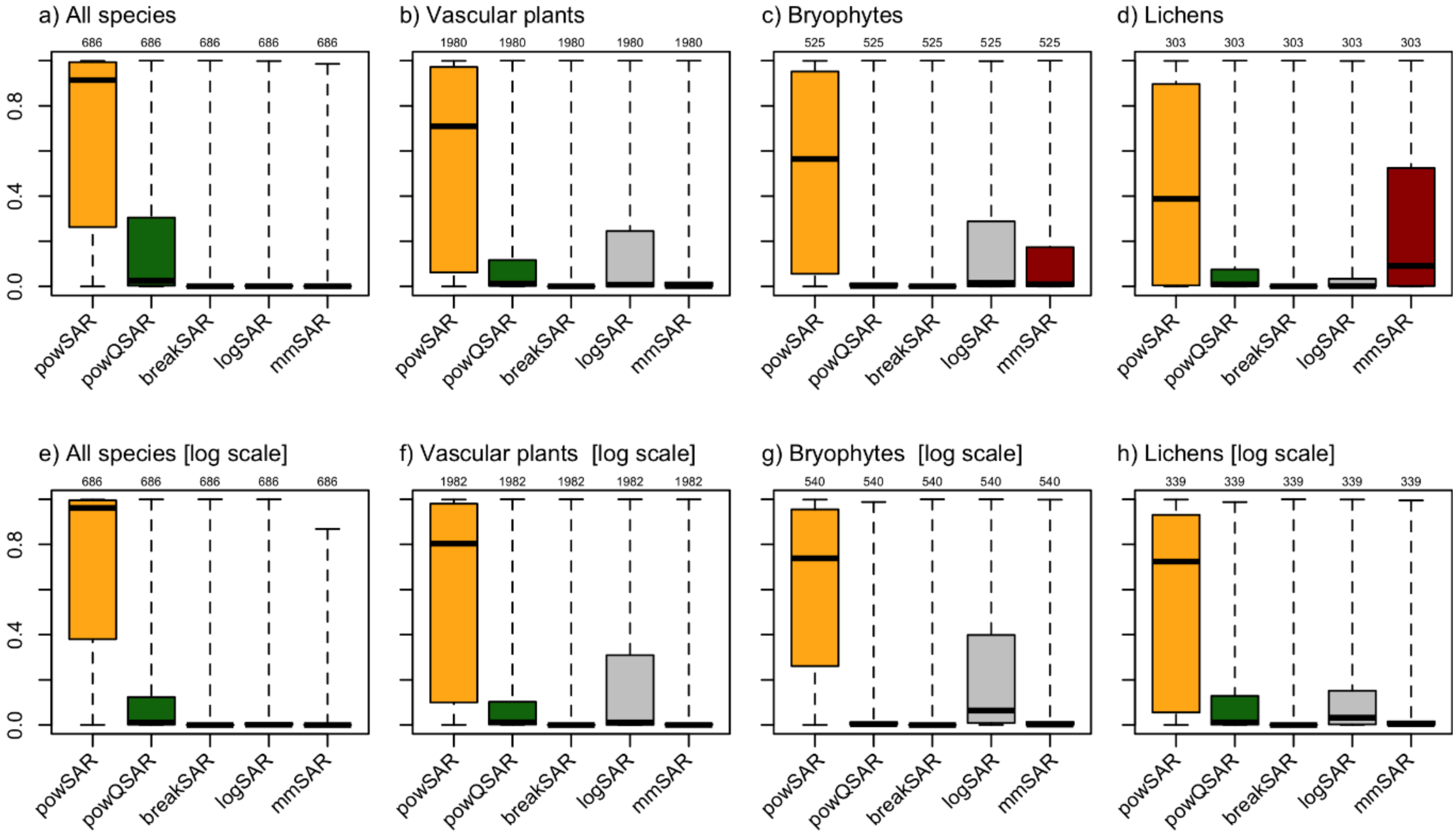
Accuracy of model selection based on simulation
(true pattern = non-nested, averaged)

Sampling design	*S*-space		log *S*-space	
	AICc	BIC	AICc	BIC
Non-nested, single plots	42%	38%	38%	36%
Nested, single plots	54%	52%	48%	54%
Nested, averaged	50%	66%	70%	80%

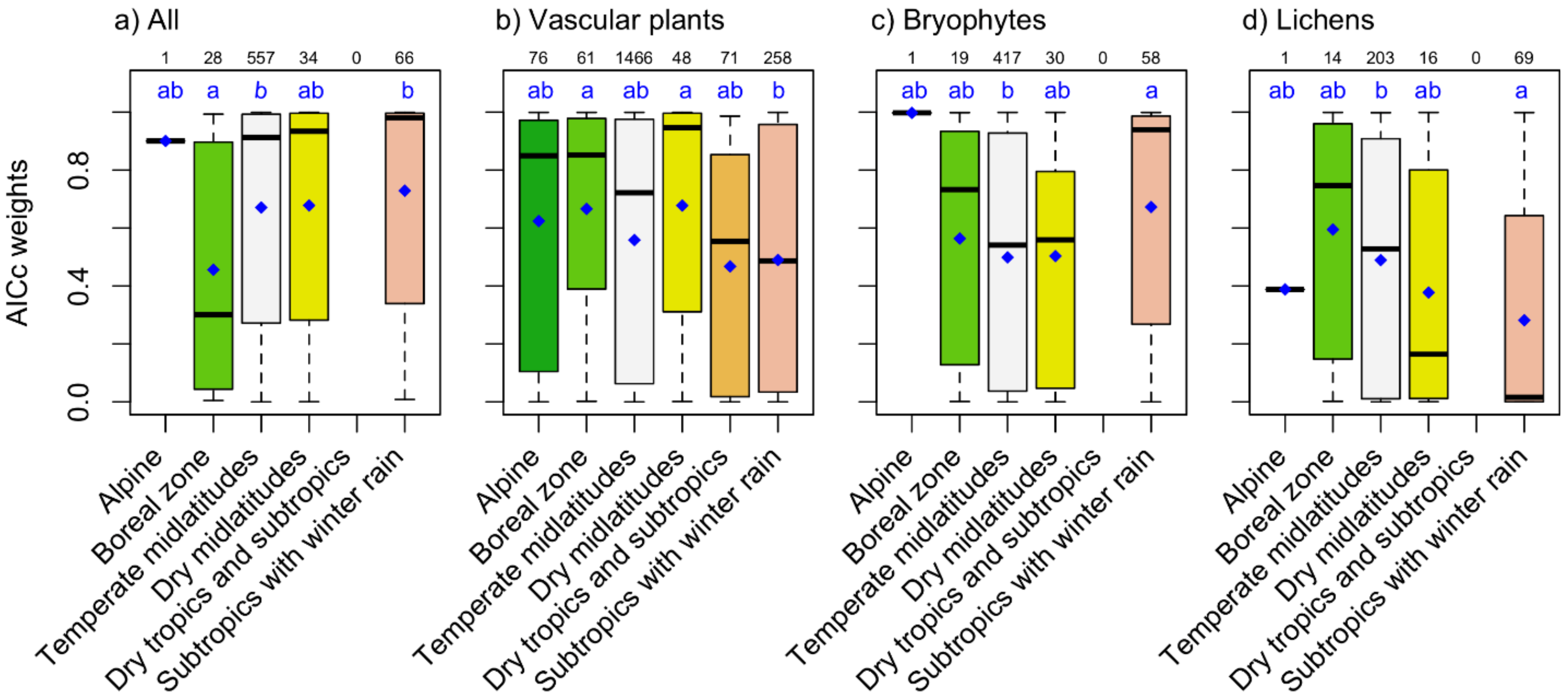
Comparison of the five functions (AICc)



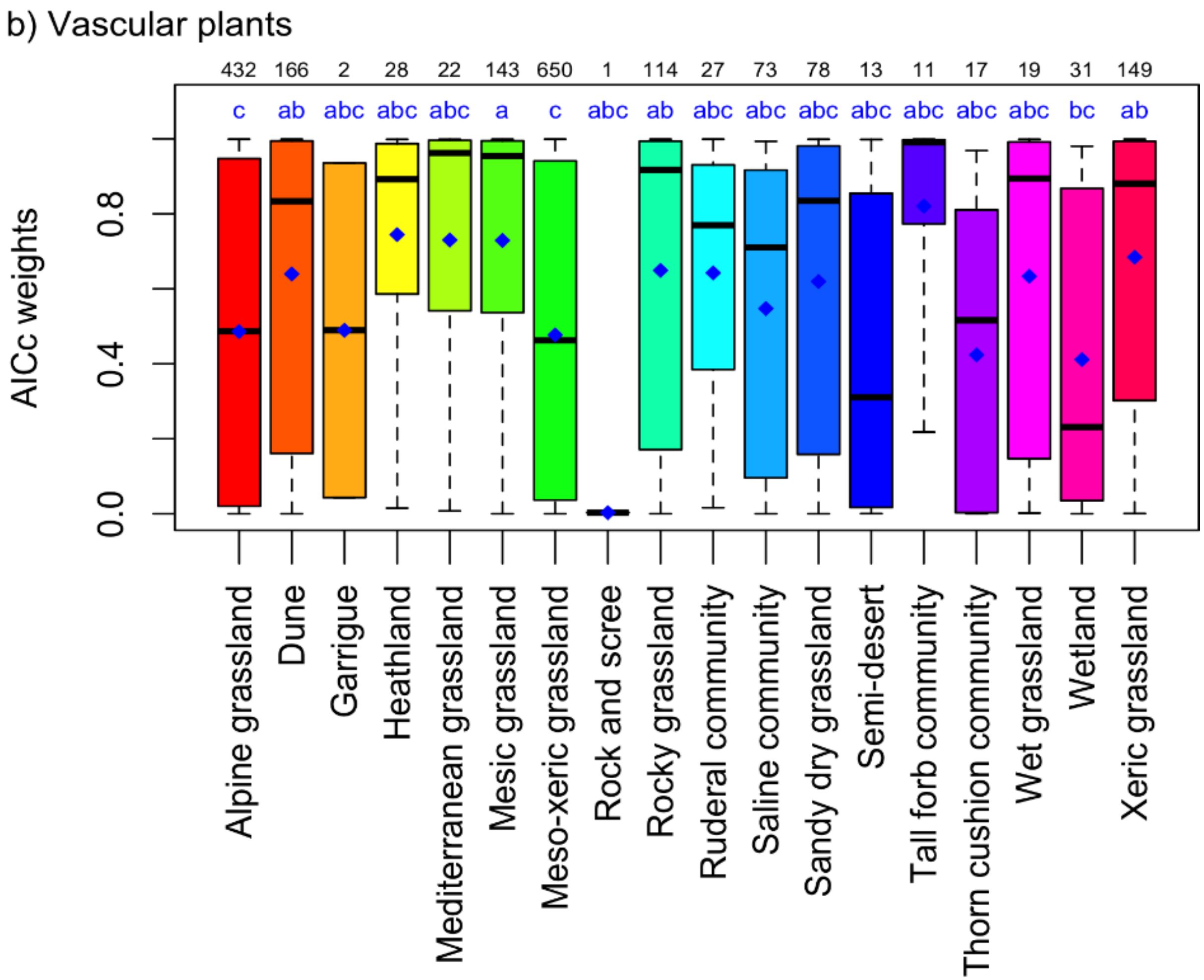
Comparison of the five functions



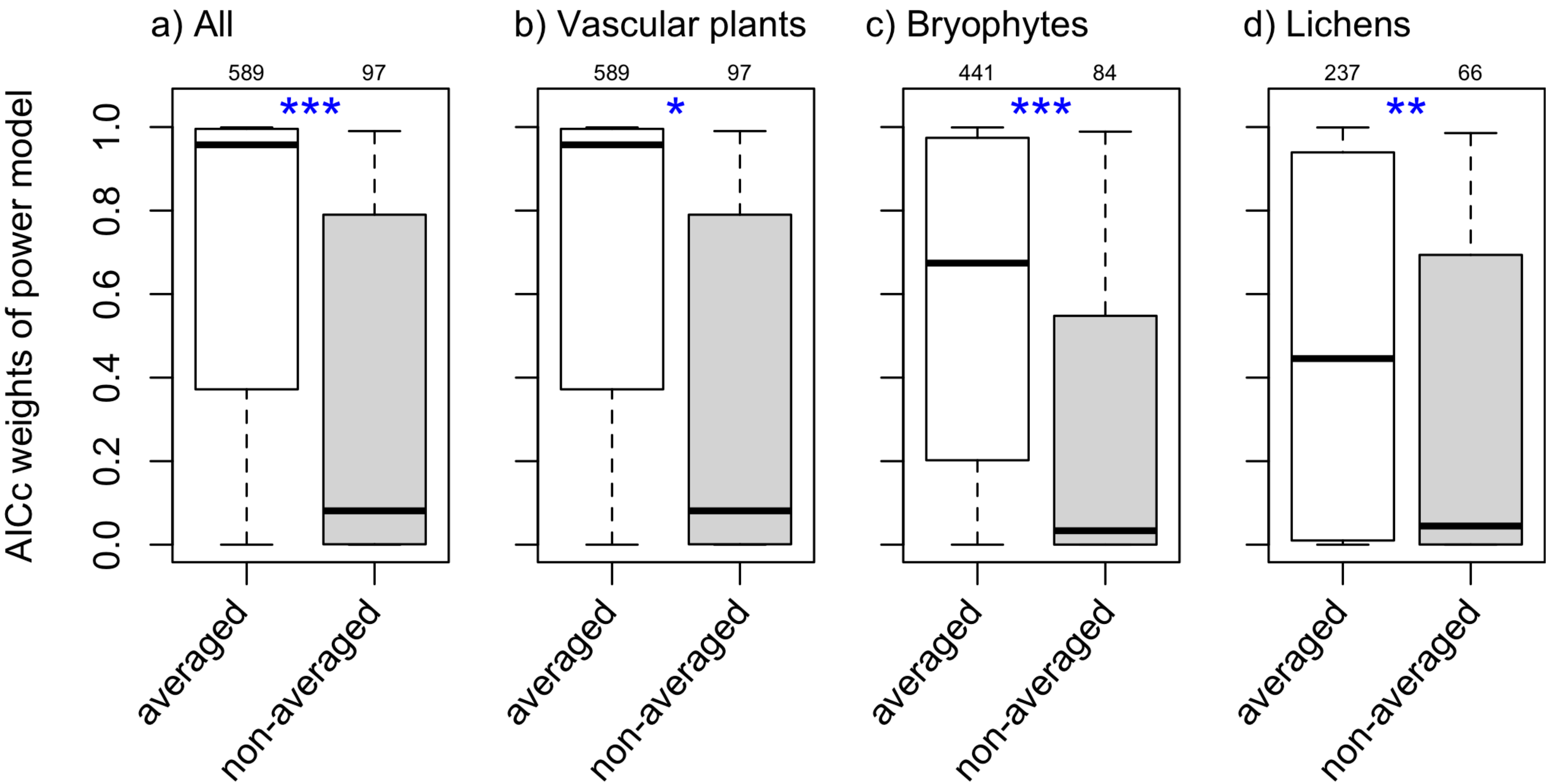
Prevalence of power function vs. biome



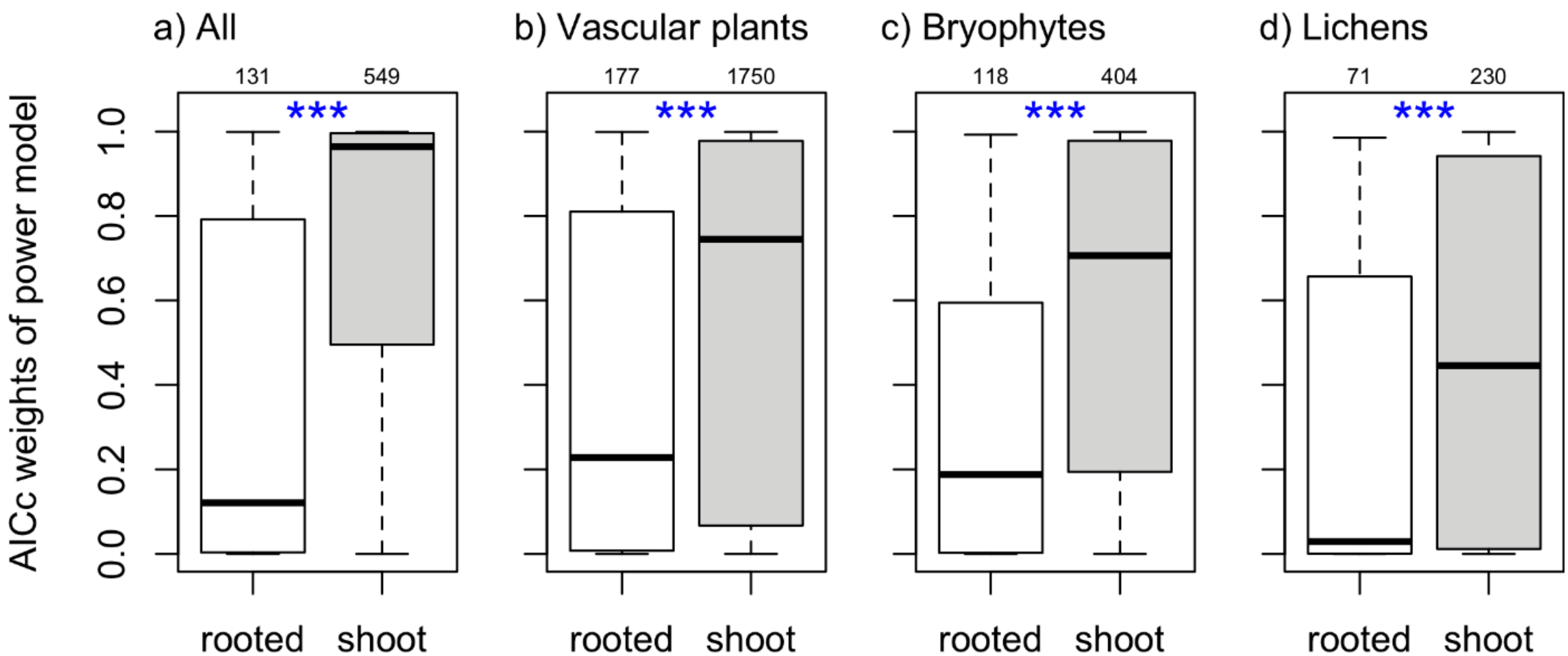
Prevalence of power function vs. vegetation type



Prevalence of power function vs. methodology I: averaging



Prevalence of power function vs. methodology II: rooted vs. shoot

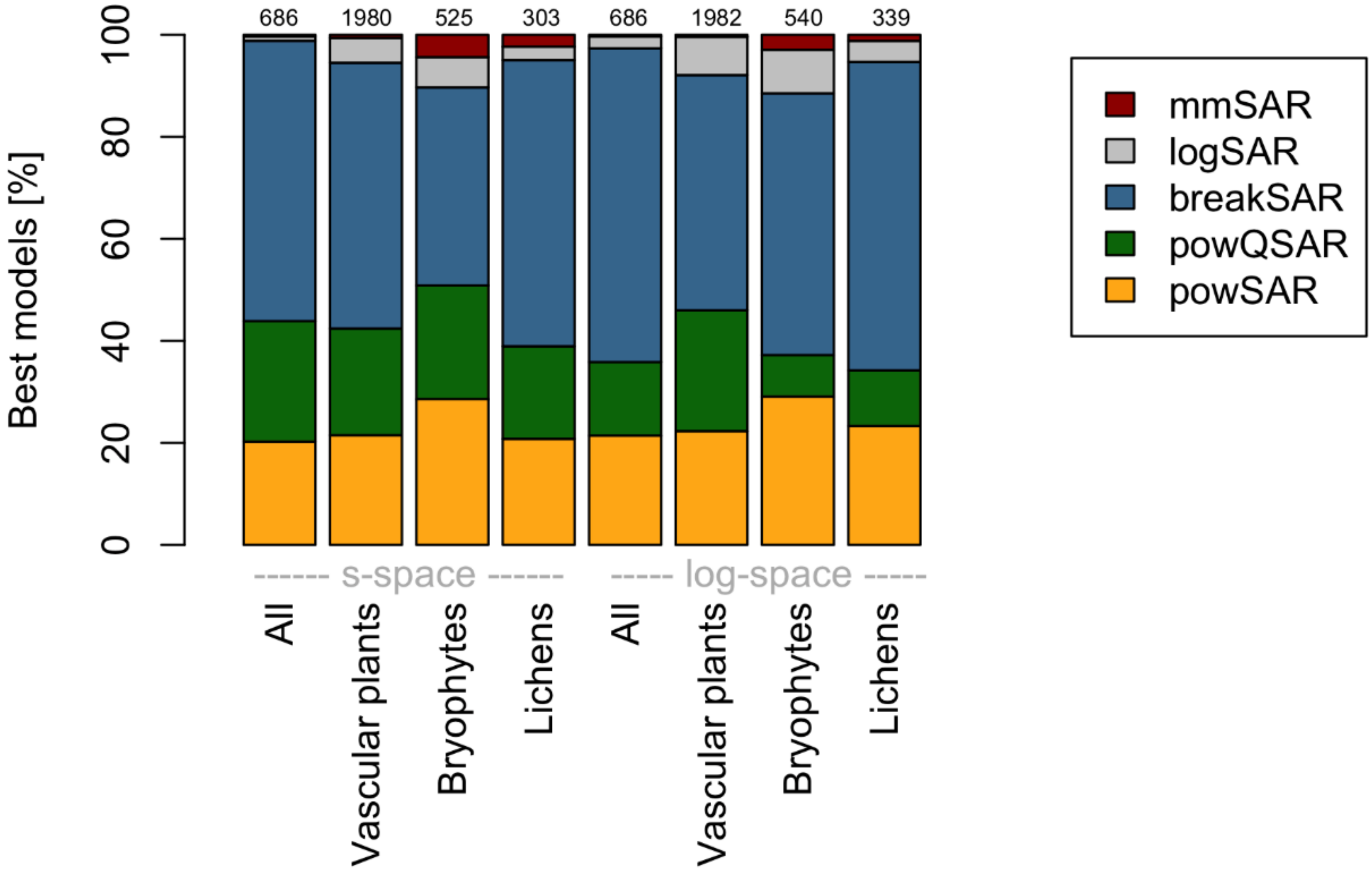


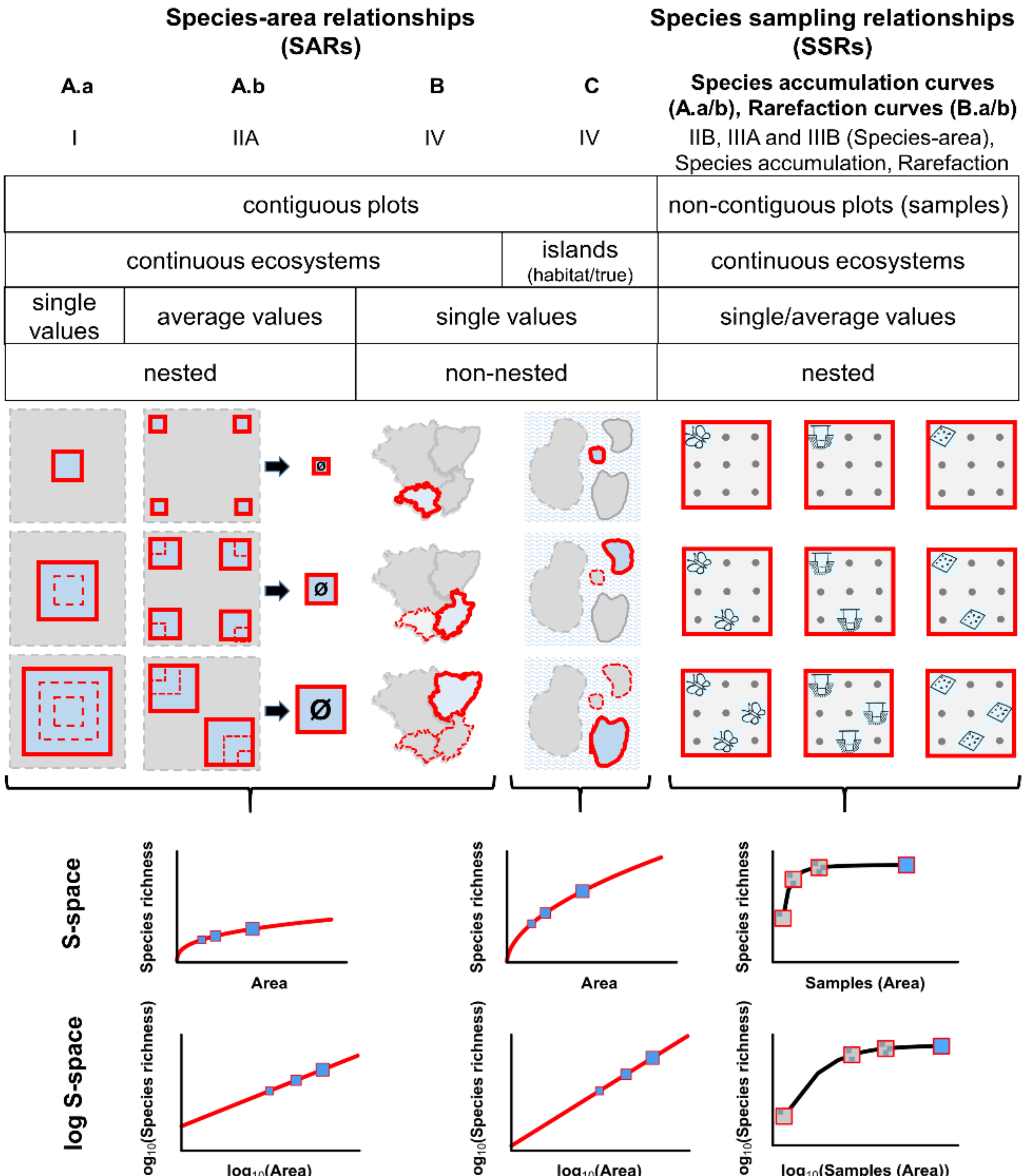
Conclusions

- ✓ **The power function also at small spatial scales is the prevalent model**
- ✓ **No support for logarithmic or saturated functions**
- ✓ **Relative performance of the power function is hardly affected by ecological context, but strongly by methodological issues** (e.g. averaged vs. single values)
- ✓ **Strong support to use power function as generic model and z-values as good measures for beta-diversity**


Thank you!

Comparison of the five functions (BIC)




Species-area relationships (SARs)
Species sampling relationships (SSRs)
A.a
A.b
B
C
Species accumulation curves (A.a/b), Rarefaction curves (B.a/b)
I
IIA
IV
IV
IIB, IIIA and IIIB (Species-area), Species accumulation, Rarefaction
contiguous plots
non-contiguous plots (samples)
continuous ecosystems
islands (habitat/true)
continuous ecosystems
single values
average values
single values
single/average values
nested
non-nested
nested
Ø
S-space
log S-space
Species richness
Area
Samples (Area)
log10(Species richness)
log10(Area)
log10(Samples (Area))