

Efficiency of spatial sampling designs in estimating abundance and species richness of carabids at landscape level

Landscape Ecology

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Jan Thiele*, Gunda Schulte auf'm Erley, Michael Glemnitz, Doreen Gabriel

* Corresponding author Thünen Institute, Institute of Biodiversity, Bundesallee 65, 38116 Braunschweig, Germany

10 jan.thiele@thuenen.de

Supplementary Information

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20 **Tab. S1:** Gaussian kernel used for sampling carabids and calculating effective sampling area of pitfall traps. Kernel size is 5 x 5 raster cells (625 m²) and standard deviation is 0.6. Cell values represent the proportions of individuals that are caught in a trap located on the central cell. The kernel was scaled so that the central cell had a catch rate of 0.4. The effective sampling area is the sum of all kernel values multiplied by raster-cell size of 25 m².

0.000006	0.000386	0.001546	0.000386	0.000006
0.000386	0.024871	0.099741	0.024871	0.000386
0.001546	0.099741	0.400000	0.099741	0.001546
0.000386	0.024871	0.099741	0.024871	0.000386
0.000006	0.000386	0.001546	0.000386	0.000006

KU1- KU3	SRC
AC1	Arable 1
AC2	Arable 2
BRA	Fallow
SAU	Margin
WAL	Forest
WAR	Forest edge
WIE	Meadow



Fig. S1: Distribution of pitfall traps for collecting carabid samples used to estimate species composition and abundance of the simulated carabid communities.

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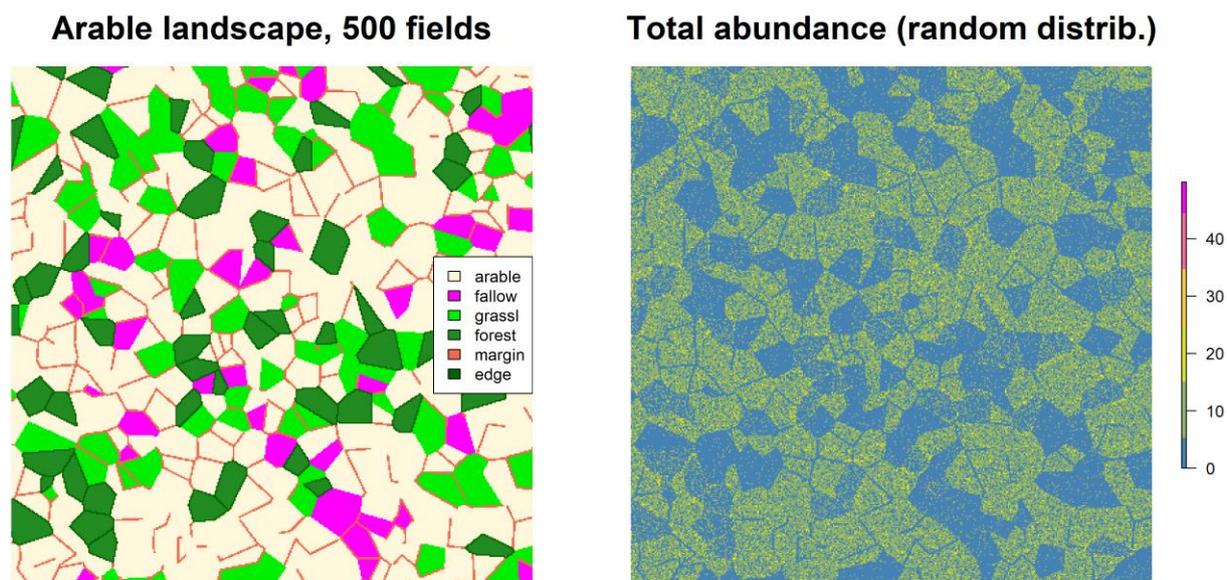


Fig. S2: Example of a simulated landscape with dominating arable land use and a subdivision of 500 fields per 2.2 x 2.2 km (left) and total abundance of carabids per 5 x 5 m grid cell in the same landscape (right). Land-use/ land-cover types comprised arable fields (arable), fallow fields (fallow), agricultural grasslands (grassl), forests (forest), field margins (margin) and forest edges (edge).

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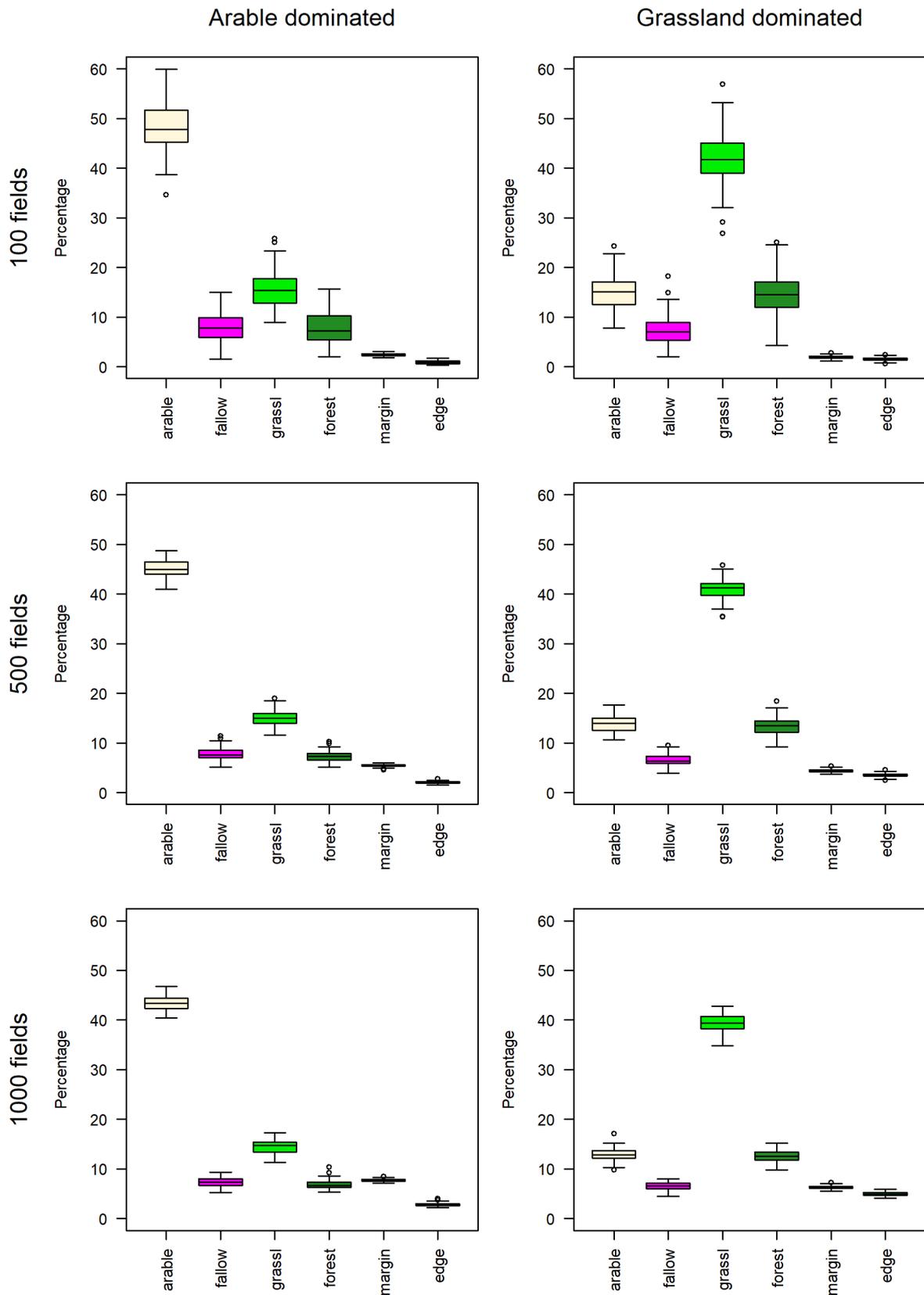


Fig. S3: Areal proportions of land-use/ land-cover types in simulated landscapes. Landscapes were dominated by either arable fields or grasslands and had different degrees of subdivision controlled by the number of fields (100, 500, 1000) per 2.2 x 2.2 km landscape. Land-use/ land-cover types comprised arable fields (arable), fallow fields (fallow), agricultural grasslands (grassl), forests (forest), field margins (margin) and forest edges (edge).

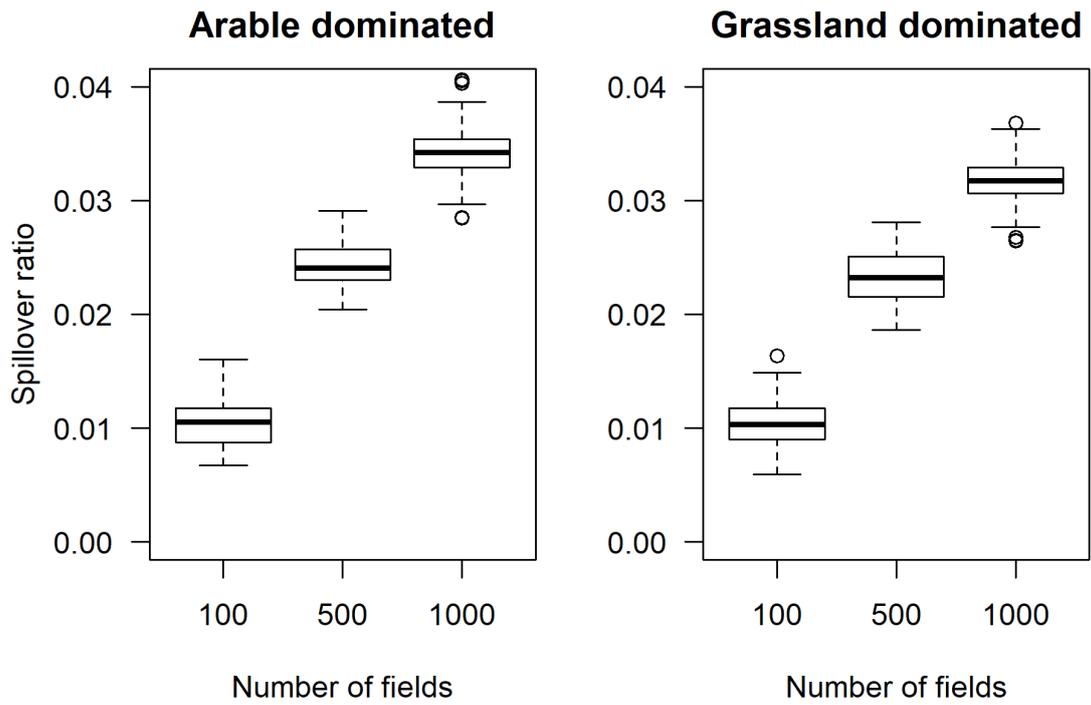


Fig. S4: Proportion of carabid individuals that occurred on the margins of arable fields due to simulated spillover (spillover ratio) in relation to the total abundance of carabids in the landscapes. Landscapes were dominated by either arable fields (left) or grasslands (right).

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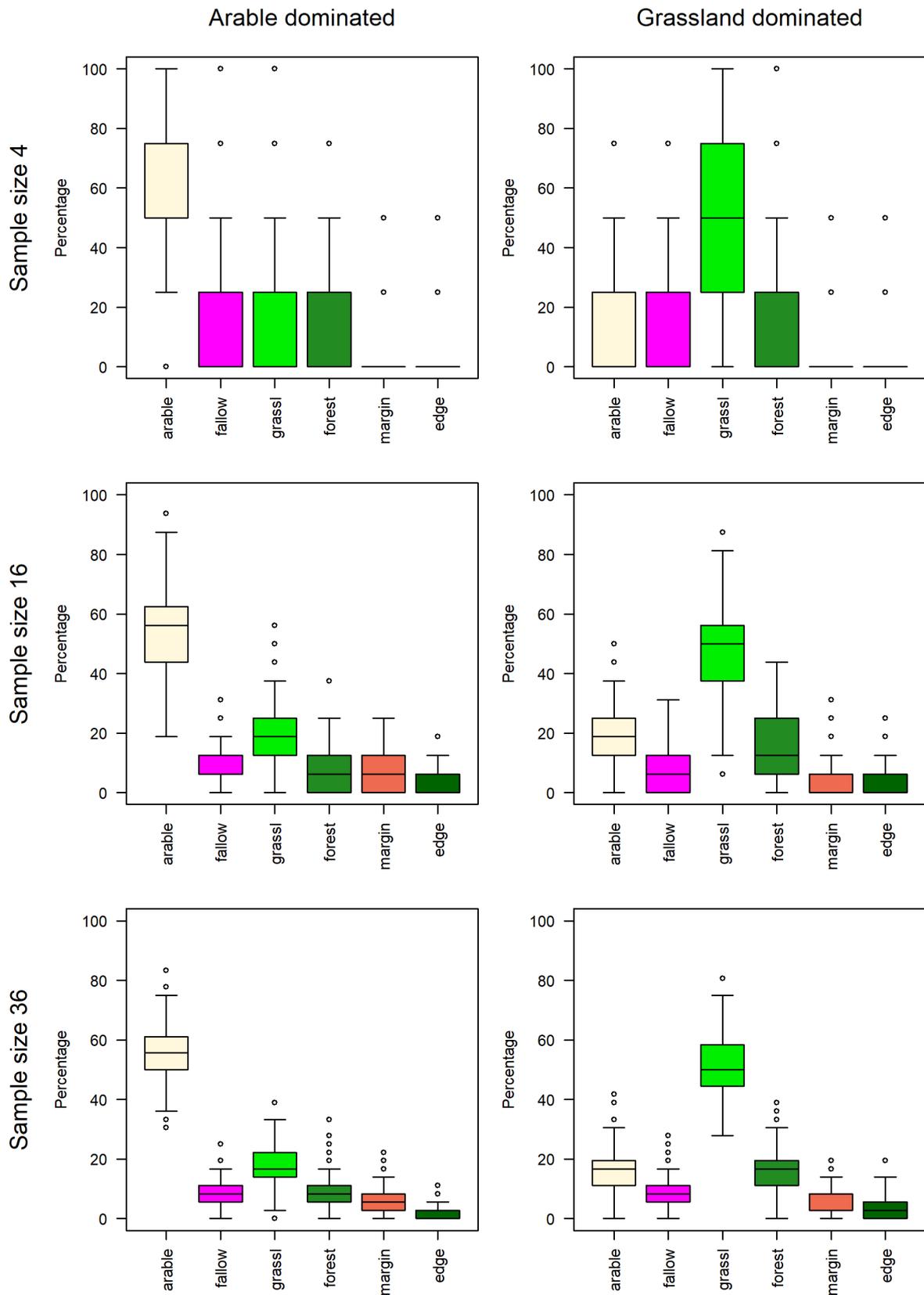


Fig. S5: Proportions of land-use/ land-cover (LULC) types in samples, i.e. number of samples from a LULC type divided by total number of samples, in percent. This example represents random sampling. Figures were similar for other spatial sampling designs except for stratified random sampling where proportions were equal for all LULC types by design. Land-use/ land-cover types comprised arable fields (arable), fallow fields (fallow), agricultural grasslands (grassl), forests (forest), field margins (margin) and forest edges (edge).

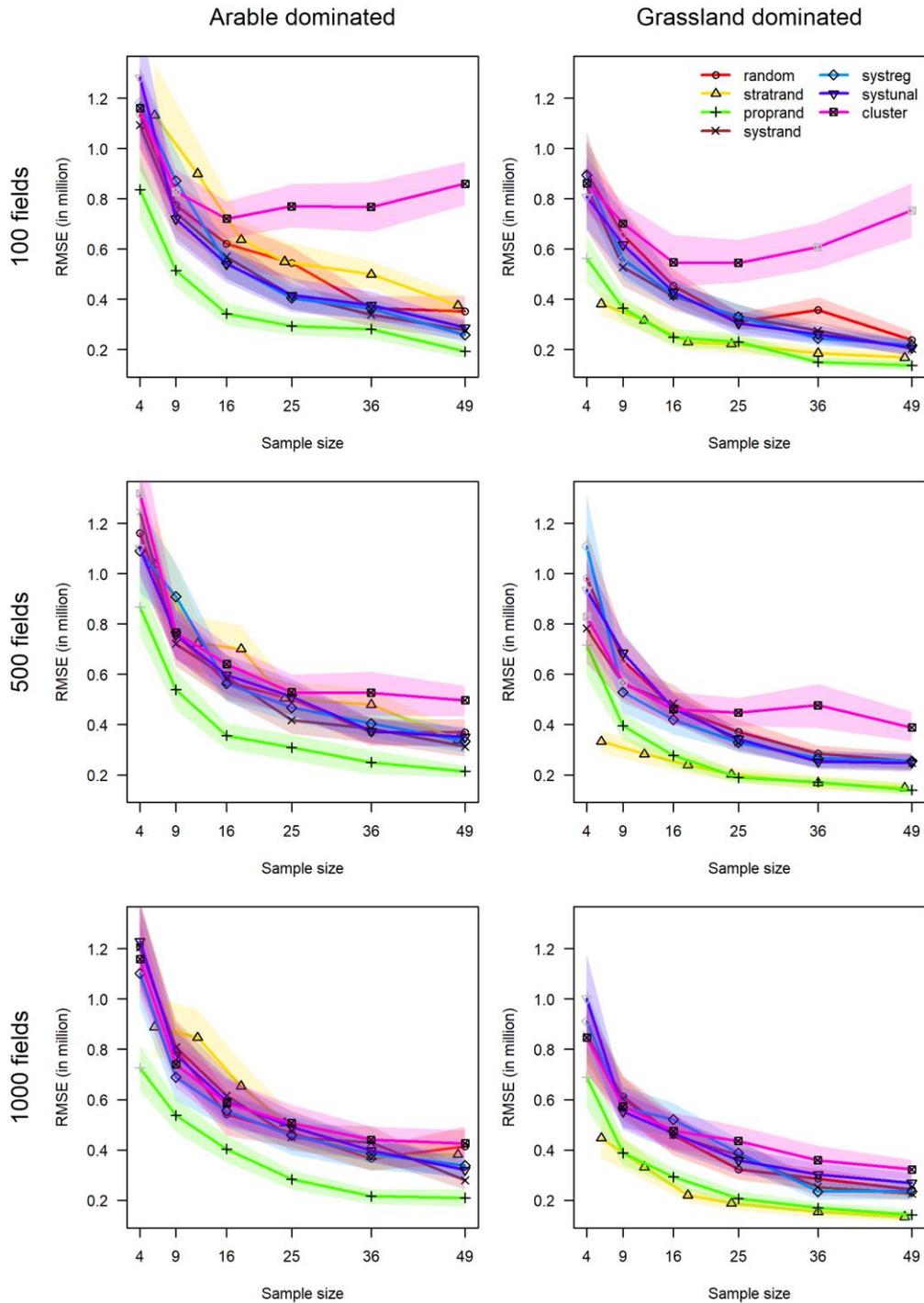


Fig. S6: Accuracy of estimated total carabid abundance at landscape level expressed as Root Mean Squared Error (RMSE) of 100 simulation runs versus sample size for seven spatial sampling designs. **RMSE of stratified random sampling is based on area-weighted abundance estimates**, while unweighted estimates were used for the other sampling designs. Simulations were run for six landscape types with either arable fields or grasslands as the dominating land use and different degrees of subdivision (100, 500 or 1000 fields per landscape). Shaded areas indicate 95 % confidence intervals based on 1000 bootstrap resamples. Light grey colour of plotting symbols indicates significant deviation from true abundances according to equivalence tests (two-one-sided t-tests).

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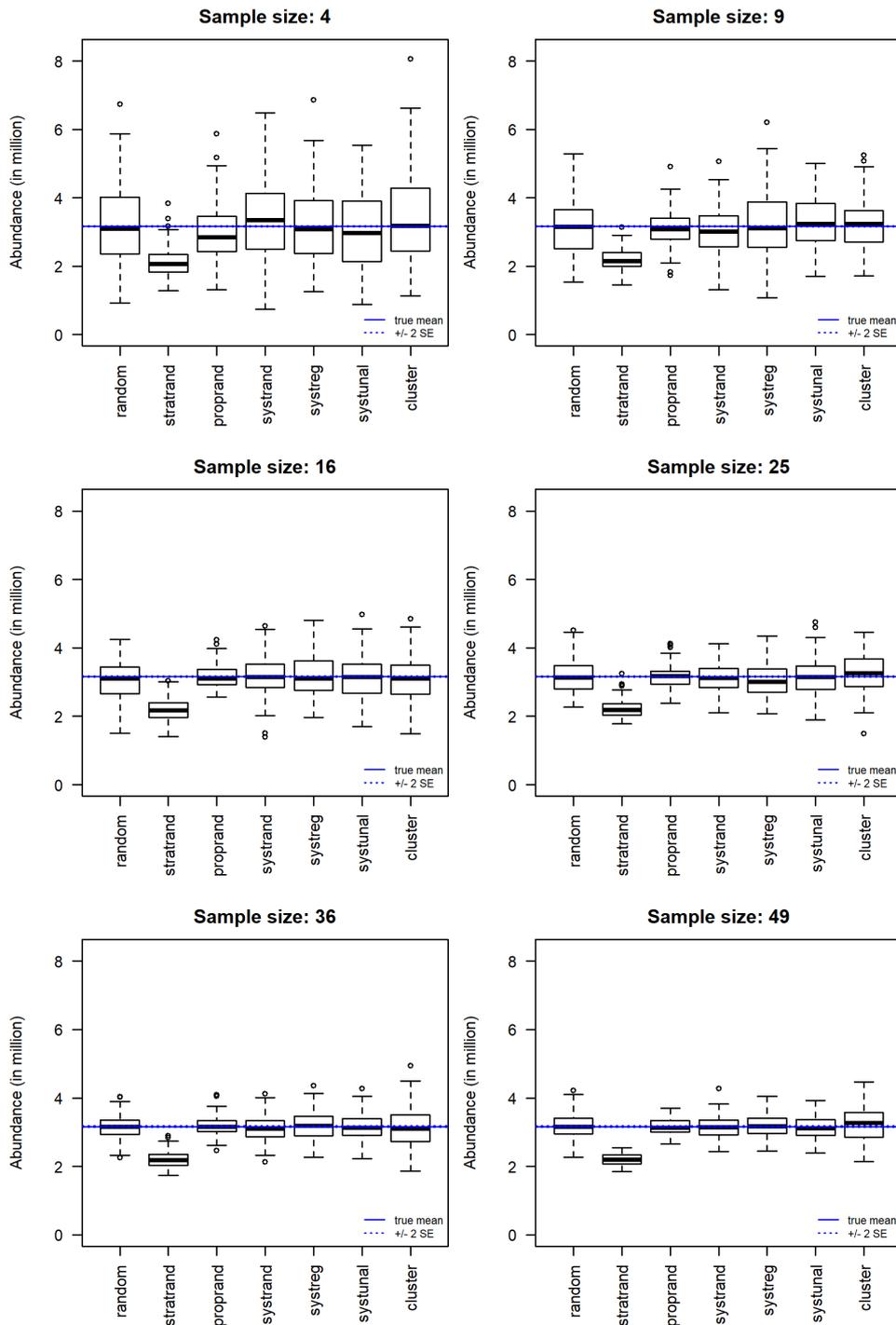


Fig. S7: Boxplots of estimated total abundance of carabids at landscape level for seven spatial sampling designs and different sample sizes (4–49 samples per 2 x 2 km landscape) in an **arable-dominated** landscape with 500 fields. Each box is based on 100 repeated simulation runs. The solid blue line indicates the mean of true total abundances over the 100 simulation runs.

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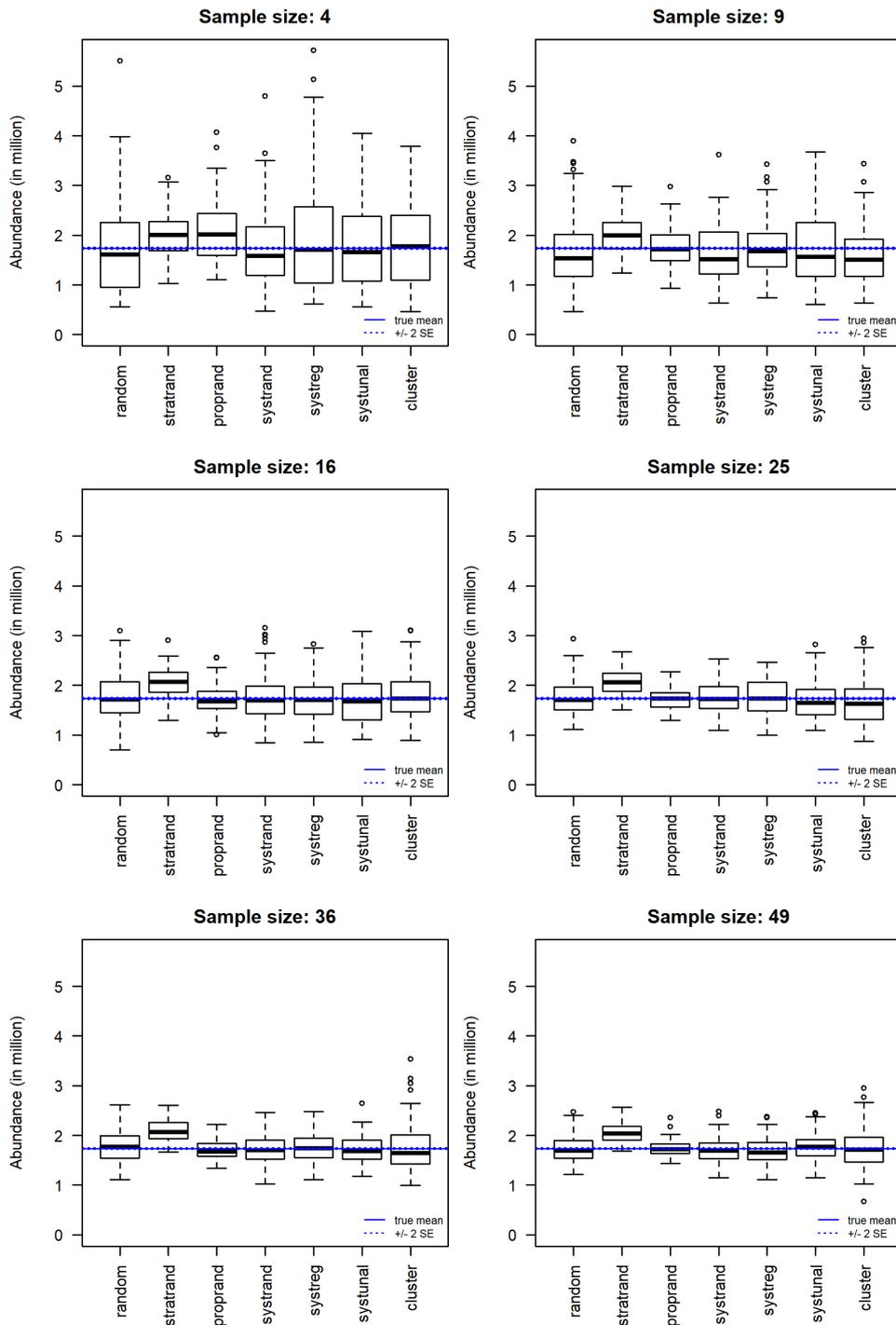


Fig. S8: Boxplots of estimated total abundance of carabids at landscape level for seven spatial sampling designs and different sample sizes (4–49 samples per 2 x 2 km landscape) in a **grassland-dominated** landscape with 500 fields. Each box is based on 100 repeated simulation runs. The solid blue line indicates the mean of true total abundances over the 100 simulation runs.

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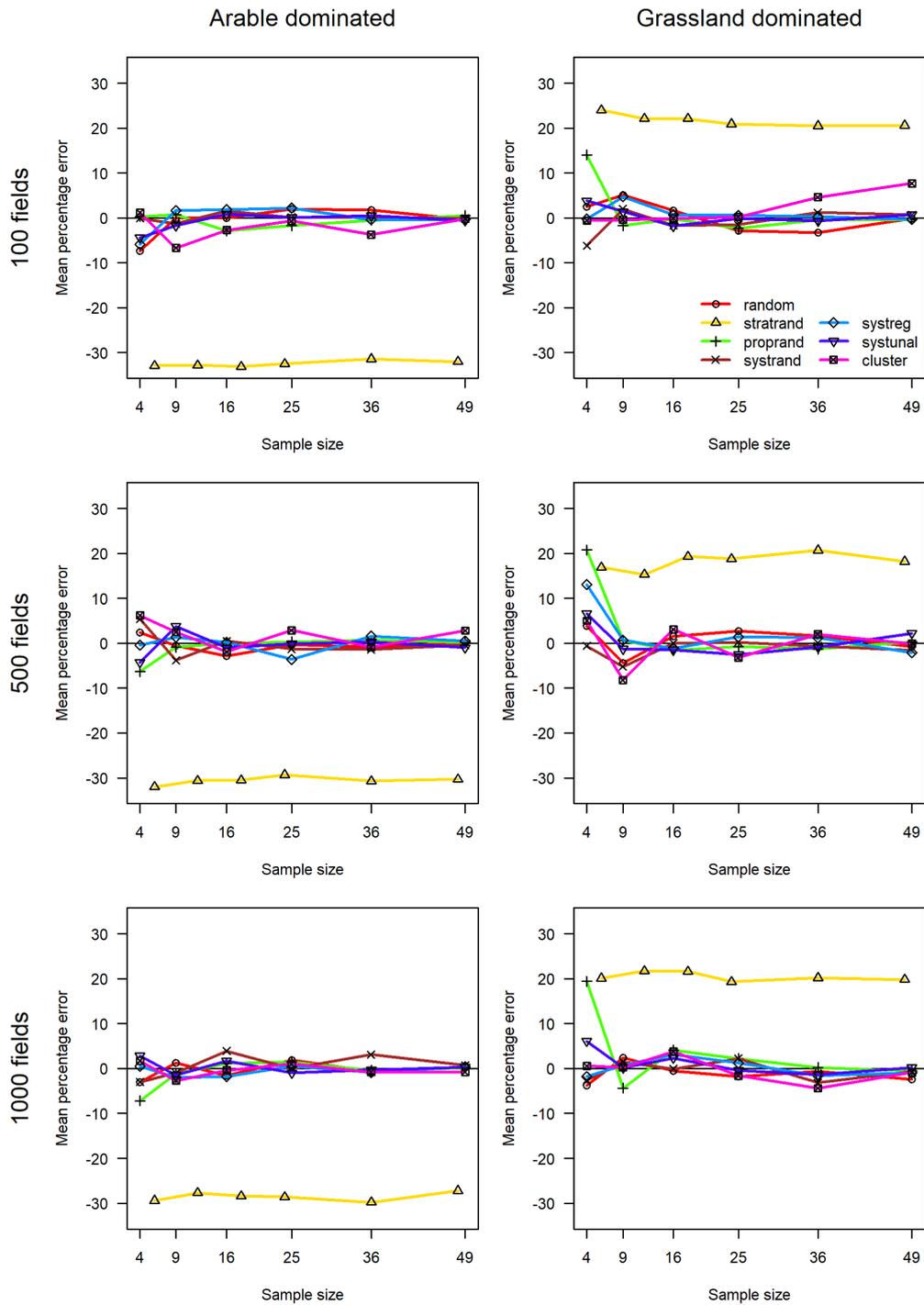


Fig. S9: Deviation of estimated total carabid abundances from true abundances calculated as Mean Percentage Error averaged over 100 simulation runs versus sample size for seven spatial sampling designs. Simulations were run for six landscape types with either arable fields or grasslands as the dominating land-use and different degrees of subdivision (100, 500 or 1000 fields per landscape).

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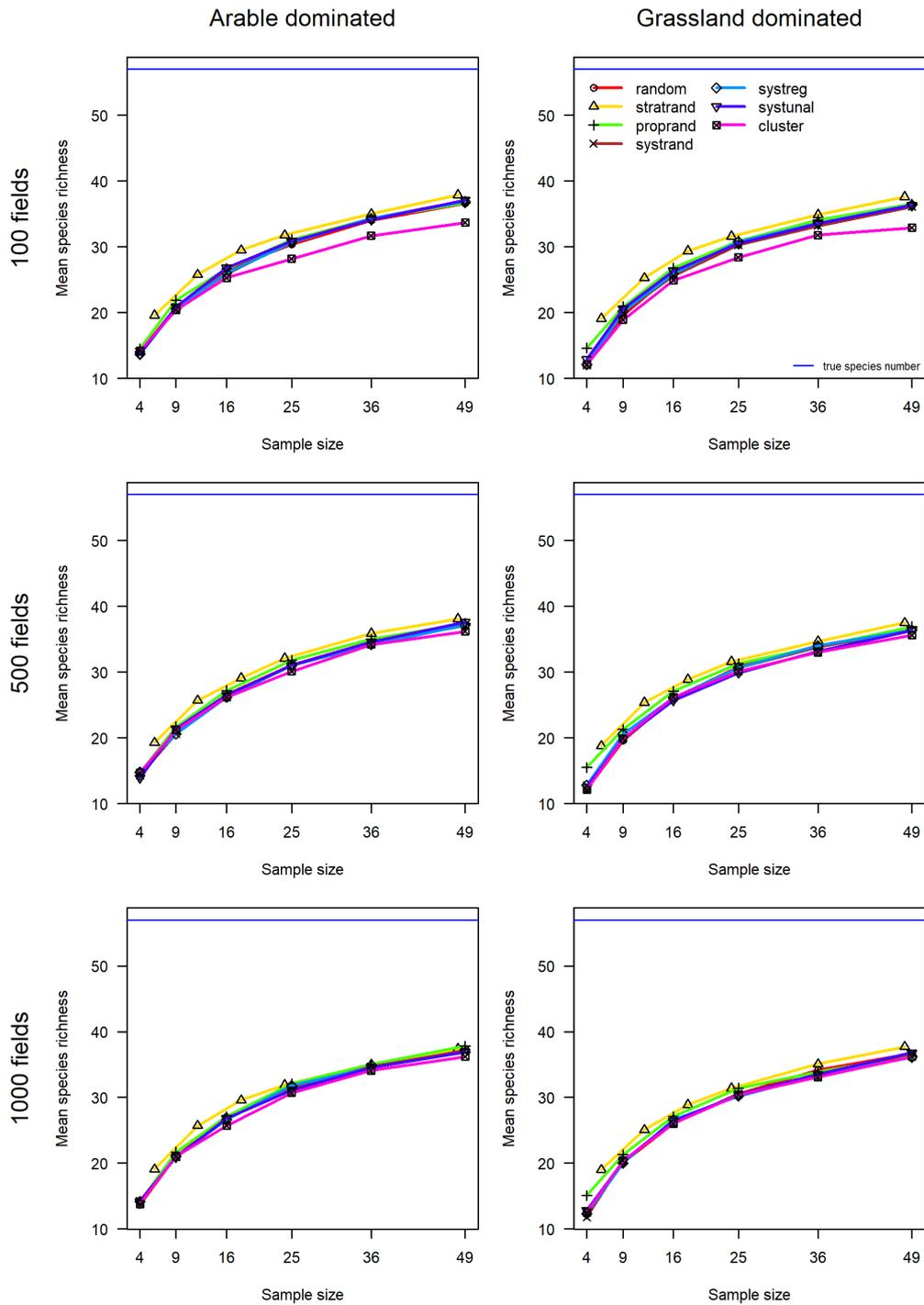


Fig. S10: Detected species richness averaged over 100 simulation runs versus sample size for seven spatial sampling designs. The blue horizontal line indicates the total species richness (57 species) in the simulated landscapes. Simulations were run for six landscape types with either arable fields or grasslands as the dominating land-use and different degrees of subdivision (100, 500 or 1000 fields per landscape).

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