**Table S8.** Overlap statistics calculated for pairs of environmental and ground beetle variables measured at the rural site at the small spatial scale. Shown for each pair: *Oe*, the mean minimum Euclidean distance between each environmental candidate boundary element and the closest beetle candidate boundary element (m); *Ob*, the mean minimum Euclidean distance between each beetle candidate boundary element and the closest environmental candidate boundary element (m); *Oeb*, the overall mean minimum Euclidean distance between beetle and environmental candidate boundary elements (m); and *Os*, the number of beetle and environmental candidate boundary elements at the same locations. †Significantly low value (*p* < 0.10). \*Significantly high value (*p* < 0.10).

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Beetle variable | Temperature | Leaf litter depth | Canopy cover | Forb cover | Grass cover | Vine cover | Rock cover | Coarse woody debris cover | All environmental variables |
| Total species evenness | 49,60,55,0† | 31,27,29,3 | 45,61,53,2 | 45,51,48,2 | 35,39,37,3 | 23†,21†,22†,3 | 26,21,24,6 | 21†,22,21†,5 | 35,29\*,32,4 |
| Open-habitat species abundance | 19,16†,17†,10\* | 37,17,27,6 | 18,13†,15†,11\* | 8†,9†,9†,13\* | 26,13†,19†,9 | 44\*,28,36\*,5 | 48\*,30,39,6 | 77\*,45\*,61\*,3 | 37,15†,26,9 |
| All species | 24,17†,20†,9 | 37\*,18,28,5 | 22,11†,16†,13\* | 7†,7†,7†,16\* | 28,16†,22,8 | 38\*,25,31\*,8 | 46\*,32,39\*,3 | 74\*,51\*,62\*,1† | 43\*,19,31\*,6 |
| *Amara aenea* | 19,16†,17†,10\* | 37,17,27,6 | 18,13†,15†,11\* | 8†,9†,9†,13\* | 26,13†,19†,9 | 44, \*28,36\*,5 | 48\*,30,39\*,6 | 77\*,45\*,61\*,3 | 37,15†,26,9 |
| *Harpalus pensylvanicus* | 13†,16†,15†,9\* | 19†,12†,16†,10\* | 9†,11†,10†,14\* | 18,21†,20†,8 | 20,16†,18†,7 | 48\*,31,40\*,2 | 27,21,24,8 | 67\*,47\*,57\*,3 | 31,14†,22,10 |
| *Sphaeroderus stenostomus lecontei* | 85\*,81\*,83\*,1† | 55\*,28,42\*,5 | 85\*,90\*,87\*,0† | 88\*,87\*,87\*,0† | 74\*,65\*,70\*,2 | 44\*,32\*,38\*,2 | 51\*,37\*,44\*,5 | 29,11†,20†,13\* | 67\*,22,45\*,5 |
| *Trichotichnus fulgens* | 15†,31,24†,9\* | 29,24,27,3 | 19,31,25,8 | 16†,29,22†,8 | 18†,24,21†,9 | 21,23,22,7 | 28,32,30,4 | 28,35,32,3 | 24,20,22,6 |

**Table S9.** Overlap statistics calculated for pairs of environmental and ground beetle variables measured at the rural site at the large spatial scale. Shown for each pair: *Oe*, the mean minimum Euclidean distance between each environmental candidate boundary element and the closest beetle candidate boundary element (m); *Ob*, the mean minimum Euclidean distance between each beetle candidate boundary element and the closest environmental candidate boundary element (m); *Oeb*, the overall mean minimum Euclidean distance between beetle and environmental candidate boundary elements (m); and *Os*, the number of beetle and environmental candidate boundary elements at the same locations. †Significantly low value (*p* < 0.10). \*Significantly high value (*p* < 0.10).

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Beetle variable | Temperature | Humidity | Slope | Leaf litter depth | Forb cover | Bare ground cover |
| Total species evenness | 70,90\*,80,0 | 64\*,56,60,0 | 33,37,35,2 | 43,41,42,0 | 73,90\*,81\*,0 | 42,29,35,1 |
| Generalist species abundance | 13†,17†,15†,4\* | 33,28,31,2 | 46,50,48,1 | 46,55\*,51,1 | 13†,17†,15†,4\* | 53,33,43,2 |
| Generalist species richness | 22,37†,30†,2 | 26,32,29,2 | 23,40,31,2 | 37,39,38,1 | 26,40,33,1 | 29,28,28,2 |
| Generalist species evenness | 109\*,100\*,105\*,0 | 89\*,65\*,77\*,0 | 32,32,32,2 | 55,43,49,0 | 112\*,100\*,106\*,0 | 76\*,35,55\*,1 |
| All species | 7†,8†,8†,5\* | 20†,18†,19†,3\* | 47,43,45,1 | 52,56\*,54\*,1 | 7†,8†,8†,5\* | 45,30,37,2 |
| All species weighted | 7†,12†,9†,5\* | 18†,18†,18†,4\* | 39,37,38,2 | 44,55\*,50,1 | 7†,12†,9†,5\* | 51,33,42,2 |
| Generalist species | 7†,8†,8†,5\* | 20†,18†,19†,3\* | 47,43,45,1 | 52,56\*,54\*,1 | 7†,8†,8†,5\* | 45,30,37,2 |
| *Anisodactylus dulcicollis* | 25,28†,26†,2 | 28,30,29,2 | 19,21†,20,3 | 33,26,30,3 | 21,24†,23†,3 | 56,44,50,0 |
| *Anisodactylus opaculus* | 16†,32,24,3 | 30,39,34,2 | 47,55,51,1 | 48,48,48,1 | 13†,29,21†,4\* | 46,34,40,2 |
| *Anisodactylus rusticus* | 16†,24†,20†,3 | 20†,24†,22†,3 | 19,18†,19,3 | 33,25,29,3 | 19,24†,22†,3 | 46,37,42,1 |
| *Chlaenius prasinus* | 64\*,69\*,67\*,0† | 46\*,38†,42\*,1† | 27\*,27†,27†,2† | 42\*,32†,37\*,1† | 67\*,69\*,68\*,0† | 49\*,32†,40\*,1† |
| *Galerita janus* | 31,52,42,2 | 37,49,43,2 | 18,22,20,2 | 43,27,35,2 | 33,52,43,2 | 67\*,53\*,60\*,1 |
| *Lebia vittata* | 0,0†,0†,7 | 15\*,7†,11†,5† | 59\*,36†,48\*,1† | 59\*,56\*,57\*,0† | 4\*,4†,4†,6† | 49\*,22†,36\*,3† |

**Table S10.** Overlap statistics calculated for pairs of environmental and ground beetle variables measured at the suburban site at the small spatial scale. Shown for each pair: *Oe*, the mean minimum Euclidean distance between each environmental candidate boundary element and the closest beetle candidate boundary element (m); *Ob*, the mean minimum Euclidean distance between each beetle candidate boundary element and the closest environmental candidate boundary element (m); *Oeb*, the overall mean minimum Euclidean distance between beetle and environmental candidate boundary elements (m); and *Os*, the number of beetle and environmental candidate boundary elements at the same locations. †Significantly low value (*p* < 0.10). \*Significantly high value (*p* < 0.10).

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Beetle variable | Slope | Leaf litter depth | Forb cover | Grass cover | Creeping forb cover | Shrub cover | Moss cover | All environmental variables |
| Total species evenness | 28,27,27,5 | 24†,26,25,2 | 23,28,25,5 | 24†,27,25,4 | 25,33,29,3 | 19†,19,19†,7\* | 24†,29,26,9\* | 29,31\*,30,6 |
| Generalist species evenness | 17†,21,19†,7\* | 24†,24,24,3 | 15†,22,19†,6 | 18†,20,19†,7\* | 21†,29,25,4 | 20†,24,22†,7\* | 19†,24,21†,8\* | 18†,22,20†,7\* |
| Open-habitat species | 36,20,28,8 | 54\*,49\*,51\*,0† | 54\*,30,42\*,2 | 57\*,40\*,48\*,6 | 70\*,37,53\*,3 | 57\*,56\*,56\*,3 | 27,21,24,8 | 47\*,28,37,7 |
| Generalist species weighted | 21,23,22,5 | 31,31\*,31\*,3† | 16,24,20,8 | 22,26,24,8 | 20,31,25,5 | 31,37\*,34\*,4 | 24,30,27,3 | 20,20,20,8 |
| *Amara aenea* | 36,25,30,6 | 50\*,46\*,48\*,0† | 52\*,29,41\*,2 | 56\*,39\*,48\*,6 | 69\*,38,53\*,3 | 55\*,51\*,53\*,3 | 27,24,25,8 | 47\*,32,40\*,5 |
| *Anisodactylus dulcicollis* | 30,22,26,7 | 41\*,34\*,38\*,4 | 37\*,22,29,8 | 46\*,30,38\*,5 | 57\*,24,40\*,4 | 50\*,45\*,47\*,2† | 32,24,28,7 | 39\*,24,31,9 |
| *Dicaelus dilatatus dilatatus* | 44\*,36,40\*,3 | 21,14†,17†,7 | 24,16†,20,8 | 20,12†,16†,10 | 23,28,25,4 | 21,13†,17†,9 | 64\*,44\*,54\*,1† | 43,33,38,3 |
| *Poecilus lucublandus lucublandus* | 62\*,29,46\*,4 | 40\*,20,30,4 | 39,12†,26,10\* | 32,14†,23,9 | 27,7†,17†,17\* | 26,13†,20,9 | 77\*,50\*,64\*,0† | 54\*,21,38,8 |
| *Pterostichus sculptus* | 32,28,30,1† | 33,32\*,32\*,4 | 22,24,23,8 | 20,28,24,7 | 21,28,25,10\* | 16†,25,21,7 | 27,36,32,5 | 28,25,26,7 |
| *Scarites subterraneus* | 30,17†,23,7 | 44\*,33\*,39\*,4 | 30,28,29,4 | 40,46\*,43\*,0† | 30,36,33,3 | 46\*,54\*,50\*,0† | 21,16†,19†,11\* | 26,22,24,6 |

**Table S11.** Overlap statistics calculated for pairs of environmental and ground beetle variables measured at the suburban site at the large spatial scale. Shown for each pair: *Oe*, the mean minimum Euclidean distance between each environmental candidate boundary element and the closest beetle candidate boundary element (m); *Ob*, the mean minimum Euclidean distance between each beetle candidate boundary element and the closest environmental candidate boundary element (m); *Oeb*, the overall mean minimum Euclidean distance between beetle and environmental candidate boundary elements (m); and *Os*, the number of beetle and environmental candidate boundary elements at the same locations. †Significantly low value (*p* < 0.10). \*Significantly high value (*p* < 0.10).

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Beetle variable | Microrelief | Leaf litter depth | Canopy cover | Vine cover |
| Total abundance | 16†,14†,15†,4\* | 43,29,36,2 | 37,29,33,2 | 71\*,51,61\*,1 |
| Forest species richness | 61,63,62,0 | 37,44,40,1 | 47,58,53,2 | 29,32,30,2 |
| Generalist species abundance | 16†,15†,15†,4 | 43,34,38,2 | 44,29,36,2 | 71\*,48,59\*,1 |
| All species | 16†,16†,16†,4\* | 43,37,40,2 | 45,27,36,2 | 71\*,42,57\*,1 |
| All species weighted | 37,42,39,0 | 44,43,43,0 | 49,51,50,1 | 52,40,46,1 |
| Open-habitat species | 29,24,26,2 | 32,24,28,2 | 44,48,46,1 | 35,24,29,2 |
| Open-habitat species weighted | 55,47,51,0 | 64\*,52,58\*,0 | 39,45,42,2 | 65,34,50,1 |
| Generalist species | 16†,16†,16†,4\* | 43,37,40,2 | 45,27,36,2 | 71\*,42,57,1 |
| *Cyclotrachelus sigillatus* | 42,31†,37†,2 | 35,31,33,2 | 74\*,67\*,70\*,0 | 46,42\*,44\*,0† |
| *Olisthopus parmatus* | 42,31†,37†,2 | 35,31,33,2 | 74\*,67\*,70\*,0 | 46,42\*,44\*,0† |
| *Poecilus lucublandus lucublandus* | 92\*,66,79\*,0 | 62\*,55\*,58\*,0 | 103\*,79\*,91\*,0 | 42,32,37,1 |
| *Scarites subterraneus* | 16†,11†,13†,4\* | 43,28,35,2 | 50,33,41,1 | 71\*,42,57,1 |
| *Scarites quadriceps* | 16,11†,13†,4 | 43,28,35,2 | 50,33,41,1 | 71,42,57,1 |
| *Stenolophus rotundatus* | 38,36,37,1 | 72\*,46,59\*,0 | 29†,14†,21†,4\* | 97\*,74\*,85\*,0 |

**Table S12.** Overlap statistics calculated for pairs of environmental and ground beetle variables measured at the urban site at the small spatial scale. Shown for each pair: *Oe*, the mean minimum Euclidean distance between each environmental candidate boundary element and the closest beetle candidate boundary element (m); *Ob*, the mean minimum Euclidean distance between each beetle candidate boundary element and the closest environmental candidate boundary element (m); *Oeb*, the overall mean minimum Euclidean distance between beetle and environmental candidate boundary elements (m); and *Os*, the number of beetle and environmental candidate boundary elements at the same locations. †Significantly low value (*p* < 0.10). \*Significantly high value (*p* < 0.10).

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Beetle variable | Temperature | Humidity | Slope | Leaf litter depth | Canopy cover | Forb cover | Grass cover | Shrub cover | Vine cover | Bare ground cover | Impervious surface cover | All environmental variables |
| Total abundance | 19,36,28,8 | 17,28,23,10\* | 33\*,47,41,4 | 31,33,32,5 | 17,35,26,8 | 19,27,23,9 | 16,23,20†,9 | 27,39,33,8 | 40\*,34,37\*,6 | 17,21,19,6 | 13,25†,19†,10\* | 16,19,17,10 |
| Total evenness | 25,45,35,4 | 29,33,31,4 | 24†,45,34,3 | 18†,23,20†,6\* | 24,45,34,6 | 21†,41,30,6 | 21†,27,24,7 | 26,40,33,2 | 18†,17†,17†,7\* | 18†,20,19†,8\* | 22,39,30,7 | 26,24,25,7 |
| Forest species abundance | 65\*,79\*,72\*,0† | 65\*,63\*,64\*,0†  | 44\*,35,39,1 | 23,22,22,9 | 67\*,84\*,76\*,0† | 61\*,61\*,61\*,1 | 54\*,63\*,59\*,0† | 34,15†,24,10\* | 29,20,24,6 | 40\*,35,37,4 | 50\*,64\*,57\*,1 | 60\*,43\*,51\*,0† |
| Forest species richness | 65\*,79\*,72\*,0† | 65\*,63\*,64\*,0† | 44\*,35,39,1 | 23,22,22,9 | 67\*,84\*,76\*,0† | 60\*,61\*,61\*,1 | 54\*,63\*,59\*,0† | 34,15†,24,10\* | 29,20,24,6 | 40\*,35,37,4 | 50\*,64\*,57\*,1 | 60\*,43\*,51\*,0† |
| Generalist species abundance | 25,50,38,5 | 22,37,30,8 | 30,50,40,4 | 32,31,31,6 | 22,51,37,5 | 22,40,31,6 | 19,34,27,7 | 23,42,33,7 | 38\*,29,33,6 | 20,26,23,5 | 15,38,27,9 | 18,21,20,9 |
| Generalist species evenness | 19†,39,29,7\* | 19†,25,22†,8\* | 28,49,38,4 | 30,32,31,4 | 18†,41,29,7 | 16†,39,27,8\* | 15†,23,19†,10\* | 20†,34,27,7 | 27†,32,29,5 | 22,27,24,4 | 19,39,29,5 | 16†,21,19†,10\* |
| Forest species | 65\*,82\*,74\*,0† | 65\*,64\*,64\*,0† | 44\*,36,40,1 | 23,22,22,9 | 67\*,87\*,77\*,0† | 61\*,64\*,62\*,1 | 54\*,63\*,59\*,0† | 34,15†,24,10\* | 29,19,24,6 | 40\*,33,36,4 | 50\*,65\*,58\*,1 | 60\*,43\*,51\*,0† |
| Open-habitat species | 27,34,31,5 | 29,23†,26,6 | 25,31,28,8 | 24,26,25,8 | 14†,18†,16†,9 | 30,38,34,6 | 23,20†,22†,8 | 28,31,30,4 | 29,22,25,8 | 16†,14†,15†,10\* | 11†,14†,13†,10\* | 22,20,21,7 |
| *Agonum punctiforme* | 15†,24†,20†,8 | 18,26,22,7 | 30,38,34,5 | 33,32,32,6 | 13†,17†,15†,11\* | 21,16†,19†,11\* | 14†,16†,15†,10\* | 41\*,35,38,6 | 47\*,36\*,42\*,4 | 19,13†,16†,10\* | 13†,16†,14†,10\* | 20,22,21,6 |
| *Anisodactylus dulcicollis* | 16†,16†,16†,11\* | 18,19†,19†,10\* | 43\*,42,42,5 | 46\*,35,40\*,3 | 12†,14†,13†,12\* | 22,10†,16†,13\* | 16†,11†,14†,11\* | 49\*,41,44\*,7 | 62\*,38\*,49\*,2 | 23,15†,19†,7 | 6†,8†,7†,15\* | 19,13†,16†,13\* |
| *Anisodactylus furvus* | 24,33†,29†,7 | 27,21†,24†,8 | 20,27†,23†,12 | 22,19†,21†,9 | 26,35†,31†,6 | 32,44,38,4 | 21,19†,20†,9 | 30,34,32,3 | 27,15†,21†,9 | 19,16†,17†,8 | 20,33†,26†,8 | 29,19†,24†,8 |
| *Chlaenius tricolor tricolor* | 18†,24†,21†,6 | 17†,17†,17†,7 | 32,61\*,47,4 | 37,31,34,5 | 18,24†,21†,6 | 28,30,29,7 | 11†,12†,11†,12\* | 46\*,55\*,51\*,2 | 47\*,32,39,5 | 18†,19†,19†,8 | 11†,24†,18†,9 | 16†,15†,16†,9\* |
| *Harpalus longicollis* | 15†,13†,14†,11\* | 17†,14†,15†,10\* | 41\*,53,47\*,4 | 51\*,50\*,50\*,1† | 14†,12†,13†,11\* | 21,13†,17†,13\* | 16†,13†,15†,11\* | 53\*,46,49\*,8 | 66\*,48\*,57\*,2 | 28,20,24,5 | 10†,13†,11†,12\* | 19,12†,15†,12\* |
| *Scarites subterraneus* | 16†,19†,18†,7 | 17,23†,20†,7 | 40\*,40,40,3 | 40\*,37,38\*,4 | 12†,16†,14†,10\* | 22,11†,16†,11\* | 16†,15†,16†,8 | 47\*,43,45\*,3 | 56\*,32,43\*,2 | 20,12†,16†,10\* | 9†,13†,11†,11\* | 20,18†,19,8 |
| *Sphaeroderus stenostomus lecontei* | 80\*,77\*,78\*,0† | 80\*,66\*,73\*,0† | 42,21†,31,5 | 32,17†,24,8 | 87\*,86\*,86\*,0† | 80\*,57\*,68\*,1† | 74\*,73\*,73\*,0† | 44,26,34,2 | 39,22,30,5 | 63\*,50\*,56\*,0† | 72\*,72\*,72\*,0†  | 73\*,41\*,57\*,1† |

**Table S13.** Overlap statistics calculated for pairs of environmental and ground beetle variables measured at the urban site at the large spatial scale. Shown for each pair: *Oe*, the mean minimum Euclidean distance between each environmental candidate boundary element and the closest beetle candidate boundary element (m); *Ob*, the mean minimum Euclidean distance between each beetle candidate boundary element and the closest environmental candidate boundary element (m); *Oeb*, the overall mean minimum Euclidean distance between beetle and environmental candidate boundary elements (m); and *Os*, the number of beetle and environmental candidate boundary elements at the same locations. †Significantly low value (*p* < 0.10). \*Significantly high value (*p* < 0.10).

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Beetle variable | Humidity | Microrelief | Slope | Leaf litter depth | Bare ground cover |
| Generalist species richness | 27,21†,24,3 | 35,26,31,2 | 61,44,52,0 | 28,16†,22†,4\* | 52,46,49,2 |
| *Amara familiaris* | 42,36,39,1 | 75\*,68\*,71\*,0 | 56,36,46,2 | 41,28,34,2 | 28,20,24,3 |
| *Chlaenius tomentosus tomentosus* | 53\*,32†,43\*,2† | 92\*,66\*,79\*,0† | 89\*,71\*,80\*,0† | 43\*,32†,38\*,2† | 28\*,17†,22†,3† |
| *Chlaenius tricolor tricolor* | 35,32,33,2 | 61,59,60,1 | 54,58\*,56,1 | 24†,27,26†,2 | 15†,18†,17†,4\* |
| *Harpalus pensylvanicus* | 34,29,32,2 | 47,45,46,1 | 37,30,34,2 | 29,18†,24†,3 | 42,33,37,2 |
| *Sphaeroderus stenostomus lecontei* | 55,61\*,58,0 | 33,41,37,1 | 41,26,33,2 | 65,63\*,64\*,0 | 96\*,95\*,95\*,0 |