Supplementary Materials

to

The permeability of natural versus anthropogenic forest edges modulates the abundance of ground beetles of different dispersal power and habitat affinity

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Table S1. Studies used in the meta-analyses.

Edge type	Human disturbance	Country	Study*
Anthropogenic	agriculture	China	Yu et al. 2007
Anthropogenic	agriculture	Japan	Kagawa & Maeto 2014
Anthropogenic	agriculture	Poland	Sklodowski 1999
Anthropogenic	agriculture	Spain	Taboada et al. 2004
Anthropogenic	agriculture	UK	Bedford & Usher 1994
Anthropogenic	forestry	Canada	Lemieux & Lindgren 2004
Anthropogenic	forestry	Canada	Spence et al. 1996
Anthropogenic	forestry	USA	Halaj et al. 2008
Anthropogenic	forestry	USA	Ulyshen et al. 2006
Anthropogenic	urbanization	Belgium	Gaublomme et al. 2008
Anthropogenic	urbanization	Belgium	Gaublomme et al. 2013
Anthropogenic	urbanization	USA	Silverman et al. 2008
Natural	none	Hungary	Elek & Tóthmérész 2010
Natural	none	Hungary	Magura 2002
Natural	none	Hungary	Magura & Tóthmérész 1997
Natural	none	Hungary	Magura & Tóthmérész 1998
Natural	none	Hungary	Magura et al. 2000
Natural	none	Hungary	Magura et al. 2001
Natural	none	Hungary	Magura et al. 2002
Natural	none	Hungary	Molnár et al. 2001
Natural	none	Hungary	Tóthmérész et al. 2014
Natural	none	Italy	Lacasella et al. 2015
Natural	none	Romania	Máthé 2006

* See for references in Table S2.

Table S2. Ground beetle species included into the meta-analyses, their dispersal power and habitat affinity, and the papers from which their abundances were extracted.

Species	Dispersal power and habitat affinity	Papers
Abax carinatus	poor disperser forest specialist	2, 9, 10, 11, 12, 13, 14, 16
Abax ovalis	poor disperser forest specialist	2, 9, 10, 11, 12, 13, 14, 16
Abax parallelepipedus	poor disperser forest specialist	2, 3, 7, 9, 10, 11, 12, 13, 14, 16
Abax parallelus	poor disperser forest specialist	2, 9, 10, 11, 12, 13, 14, 15, 16
Abax schueppeli	poor disperser forest specialist	2, 15
Acupalpus testaceus	good disperser open-habitat species	22
Amara aenea	good disperser open-habitat species	7
Amara convexior	good disperser open-habitat species	7
Amara curta	good disperser open-habitat species	7
Amara equestris	good disperser open-habitat species	15
Amara eurynota	good disperser open-habitat species	7
Amara familiaris	good disperser open-habitat species	21
Amara montivaga	good disperser open-habitat species	15
Amara nitida	good disperser open-habitat species	15
Anisodactylus binotatus	good disperser open-habitat species	21
Aptinus bombarda	poor disperser forest specialist	9, 10, 11, 12, 13, 14, 16
Asaphidion flavipes	good disperser open-habitat species	21
Badister meridionalis	good disperser open-habitat species	21
Bembidion oblongulum	poor disperser forest specialist	8
Calosoma tepidum	good disperser open-habitat species	5
Carabus arvensis	poor disperser forest specialist	2, 9, 10, 11, 12, 13, 14, 16
Carabus auronitens	poor disperser forest specialist	3, 15
Carabus convexus	poor disperser forest specialist	2, 9, 10, 11, 12, 13, 14, 16, 21
Carabus coriaceus	poor disperser forest specialist	15
Carabus hortensis	poor disperser forest specialist	9, 10, 11, 12, 13, 14, 16, 18
Carabus intricatus	poor disperser forest specialist	2, 11, 12, 13, 14, 15, 16
Carabus limbatus	poor disperser forest specialist	17
Carabus lineatus	poor disperser forest specialist	20
Carabus linnei	poor disperser forest specialist	15
Carabus marginalis	poor disperser forest specialist	15
Carabus nemoralis	poor disperser forest specialist	18
Carabus obsoletus	poor disperser forest specialist	2, 15
Carabus problematicus	poor disperser forest specialist	4
Carabus variolosus	poor disperser forest specialist	15
Carabus violaceus	poor disperser forest specialist	3
Carabus zawadszkii	poor disperser forest specialist	2
Cicindela germanica	good disperser open-habitat species	2
Cicindela longilabris	good disperser open-habitat species	5
Clivina bipustulata	good disperser open-habitat species	22
Cychrus attenuatus	poor disperser forest specialist	2, 3
Cychrus caraboides	poor disperser forest specialist	2, 15
Cychrus italicus	poor disperser forest specialist	7
Cychrus okamotoi	poor disperser forest specialist	23

Cychrus spinicollis	poor disperser forest specialist	20
Cychrus tuberculatus	poor disperser forest specialist	5
Cyclotrachelus brevoorti	poor disperser forest specialist	22
Dicheirotrichus cognatus	good disperser open-habitat species	19
Harpalus affinis	good disperser open-habitat species	5
Harpalus attenuatus	good disperser open-habitat species	7
Harpalus chalcentus	good disperser open-habitat species	6
Harpalus rubripes	good disperser open-habitat species	7, 21
Harpalus serripes	good disperser open-habitat species	21
Harpalus tardus	good disperser open-habitat species	7, 21
Lebia cyanocephala	good disperser open-habitat species	7
Lebia chlorocephala	good disperser open-habitat species	21
Leistus rufomarginatus	poor disperser forest specialist	7, 15
Leistus spinibarbis	good disperser open-habitat species	7
Licinus italicus	poor disperser forest specialist	7
Molops piceus	poor disperser forest specialist	2, 9, 10, 11, 12, 13, 14, 15, 16
Nebria asturiensis	poor disperser forest specialist	20
Notiobia terminata	good disperser open-habitat species	22
Notiophilus aestuans	good disperser open-habitat species	7
Omus dejeanii	poor disperser forest specialist	5
Panagaeus bipustulatus	good disperser open-habitat species	12, 13, 16, 21
Poecilus chalcites	good disperser open-habitat species	22
Poecilus cupreus	good disperser open-habitat species	2
Poecilus versicolor	good disperser open-habitat species	21
Pseudoophonus pensylvanicus	good disperser open-habitat species	17, 22
Pseudoophonus rufipes	good disperser open-habitat species	2, 7, 9, 10, 11, 12, 13, 14, 15, 16, 21
Pterostichus brevicornis	poor disperser forest specialist	19
Pterostichus burmeisteri	poor disperser forest specialist	2, 9, 10, 11, 12, 13, 14, 16
Pterostichus cantaber	poor disperser forest specialist	20
Pterostichus cantabricus	poor disperser forest specialist	20
Pterostichus cristatus	poor disperser forest specialist	3
Pterostichus herculaneus	poor disperser forest specialist	5
Pterostichus lama	poor disperser forest specialist	5
Pterostichus lattini	poor disperser forest specialist	5
Pterostichus madidus	poor disperser forest specialist	1, 3
Pterostichus riparius	poor disperser forest specialist	8, 19
Pterostichus trinarius	poor disperser forest specialist	17
Scaphinotus angulatus	poor disperser forest specialist	5
Scaphinotus angusticollis	poor disperser forest specialist	5, 8
Scaphinotus marginatus	poor disperser forest specialist	5, 8, 19
Scaphinotus rugiceps	poor disperser forest specialist	5
Scarites spp.	good disperser open-habitat species	22
Zacotus matthewsii	poor disperser forest specialist	5

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Table S3. Estimates and heterogeneities in the models.

Abundance of flying grasslander (macropterous open-habitat) species

Subgroup	Mean effect size (model)	Lower CI bound (model)	Upper CI bound (model)	SE (model)	p value (model)	Q (hetero-geneity)	p value (hetero-geneity)	I^2
Edges with human influences	-0.142	-0.351	0.067	0.107	0.183	19.628	0.237	18%
Edges with natural processes	-0.320	-0.425	-0.216	0.053	<0.001	26.117	0.928	0%
Overall	-0.285	-0.378	-0.191	0.048	<0.001	47.976	0.738	0%
Edges disturbed by forestry	-0.177	-0.783	0.429	0.309	0.567	18.629	0.180	25%
Overall	-0.153	-0.397	0.091	0.125	0.218	19.628	0.237	18%

Component of variance	Q	d.f.	p
Edges with human influences	19.628	16	0.237
Edges with natural processes	26.117	38	0.928
Within	45.745	54	0.780
Between	2.230	1	0.135
Total	47.976	55	0.738

Abundance of walking specialist (brachypterous forest specialist) species

Subgroup	Mean effect size (model)	Lower CI bound (model)	Upper CI bound (model)	SE (model)	p value (model)	Q (hetero-geneity)	p value (hetero-geneity)	I^2
Edges with human influences	0.395	0.109	0.681	0.146	0.007	96.111	<0.001	62%
Edges with natural processes	-0.088	-0.300	0.125	0.109	0.420	653.836	<0.001	84%
Overall	-0.002	-0.136	0.131	0.068	0.972	773.303	<0.001	82%
Edges disturbed by agriculture	0.664	0.234	1.093	0.219	0.002	6.364	0.607	0%
Edges disturbed by forestry	0.086	-0.153	0.325	0.122	0.479	45.003	0.001	58%
Edges disturbed by urbanization	0.979	0.472	1.486	0.259	<0.001	23.368	0.001	74%
Overall	0.398	0.095	0.701	0.155	0.010	87.341	<0.001	60%

Component of variance	Q	d.f.	p
Edges with human influences	96.111	37	<0.001
Edges with natural processes	653.836	105	<0.001
Within	749.947	142	<0.001
Between	7.052	1	0.008
Total	773.303	143	<0.001

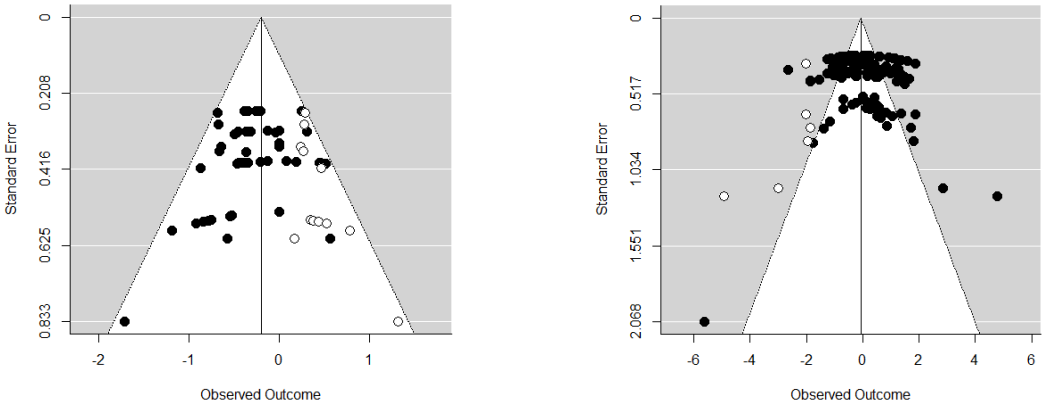
Component of variance	Q	d.f.	p
Edges disturbed by agriculture	6.364	8	0.607
Edges disturbed by forestry	45.003	19	0.001
Edges disturbed by urbanization	23.368	6	0.001
Within	74.735	33	<0.001
Between	12.606	2	0.002
Total	87.341	35	<0.001

Table S4. Results of regression test for funnel plot asymmetry of abundances of flying grasslander (macropterous open-habitat) and walking specialist (brachypterous forest specialist) ground beetle species.

	Weighted regression		**Mixed-effects meta-regression**	
Macropterous open-habitat species	$t_{1, 54} = -1.7928$	$p = 0.0786$	$z = -1.6417$	$p = 0.1006$
Brachypterous forest specialist species	$t_{1, 142} = 2.4612$	$p = 0.0150$	$z = 3.3316$	$p = 0.0009$

Table S5. Model results after trim and fill for the abundances of flying grasslander (macropterous open-habitat) and walking specialist (brachypterous forest specialist) ground beetle species.

	Estimated missing studies	Estimate (Hedges′ g)	Lower CI bound	Upper CI bound	Standard error	p value
Macropterous open-habitat species	12 (SE = 4.9397)	-0.1989	-0.2887	-0.1091	0.0458	<0.0001
Brachypterous forest specialist species	7 (SE = 7.4146)	-0.0706	-0.2210	0.0797	0.0767	0.3571



(**a**) (**b**)

Figure S1. Funnel plots with missing data (empty circles) for the abundance of flying grasslander (macropterous open-habitat) (a) and walking specialist (brachypterous forest specialist) ground beetle species (b).