Relationship between species traits and landscape extent in ground beetles
(Coleoptera: Carabidae)

by

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Abstract

The spatial scale at which landscape structure best predicts an ecological response (the “scale of effect”) typically requires measuring landscape structure at multiple spatial extents and is determined post-sampling. It is commonly assumed that the scale of effect is associated with a species’ daily movements and/or infrequent dispersal events.

Alternatively, it has been predicted that the reproductive potential of a species may also determine the scale of effect. I tested these hypotheses using body length, relative wing size, and egg count measurements of carabid beetles, proxies for movement, dispersal, and reproductive potential, respectively, across Eastern Ontario. I determined the scale of effect for 13 carabid species, and calculated cross-species correlations between the scale of effect and body length, relative wing size, and mean eggs. I found a positive correlation between body length and the scale of effect, and negative correlations between relative wing size and mean egg counts and the scale of effect. Surprisingly, model ranking revealed mean egg counts to be the best predictor of the scale of effect, followed by body length and relative wing size, respectively. Interestingly, this result suggests that the reproductive potential of a species may be more important in predicting the scale of effect than a species’ movement or dispersal ability. As such, reproductive potential should be considered in conjunction with the movement potential of a species when predicting the scale of effect.

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1 Introduction

The abundance and distribution of organisms is influenced by the landscape context (i.e., surrounding agricultural activities, forest cover, road density, etc.), but the spatial scale at which the landscape context most strongly influences an ecological response is often unknown. Empiricists commonly evaluate the spatial scale at which landscape structure best predicts an ecological response using a multi-scale approach. An ecological response is measured at multiple focal sites within a study region and landscape structure is measured within nested buffers (or scales) of increasing radii surrounding each focal site (Brennan et al. 2002). The scale at which landscape structure best predicts an ecological response within the sampling site is known as the ‘scale of effect’ (Figure 1). This approach maximises the probability that landscape structure is measured at the appropriate scale for the species of interest. For example, Roland and Taylor (1997) measured forest structure within seven nested spatial scales to determine the influence of forest structure on parasitism rates for four parasitoid flies. By measuring forest structure at seven different scales, Roland and Taylor (1997) improved their chances of detecting a response in parasitism rates to forest structure. This allowed them to detect the individual scales of effect for each parasitoid fly.

Predicting the correct scale of effect is critical for observing a species response to landscape structure that may otherwise be masked or unapparent if the incorrect spatial scale is selected (Holland et al. 2005a; Jackson and Fahrig 2012; Martin and Fahrig 2012; Jackson and Fahrig 2014). Therefore, it is important that landscape structure be measured at multiple scales (e.g., Findlay and Houlihan 1997; Holland et al. 2005a; Boscolo and Metzger 2009; Smith et al. 2011) when the appropriate scale of effect for the study

species or system is unclear, to best detect an ecological response (Brennan et al. 2002). For example, Renfrew and Ribic (2007) found grassland bird abundance responded more strongly to landscape structure (e.g., proportion of suitable grassland) at their largest scale of investigation (1200 m), and Rusch et al. (2011) found parasitism rates of a pollen beetle parasitoid responded most strongly to landscape structure (e.g., proportion of woodland) at one of their intermediate spatial scales (1250 m). If Renfrew and Ribic (2008) or Rusch et al. (2011) had limited their investigations to spatial scales below the respective scales of effect for grassland bird abundance and parasitism rates, they may not have detected any significant species responses to the landscape structure.

The scales selected for multi-scale studies should also consider the responses of all species in the study to landscape structure. Researchers may arbitrarily select a single range of scales to encompass the expected range of landscape interaction for the species in their study. For example, Kato et al. (2010) selected a range of scales from 100 m to 1500 m in radius to determine the scale at which forest cover best predicts egg masses in two anuran species. Kato et al. (2010) selected their range of scales based on the expected movement ranges of anurans in general, and did not select scales specific to each species in their study. However, different species respond to the surrounding landscape at different spatial scales (Wiens 1989; Levin 1992; With 1994), even within the same family (Holland et al. 2004). Therefore, in multi-species studies, landscapes need to be large enough to capture a range of spatial scales that encompass the extents of landscape interaction for all species.

A limitation of using a multi-scale approach is that the scale of effect cannot be determined until sampling has been conducted (Jackson and Fahrig 2012). This restricts

researchers in selecting sampling points distanced far enough apart to ensure that surrounding landscapes of varying size are independent and non-overlapping (Figure 2a). If the points are too close together, given the scale of effect, then landscapes will overlap, leading to low variation in landscape structure across landscapes and, therefore, low power to detect an effect of landscape structure. In addition, points too close together may lack independence in the response variable, as detected by spatial autocorrelation (Brennan et al. 2002). Since the scale of effect is unknown *a priori*, the range of selected landscape sizes needs to encompass the predicted spatial scale(s) appropriate to a given study system (Brennan et al. 2002). If we have selected a wide enough range, such that the actual scale of effect is within the range of scales analyzed, then in retrospect, after we have completed the multi-scale analysis, we will know that the sample points for the response variable could have been selected to be closer together than they were. Selecting non-overlapping landscapes at the scale of effect requires less separation between sample points than selecting non-overlapping landscapes at the maximum scale in the multi-scale analysis encompassing the scale of effect. Thus, in a given area, fewer landscapes can be sampled using a multi-scale approach than in a single-scale analysis if the scale of effect is known *a priori* (Figure 2). The latter would allow the researcher to sample more landscapes that are closer together within the same given area (Figure 2b).

If the scale of effect could be accurately predicted *a priori*, landscapes for ecological and conservation-based research could be selected at the appropriate spatial scale prior to sampling. Predetermined scales of effect would allow for more landscapes to be sampled and less time and resources spent travelling between sampling points for landscape ecological studies. Further, if the scale of effect could be predicted without

conducting a multi-scale analysis, conservation managers could better allocate resources into conserving landscapes at appropriate spatial scales for threatened and endangered species. This could lead to better reserve design and conservation management plans.

To predict the scale of effect *a priori*, we need to know the relationships between species traits and the scale of effect. A few empirical studies have evaluated such relationships. Most relate body size to the scale of effect, on the assumption that body size is an indirect measure of a species' mobility, and that a more mobile species should have a larger scale of effect. Body size, has been shown to be positively related to scale of effect in four parasitoid fly species (Roland and Taylor 1997) and seven long-horned beetle species (Holland et al. 2005a). Further, in a recent meta-analysis study, Thornton and Fletcher (2014) found a positive relationship between body size and the scale of effect in birds across 22 studies. However, body size was not correlated with the scale of effect for 56 songbird species (Tittler 2008), suggesting that body size may not always be a reliable predictor of the scale of effect.

There have been no empirical studies evaluating the relationship between reproductive potential and the scale of effect. Intuitively, one may expect the scale of effect to be larger for more fecund species on the assumption that species with higher reproductive outputs require larger landscapes to meet reproductive needs and to reduce conspecific competition for limited resources. However, in their simulation study, Jackson and Fahrig (2012) tested the association between reproductive rate and the scale of effect, finding that more fecund species had smaller scales of effect than less fecund species. It is unclear as to why more fecund species had reduced scales of effect. Empirical studies have revealed a strong negative association between reproductive rate

and the minimum habitat required for long-horned beetles (Holland et al. 2005b) and between reproductive rate and the amount of forest required for birds (Vance et al. 2003). These studies suggest that species with higher reproductive rates are able to persist with less habitat, and perhaps persistence with less habitat is related to smaller scales of effect for these species. However, the potential link between reproductive rate and scale of effect has not been explicitly tested.

Carabid beetles (Coleoptera:Carabidae) provide a model taxon to evaluate how species traits influence the scale of effect. Carabids interact with their environment by walking (Lovei and Sunderland 1996), with larger species being more mobile than smaller species (Juliano 1983; Brouwers and Newton 2009; Laparie et al. 2013). Higher mobility in larger beetles (i.e., larger body size) allows for daily movements of hundreds of metres for some species (de Vries et al. 1996; Bilde and Topping 2004), perhaps associating increased body size with larger scales of effect. As well, many carabids are winged and capable of dispersal via flight. Winged dispersal events in carabids are typically associated with seasonal changes in habitat quality (Turin and den Boer 1988) or mating opportunities (Hawkes 2009), with reduced habitat qualities and mating opportunities promoting winged dispersal. However, winged dispersal events are infrequent and are not associated with daily movements for carabids (Jopp and Reuter 2005; Brouwers and Newton 2009). Wing size in carabids has been associated with dispersal potential, with species with larger wings dispersing farther distances (den Boer 1980; Desender 1989). Therefore, wing size, as a proxy for dispersal potential, may be associated with larger scales of effect.

Carabid beetles can also be used to test the prediction that reproductive potential is negatively associated with the scale of effect. Since carabids have variation in egg production between species (Juliano 1986; Honek 1993; Lovei and Sunderland 1996), it is possible to test whether carabid species with high reproductive outputs (e.g., egg counts) have reduced scales of effect, as predicted by Jackson and Fahrig (2012).

The purpose of this study was to test the hypotheses that the scale of effect of the landscape increases with increasing movement range and decreasing reproductive potential. To do this I first determined the spatial scale at which habitat amount best predicts abundance for twenty-six carabid species (i.e., their scales of effect) and then tested the predictions that: (1) larger carabids should have larger scales of effect; (2) carabids with larger wings should have larger scales of effect; and, (3) carabids with higher egg counts should have smaller scales of effect.

1.1 Ecology and Life History of Carabidae

The family Carabidae (also known as the ground beetles) contains more than 40,000 described species (Erwin 1985). These are associated with several habitats, including riparian (Kotze and O'Hara 2003), forest (Jeanneret et al. 2003; Rainio and Niemela 2003), and agricultural (den Boer 1970; Turin and den Boer 1988; Joyce et al. 1999) habitats. In the Northern Hemisphere, carabids are common in agricultural fields and are generally considered beneficial natural enemies of agricultural pests (Bianchi et al. 2006; Rusch et al. 2013). However, agricultural practices and management influence oviposition, abundance, and spatial distribution of carabids through changes to habitat structure such as cultivation, changes in crop types, and agrochemical application (Thiele 1977). As such, agricultural habitats are generally considered unstable for carabids (Turin

and den Boer 1988), with non-crop field margins providing refuges in agricultural systems (Bianchi et al. 2006; Tschamntke et al. 2007).

Carabids interact with their environments with directed random walking behaviours until suitable habitat is located (Lovei and Sunderland 1996). Body size in carabids is associated with mobility (Juliano 1983; Brouwers and Newton 2009; Laparie et al. 2013), with larger species capable of searching larger areas for suitable habitats. Ancestrally, functional wings were the primary dispersal mode for carabids. However, flightlessness and flight dimorphism has repeatedly evolved (Lovei and Sunderland 1996) and flightless species tend to be more abundant in stable environments (Hedin et al. 2008).

Carabids breed either in the spring or autumn (Rainio and Niemela 2003). Spring breeders overwinter as adults, while autumn breeders overwinter as larvae (Lindroth 1992). Fecundity can range from fewer than ten eggs per female to hundreds per female (Lovei and Sunderland 1996), with egg production dependent on both physiological and environmental conditions (Juliano 1986; Honek 1993).

2 Methods

2.1 Overview

The goal of my study was to test the predictions that larger carabids and carabids with larger wings should have larger scales of effect, and that carabids with high egg counts should have smaller scales of effect. To address these predictions, carabid beetle sampling sites were first selected within crop fields across Eastern Ontario (approximately 6000 km² of crop land in Eastern Ontario). Sampling sites were either at the edge of the field or in the field crop field interior. These two site types were selected

to sample both carabids that use field margins and crop interior as potential habitats. At each sampling site, pitfall traps were installed and the local cover type (e.g., grass, mixed shrub, etc. for border trap locations and cereal, corn, soybean, etc. for field trap locations) was noted.

Before I could test predictions relating the scale of effect to carabid species traits, I first needed to determine the scale of effect for each carabid species captured. To do this I used a multi-scale approach. I created 20 spatial buffers of increasing radii around each sampling point. I calculated habitat amount within each spatial buffer, where 'habitat' was defined individually for each species.

To calculate habitat amount, I first determined the cover types associated with each carabid species captured. I defined habitat for each species as the local cover type(s) in which the proportion of individuals captured within a given cover type was greater than or equal to the proportion of traps located within that cover type. I calculated the total amount of habitat within each landscape surrounding a sampling point as the sum of the areas of all the cover types used by that species. To determine the scale of effect for a species, I then regressed abundance (the number of individuals of a species captured at each sampling site) on habitat amount, separately for each buffer radius (scale), using Poisson regressions. The scale of effect for a species was then the buffer radius at which habitat amount best predicted abundance, defined as the scale with the largest positive slope coefficient.

With the scale of effect for each species determined, I conducted cross-species analyses to test whether larger carabids and carabids with larger wing sizes had increased scales of effect, and whether carabids with high egg counts had reduced scales of effect.

Body size (e.g., body length and dry mass), wing size (e.g., relative wing size and index of wing loading), and reproductive potential (e.g., mean eggs) were measured for each carabid specie. To test the predictions, I conducted cross-species weighted regressions to determine whether these potential predictors predict the scale of effect.

2.2 Site Selection

The study area was in Eastern Ontario, bounded by the Ottawa River and St. Lawrence River to the north and south, respectively, and by the Canadian Shield and Ontario-Quebec border to the west and east, respectively (Figure 3). Crop and pasture land occupy approximately 45% of the total land cover in the study area (Statistics Canada 2012). The majority of crop fields were corn or soybean, which account for approximately 20% and 18% of the total crop land, respectively (Statistics Canada 2012). Forested areas in this region are largely dominated by deciduous species, including Aceraceae, Betulaceae, and Fagaceae (MNR 2012). As well, Pinaceae (largely *Cedrus*, *Pinus*, and *Tsuga sp.*) are abundant in northern areas of the region and along the St. Lawrence River (MNR 2012).

552 sampling sites were selected within agriculturally dominated areas within the study area. An additional 11 sampling sites were selected due to the destruction of traps at some sampling sites, resulting in a total of 563 sampling sites used for analyses. 276 sites (plus 6 replacement sampling sites) were sampled in 2011 (June 11th to August 31st) and 276 sites (plus 5 replacement sites) were sampled in 2012 (June 11th to August 31st). Sampling sites were clustered in groups of six (276 sampling sites / 6 sampling sites per cluster = 92 clusters of sampling sites; Figure 3) for ease of carabid sampling and to

maximise the number of crop fields sampled. Each cluster of sampling sites was separated by a minimum of 3 km from any other cluster, and each cluster of sampling sites consisted of three sampling sites adjacent to a crop field border (henceforth, border sites) and 3 sampling sites 25 m into a crop field (henceforth, field sites; Figure 4). Each border site was paired with a field site (i.e., each field site was located 25 m from its paired border site) to sample carabid species that associate with either field border or field interior cover types. Border sites were selected such that each border site was: (1) adjacent to a crop field border; (2) between two crop fields (separated by a narrow non-crop margin); (3) a minimum of 50 m from any non-agricultural land use (e.g., pond or road); and, (4) at least 200 m from any other border site. Note that sampling site locations were selected and carabid sampling was conducted as part of the Geomatics and Landscape Ecology Laboratory's (GLEL) Agriculture Project at Carleton University.

I classified local cover types for border and field sites to determine habitat association for carabids within the study area. Local cover types were classified at each border and field site. Field sites were predominantly in corn and soybean fields (~35%), but were also located in: abandoned field, cereal, fallow, hay, legume, mixed vegetable, pasture, and winter wheat fields (Appendix A). Field margins next to border sites were classified as: abandoned, fallow, grass, mixed shrub, or treed (Appendix A). A border site was considered to be adjacent to an abandoned or fallow field margin when there was no discernable grass, scrub, or treed field margin between the crop field and the adjacent abandoned or fallow field.

2.3 Pitfall Trapping and Species Identification

Two pitfall traps were installed 50 m apart at each sampling site (i.e., two pitfall traps per border site and two pitfall traps per field site). The paired border and field sites thus formed a rectangular set of four traps, with the two border traps adjacent to the non-crop border and the two field traps 25 m into the crop field (Figure 4). Pitfall traps were 16 oz plastic cups (~470 mL, 9 cm diameter, 11 cm tall) placed in the ground so that the top of each trap was level with the soil (Figure 5a). Each trap was half filled with water with dish soap added to break the surface tension (approximately 10 drops of soap per 1 L water). An 18 cm² roof was mounted approximately 3 cm above each trap to prevent flooding from rain (Figure 5b).

Each sampling site was visited twice with a minimum of 16 days between visits, and pitfall traps at each sampling site were set for four days before carabids were collected, on each visit. Carabids captured from the two traps at each sampling site were combined into a single sample for that site (i.e., two border traps provided a single sample for a border site and two field traps provided a single sample for a field site; Figure 4b). Samples were rinsed through a 1 mm sieve, and carabids were removed and stored in 70% ethanol. For analyses, carabids captured at a sampling site were combined across both visits to provide a single sample for a given sampling site.

Carabids in each sample were identified to species using dichotomous keys based on morphological characters (Lindroth 1969; Bousquet 2010). Tiger beetles (Cicindelinae) were included with other ground beetles as phylogenetic research has placed tiger beetles within the family Carabidae (Maddison et al. 1999). Further, despite tiger beetles being more likely to fly, they are still largely ground-dwelling beetles similar to other carabids (Lovei and Sunderland 1996) and are likely to interact with the

surrounding landscape similar to other ground beetles. The number of species and number of individuals per species were determined for each sample (Appendix B). The number of individuals of a species within a sample was considered an index of species abundance for that sampling site.

2.4 Defining Landscapes and Habitat Association

I needed to measure landscape structure (e.g., habitat amount) at multiple spatial scales because I did not know *a priori* the scale of effect for each of the carabid species captured. Therefore, I created 20 circular spatial buffers (henceforth, landscapes) around each sampling site, ranging from 50 m to 1000 m in radius at 50 m increments, in ArcGIS 10.1 (ESRI 2012). I selected this range of landscape sizes because carabids can move hundreds of metres (de Vries et al. 1996; Bilde and Topping 2004), and I wanted a range of scales that would be likely to contain the scales of effect of the carabids in my study. All cover types within each landscape were digitised from aerial photographs (50 cm resolution).

The scale of effect is defined as the scale at which landscape structure best predicts an ecological response. In my study, I was interested in determining the scale of effect for carabids using habitat amount as my metric of landscape structure. Habitat association varies between carabid species and has been documented in the literature (summarised in Larochelle and Larivière 2001; Larochelle and Lariviere 2003). However, when using the literature to define habitat, nearly all cover types in our landscapes are classified as habitat for most species. This is likely because the literature reports habitat as any cover type in which the species has been detected. Some of these may be only rarely used or used only during dispersal. Using habitat defined in this way would lead to

little to no variation in habitat amount across spatial scales, which would make determining the scale of effect impossible.

Therefore, I determined habitat association for each species using local cover types and my carabid capture data. First, habitat association was only determined for species present in a minimum of eight of the 92 clusters of sampling sites (approximately 8% of clusters; Figure 6; Appendix B). This cut-off was set at to maximize the number of species (26 species) available for the scale of effect analyses and to eliminate rare species for which insufficient data would limit the reliability of the estimate of the scale of effect. Since the landscapes around each sampling site in a cluster significantly overlapped, habitat amount within each landscape surrounding sampling sites in a cluster (i.e., the landscapes around each of the six sampling sites in a cluster) would be similar. Therefore, each cluster of sampling sites provided an independent set of landscapes. The cut-off thus ensured that a species in the analysis was present in at least eight independent landscapes. Second, I determined habitat association for each species using the local cover types in which that species was captured. As sampling sites were not equally distributed among cover types (e.g., ~35% of field traps were in either corn or soybean), I defined the habitat association for each species as the local cover type(s) in which the proportion of individuals captured within a given cover type was greater than or equal to the proportion of traps located within that cover type (Appendix C). If the proportion of individuals captured in a cover type was lower than the proportion of traps in the same cover type, the cover type was not considered habitat.

Some rare agricultural land uses (e.g., apple orchards) or non-agricultural cover types (e.g., wetland) did not contain traps and so those cover types was not captured in

the habitat association analysis. However, treed field margins are similar to forested areas in terms of cover type. Even though sampling sites were not present in forest *per se*, I considered forest as a potential habitat association if treed field margins were classified as habitat for a given species, as forest has been documented as habitat for each species in which treed field margins were considered habitat (Larochelle and Larivière 2001; Larochelle and Lariviere 2003).

Once I had determined habitat associations for each species, I calculated the total amount of habitat within each of the 20 landscapes surrounding each sampling site, for each species present in at least eight clusters of sampling sites (Figure 6). Habitat amount for a species was the total area of all cover types classified as habitat for that species within a landscape (Appendix D).

2.5 Carabid Measurements

I measured the body length, dry mass, relative wing size (RWS), index of wing loading (IWL), and egg counts to obtain averages per species. I aimed to measure body length, dry mass, RWS, and IWL of 30 individuals per species and egg counts of 20 females per species. If I did not have the desired number of individuals for a given measurement, I measured all individuals available (Table 1; Appendices E and F).

I measured body size as the body length and dry mass. Body length was measured from the posterior tip of the elytra to the anterior tip of the mandibles using digital Vernier calipers (to the nearest 0.01 mm). For dry mass, I dried carabid specimens in a drying oven at 60°C for 24 hours and weighed them to the nearest 0.1 mg (Sartorius Practum Series scale).

I measured wing size as both the relative wing size (RWS) and the index of wing loading (IWL). Relative wing size corrects for allometry (den Boer 1980), and predicts an individual's ability to fly. Individuals with a RWS less than 70% are incapable of flying (Desender 1989). I measured the length and width of the left wing and elytron for each beetle, and calculated the RWS as:

$$\text{Relative Wing Size} = \frac{\text{Wing Length} * \text{Wing Width}}{\text{Elytra Length} * \text{Elytra Width}}$$

To approximate wing loading I used the dry masses of the beetles and estimated total wing area as two times the product of the left wing's length and width. Beetles with low wing loadings require less energy to fly (Angelo and Slansky 1984), and are potentially able to disperse farther than beetles with higher wing loadings. I calculated the IWL as:

$$\text{Index of Wing Loading} = \frac{\text{Dry Mass}}{2(\text{Wing Length} * \text{Wing Width})}$$

I dissected females and counted eggs as a measure of reproductive potential. I cut lengthwise along the abdomen to expose the reproductive organs and teased apart the soft tissues to release any eggs present. I calculated the mean number of eggs per female with eggs present (henceforth, mean eggs).

2.6 Statistical Analyses

2.6.1 Determining the Scale of Effect

For each carabid species, I performed Poisson regressions at each spatial scale to determine the scale at which habitat amount best predicted species abundance (i.e., the scale of effect). From the Poisson regressions, I determined the scale of effect as the spatial scale with the largest positive slope coefficient (Figure 7; Appendix G). Species where the largest slope coefficient was negative (7 of 26 species) were removed from

subsequent analyses (Figure 6) because these results suggest that abundance was negatively related to habitat amount for these species, indicating that habitat was likely inappropriately defined for these species.

In determining the scale of effect I did not correct for spatial independence between my landscapes because there are no statistical tests involved in estimating the scale of effect. Therefore, there is no need to adjust degrees of freedom for lack of independence (Schooley 2006; Zuckerberg et al. 2012).

2.6.2 Testing Predicted Relationships between the Scale of Effect and Species Traits

I wanted to test the three cross-species predictions that the scale of effect would be larger for carabids with increasing body size, increasing wing size, and decreasing egg counts. First, to test all three predictions, carabid species needed to have wings present and have at least one female with eggs present to compare wing sizes and egg counts, respectively (13 species). Second, to test the independent effects of body size (body length and dry mass), wing size (RWS and IWL), and egg counts (mean eggs) on the scale of effect, my predictor variables could not be highly correlated. I calculated Spearman rho correlations between my body size, wing size, and egg count predictors to determine if these predictor variables were correlated. The predictors that were least correlated with other predictors were selected for further analyses. Dry mass and IWL were significantly correlated (Figure 8), and thus removed from subsequent analyses. Body length was also significantly correlated with the IWL (Figure 8), but to a lesser degree than dry mass; it was also less correlated with RWS. Therefore, body length provided a more independent measure of body size than did dry mass.

In predicting the scale of effect using carabid species traits, I performed weighted linear regressions to test relationships between scale of effect and body length, RWS, and log (mean eggs) ; mean eggs was log transformed to meet model assumptions. Each predictor variable had a different scale of measurement, and were standardised to have each predictor contribute equally to regression analyses. The regressions were weighted, to give higher weight to species for which I had higher certainty in my estimate of the scale of effect (generally due to larger sample sizes for these species). The inverse of the standard error of the slope coefficient from the scale that best predicted species abundance (the scale of effect: Appendix G) was used as the weighting value for each species. The inverse variance provided an indirect indicator of my confidence for the scale of effect estimates for each carabid species. I executed multiple weighted regressions for all eight possible combinations of the predictors. Combinations excluded interaction terms between predictors due to limited degrees of freedom.

I calculated the relative support for each model using Akaike information criterion for small sample size (AIC_c ; Burnham and Anderson 2002). I calculated model weights (w_i) for each of the eight models, which indicated the probability that a model was the best model for the data (Burnham and Anderson 2004), and calculated the sum of model weights ($\sum w_i$) for each predictor for all models in which a given predictor was present. Further, I calculated the model-averaged slope coefficient estimates and their confidence intervals for each predictor variable across all models containing that predictor variable using the ‘AICcmodavg’ package in R. Model-averaged estimates were weighted by Akaike weights. Model-averaged slope coefficient estimates reveal the relative support of each predictor variable, averaged across all potential models

containing a given predictor. In other words, they indicate the relative importance of the predictors in predicting the scale of effect. All statistical analyses were conducted in R version 3.0.2 (R Core Team 2013).

3 Results

A total of 22,187 individual carabids representing 73 species were captured (Appendix B). *Pterostichus melanarius* and *Harpalus pensylvanicus* accounted for approximately 80% of the total captures (13,298 and 4,418 individuals, respectively). The number of species captured per trap (i.e., the combined captures from two border or two field traps at a sampling site during a single visit) varied, with most traps capturing only 1 or 2 species (~27% and 26% of traps, respectively), although a single trap captured 12 species (Appendix H). The number of individuals caught per trap (again, the combined captures from a single sampling site during a single visit) also varied, with as many as 532 individuals captured in a single trapping sample. However, approximately 62% of trapping samples contained fewer than 10 individuals (Appendix H).

Of the 73 species captured, only 26 species were present in at least eight clusters of sampling sites (Appendix B). Therefore, habitat associations were determined for these 26 species. Border traps were primarily adjacent to mixed shrub and grass field margins (~40% of all traps), and field traps were primarily located in corn and soybean fields (~35% of all traps; Appendix C). However, most species had mixed shrub or grass habitats as one of their potential habitat associations (16 and 21 species, respectively) compared to corn and soybean habitats (2 and 5 species, respectively; Appendix C).

The largest slope coefficients (Appendix G) were negative for 7 of the 26 species (*Agonum thoreyi*, *Bembidion mimum*, *Bembidion quadrimaculatum*, *Harpalus erraticus*,

Harpalus herbivagus, *Ophonus puncticeps* and *Patrobus longicornis*; Figures 7; Appendix G). This indicated a negative relationship between 'habitat' amount and abundance at the scale of effect. Since this calls into question my habitat definition for these species, they were eliminated from further analyses. The scale of effect was taken as the largest positive slope coefficient (Appendix G) for the remaining 19 species (Figure 7).

Of these 19 species, only 13 had individuals with eggs present (Table 1; Appendix G). Since egg counts were needed to test the prediction that the scale of effect should be negatively related to egg counts, the six species without egg counts (Appendix H) were excluded from subsequent analyses. These 13 species were used to test the relationship between carabid species traits and the scale of effect.

Of the five initial predictor variables, dry mass and IWL were significantly correlated for all species with egg counts (Spearman's $\rho = 0.72$, $P < 0.01$; Figure 7) and were excluded from subsequent analyses (Figure 6). Body length was not significantly correlated with the RWS (Spearman's $\rho = -0.23$, $P = 0.46$) or mean eggs (Spearman's $\rho = -0.12$, $P = 0.71$), and the RWS was not significantly correlated with mean eggs (Spearman's $\rho = -0.019$, $P = 0.95$; Figure 7). Therefore, body length, RWS, and mean eggs were selected to represent body size, wing size, and reproductive potential, respectively.

Weighted regressions supported the hypotheses that species traits predict the scale of effect in carabid beetles. There was a cross-species positive relationship between body length and the scale of effect (Figure 9a), and a cross-species negative relationship between RWS (Figure 9b) and log (mean eggs) (Figure 9c; Table 2). Log (mean eggs)

had the largest R^2 value ($R^2 = 0.340$), followed by body length ($R^2 = 0.305$) and RWS ($R^2 = 0.219$; Table 2). Model ranking using AIC_c values revealed log (mean eggs) to be the best predictor of the scale of effect (Table 2). However, all models had a ΔAIC_c value less than 7, suggesting the models did not differ strongly in their support (Burnham et al. 2011). Further, adding the model weights for each model in which a given predictor was present reveals that log (mean eggs) is the most informative when predicting the scale of effect ($\sum w_i = 0.586$), followed by body length ($\sum w_i = 0.430$) and RWS ($\sum w_i = 0.231$; Table 3). Model-averaged standardised slope coefficient estimates and confidence intervals also showed log (mean eggs) to be the most informative when predicting the scale of effect, followed by body length and RWS, respectively (Figure 10).

4 Discussion

My results support the prediction that larger carabid beetles have larger scales of effect than smaller carabid beetles. Species with longer body lengths were found to respond to habitat amount in the surrounding landscape at larger spatial scales, whereas species with shorter body lengths were found to respond to habitat amount in the surrounding landscape at smaller spatial scales (Table 2). This result is similar to the results of Roland and Taylor (1997) and Holland et al. (2005a) who found that larger parasitoid flies and long-horned beetles responded to landscape structure at larger spatial scales, respectively. Further, in their meta-analysis, Thornton and Fletcher (2014) found a positive relationship between the body size of birds and their scales of effect. On the other hand, Tittler (2008), found no relationship between body sizes in songbirds and their scales of effect.

I found less support for an effect of wing size on the scale of effect in carabids. On the assumption that wing size is an index of dispersal distance in carabids (den Boer 1990; Homburg et al. 2013), I had expected a positive relationship (Jackson and Fahrig 2012). That I found a stronger relationship between body size and the scale of effect than between wing size and the scale of effect could indicate that the scale of effect is more strongly linked to daily mobility than to occasional dispersal events. Carabids move within their environment largely by walking (Lovei and Sunderland 1996), and larger carabids are able to move faster and potentially farther (Juliano 1983; Brouwers and Newton 2009; Laparie et al. 2013). It is likely that winged dispersal events in carabids are only a means to locate new habitats when local conditions are unfavourable (e.g., food limitations; Turin and den Boer 1988) or to locate potential mating partners (Hawkes 2009).

My results support the prediction (Jackson and Fahrig 2012), that species with higher reproductive rates have smaller scales of effect of the landscape. Species with higher mean egg counts responded to habitat in the surrounding landscape at smaller spatial scales than species with lower mean egg counts (Table 2). This study is the first empirical test of that prediction. Reproductive rate is known to be related to species sensitivity to landscape changes such as habitat loss (e.g., Vance et al. 2003; Holland et al. 2005b) and road density (Rytwinski and Fahrig 2011; Rytwinski and Fahrig 2012), but to date no other study has evaluated the influence of reproductive rate on the scale of effect of landscape variables.

The scale of effect is typically thought to be a function of a species' mobility (Holling 1992; Carr and Fahrig 2001; Ricketts et al. 2001). The association between body

size and the scale of effect is related to the effects of landscape structure on species mobility. Larger species move farther distances (Bowman et al. 2002; Holland et al. 2005) and colonise more distant habitat patches than smaller species (Roland and Taylor 1997), suggesting that the surrounding non-habitat matrix may act as less of a barrier to movement for larger species. Further, dispersal or movement behaviour may also influence the scale of effect. Gap-avoidance behaviours may reduce scales of effect, as gap-avoidant individuals are less likely to risk long-distance dispersal and movements within the non-habitat matrix (Jackson and Fahrig 2012). Therefore, species traits influencing mobility (e.g., body size) and movement related behaviours (e.g., gap-avoidance) provide potential explanations for understanding the association between species mobility and the scale of effect of the landscape.

The negative relationship between reproductive potential and scale of effect is not inherently clear. In carabids, the negative association between mean egg counts and the scale of effect may be related to the home range requirements of carabids. Carabids with large home range requirements having relatively low reproductive potentials (Kotze and O'Hara 2003). This suggests that carabids with low reproductive potential and large home range requirements may have larger scales of effect than carabids with high reproductive potential. However, this explanation is unlikely as egg counts were poorly correlated with body length (Spearman's $\rho = -0.12$, $P = 0.71$), a correlate of home range size (Bowman et al. 2002). Another possible explanation for the relationship between reproductive potential and the scale of effect is that species with high reproductive potential have no effect to landscape context. This would depend on finding a larger reduction in the range of habitat amount with increasing spatial scale for species with

higher egg counts compared to species with lower egg counts, resulting in an apparent effect of the landscape at small spatial scales for these species. There was a reduction in variance in habitat amount with increasing spatial extent for all carabid species with egg counts (13 species), but species with higher egg counts did not necessarily have a larger reduction in variance with increasing spatial extent compared to species with lower egg counts (Appendix I). Therefore, it is unlikely that species with higher egg counts are responding to smaller spatial scales due to an apparent landscape effect.

Another possible reason behind the negative relationship found between reproductive potential and the scale of effect may be related to the influence of reproductive rate on population persistence and/or size. It has been suggested that species with low reproductive potentials require large amounts of habitat for population persistence (Fahrig 2001). However, populations with low reproductive potentials requiring more habitat for persistence does not necessarily suggest the individuals within these populations also require larger amounts of habitat. Further, species with high reproductive potentials are more likely to have larger population sizes than species with low reproductive potentials. If local population dynamics for species with high reproductive outputs are less reliant or affected by long-distance migrants, than these species may, in turn, have smaller scales of effect. In comparison, species with low reproductive potential may risk longer distance migrations to locate mates due to low population size, and thus may have associated larger scales of effect to the landscape.

Contrary to Jackson and Fahrig (2012), my data suggests that reproductive potential better predicts of the scale of effect than the movement biology of a species. I found that mean egg counts better predicted the scale of effect than did body length or

RWS (Table 2 and 3), my predictors for mobility and dispersal, respectively. This may be a result of mean egg counts being a better predictor of reproductive potential than either body length or RWS was of carabid mobility and dispersal, respectively. Further, this is the first empirical test of the relationship between reproductive potential and the scale of effect, and it may be that reproductive potential is a better predictor of scales of effect than a species mobility or dispersal potential but has previously been untested. Therefore, my data suggests that the reproductive biology of a species should be considered when predicting scales of effect in conjunction with a species movement.

The relative support of each predictor in determining the scale of effect is further supported in post-hoc analyses. Assuming that *Pterostichus melanarius* may be an influential outlier due to its reduced wing size (RWS = 0.12; Table 1), I removed this species and re-tested whether body length, RWS, and mean egg counts determine the scale of effect for the 12 remaining species. Post-hoc results remained largely unchanged, with log (mean eggs) still being the best predictor of the scale of effect, followed by body length and RWS (Appendices J-N). Further, including species without egg counts, I determined whether body length consistently better predicts the scale of effect compared to RWS. Using all 19 species measured, I found that body length better predicts the scale of effect than RWS (Appendices O-R).

I found that species traits can be used to predict the scale of effect. Although the relative importance of reproductive potential was greater than the mobility or dispersal potential of a species (Figure 10 and Table 3), my results still suggest that the movement biology of a species is important when predicting the scale of effect. Therefore, researchers should incorporate traits reflecting the movement and reproductive potential

of their study organism when selecting landscape size. Based on my results, landscape size could be predicted from my model results for carabids that were rare within my landscapes. Provided that body length and/or egg counts are available for these species, it is possible to use my regression equations to predict the scale of effect for these species. Further, my models may also provide a framework for predicting scales of effect for carabids within similar open-habitat environments. However, the reliability of using my regression equations to predict landscape size for carabids needs to be tested across carabid species and across similar environments.

These results could be used in conservation management if the movement and reproductive biology of species of interest are known. Conservation managers should consider the movement potential and reproductive life history of endangered species when outlining management plans, selecting refuge or conservation areas that reflect the movement and reproductive biology of the species of interest. That is, species of larger body size and greater movement ability should be managed at spatial scales larger than smaller species with limited movement abilities. Similarly, species with low reproductive potential should be managed at spatial scales larger than species with high reproductive potential.

Further research is still required to understand how species traits influence the scale of effect. Relatively few studies have assessed the impact of species traits on the scale of effect (Roland and Taylor 1997; Holland et al. 2005a; Jackson and Fahrig 2012). And of these studies, only the simulation study of Jackson and Fahrig (2012) assessed the impact of reproductive rate on the scale of effect through individual-based simulation models. Further, many studies support the idea of using species traits to predict the scale

of effect (Roland and Taylor 1997; Holland et al. 2005a; Jackson and Fahrig 2012; Thornton and Fletcher 2014; Jackson and Fahrig 2014), but empirical support for species traits predicting the scale of effect across taxa are lacking. Also, most studies focus on correlates of movement biology for predicting the scale of effect, and little attention has been paid to how reproductive biology influences the scale of effect. It is, therefore, imperative that the impact of species traits on the scale of effect be tested across multiple taxa, and that the reproductive biology of a species is evaluated as it relates to the scale of effect.

4.1 Conclusion

Few studies have tested whether species traits can predict the scale of effect. However, of these few studies, most support the idea that a species movement biology, typically measured as a species body size, positively predicts the scale of effect (Roland and Taylor 1997; Holland et al. 2005a; Thornton and Fletcher 2014). I found further evidence to support this hypothesis, implying that a species' movement potential is an important predictor of the scale of effect. To my knowledge, no other study has empirically tested whether a species reproductive potential can predict the scale of effect. I found evidence supporting the theory that reproductive potential is negatively related to the scale of effect (Table 2), and that reproductive potential is a stronger predictor of the scale of effect than a species movement biology (Figure 10 and Table 3). My results cannot be generalised to say that reproductive potential always better predicts the scale of effect than does the movement of a species because this is the first empirical study to test the effect of reproductive potential on the scale of effect. As such, more empirical research needs to be conducted to corroborate my findings. However, my results suggest

that the reproductive biology of an organism should be considered when predicting the scale of effect.

Figures

Figure 1. A schematic representation of a multi-scale approach used to predict the scale of effect. An ecological response (e.g., species abundance) is measured within each sampling site (●) across the study region. The landscape variable (e.g., habitat amount) is measured at multiple spatial scales around each sampling site, and the strength of the relationship between landscape structure and the ecological response is calculated at each scale. The spatial scale at which the strength of the relationship is strongest is known as the scale of effect.

Figure 2. The selection of sampling sites (●) with surrounding non-overlapping landscapes within a study region using: (a) a multi-scale approach using a range of spatial scales relevant to the species of interest to find the optimal scale (i.e., the scale of effect) at which landscape structure (within each spatial buffer) best predicts an ecological response (measured at each sampling site); and, (b) a single scale approach with the known scale of effect for the species of interest. Fewer landscapes within the same study region are sampled when the scale of effect is unknown (a) because multiple scales are selected to maximise the probability that the true scale of effect is contained within the range of scales analyzed and so the range of scales extends beyond the scale of effect for the study species. If the scale of effect is known (b), sampling sites can be closer together which allows for more sites to be sampled within the same study region.

Figure 3. Distribution of the 92 clusters of sampling sites studied across eastern Ontario. Each cluster of sampling sites consists of three border and three field sampling sites (i.e., six sampling sites per cluster). For clarity, each circle represents a cluster of six sampling sites.

(a)

Figure 4. (a) Example cluster of six sampling sites, with a sampling site consisting of two border (white) and two field (black) traps each (i.e., three pairs of border traps and three pairs of field traps constituting three border sampling sites and three field sampling sites, respectively). (b) The typical setup of border (B) and field (F) pitfall traps, with a sample site (X) denoted as the midpoint between a pair of traps. Carabids captured from two border traps or two field traps were combined into a single border or field sample, respectively. Samples were further combined over the two visits to each sampling site, providing a single measure of carabid abundance at each sampling site.

Figure 4 continued

(b)

(a)

(b)

Figure 5. Photographs of (a) an installed pitfall trap with soap solution, and (b) installed roof to prevent flooding of pitfall trap.

Figure 6. Flowchart depicting the number of species used in scale of effect analyses and species traits predicting the scale of effect analyses. Conditions for the exclusion of species are provided in the diamonds. Only species that satisfied the conditions provided in the diamonds were used in subsequent analyses.

Figure 6 continued

Figure 7. The slope coefficients at each spatial scale for Poisson regression models of carabid abundance on habitat amount. The scale of effect (i.e., the scale at which habitat amount best predicts species abundance) was taken as the scale with the largest positive slope coefficient. Species where the largest absolute slope coefficient was negative were excluded from subsequent analyses.

Figure 7 continued

Figure 7 continued

Figure 8. Predictor variables plotted against each other with Spearman rho correlations (rho in the graphic) and associated P-values for all carabids with egg counts (n=13).

Figure 9. Weighted simple linear regressions of the scale of effect (i.e., the buffer radius at which habitat amount best predicted species abundance) on (a) body length, (b) relative wing size, and (c) log (mean eggs) for the 13 carabid species with egg counts. Each simple linear regression is weighted by the inverse of the standard errors of the slope coefficient of the best model from the scale of effect analyses; larger circles correspond to data points with lower standard errors (higher weights; Appendix G).

Figure 10. Model-averaged slope coefficient estimates for standardised species traits (i.e., body length, relative wing size, and log (mean eggs)) predicting the scale of effect and their respective confidence intervals ($\alpha = 0.05$) for all species with egg counts. Slope coefficients were averaged across all candidate models containing each individual predictor variable (4 models for each predictor variable) based on the AICc model weights for each predictor. Sample size = 13 carabid species.

Tables

Table 1. Summary of Carabid beetle species traits. All morphometric traits and egg counts include the mean value for the trait and the standard error. The number in parentheses indicates the sample size trait.

Species	Body Length (mm)	Dry Mass (mg)	Relative Wing Size	Index of Wing Loading (mg/mm ²)	Mean Eggs
<i>Amara aenea</i>	8.18 ± 0.076 (30)	7.09 ± 0.42 (30)	1.31 ± 0.035 (30)	0.27 ± 0.016 (30)	2.9 ± 0.55 (20)
<i>Anisodactylus sanctaecrucis</i>	10.48 ± 0.18 (30)	11.70 ± 2.72 (30)	1.64 ± 0.049 (30)	0.27 ± 0.055 (30)	1.7 ± 0.26 (20)
<i>Chlaenius pusillus</i>	8.63 ± 0.14 (12)	4.85 ± 0.32 (9)	1.51 ± 0.045 (9)	0.23 ± 0.020 (9)	6 ± 1 (2)
<i>Chlaenius tricolor</i>	12.61 ± 0.083 (30)	19.52 ± 0.95 (30)	1.79 ± 0.046 (30)	0.25 ± 0.012 (30)	3.65 ± 0.91 (20)
<i>Cicindela punctulata</i>	11.32 ± 0.074 (16)	13.85 ± 1.21 (11)	2.17 ± 0.042 (11)	0.21 ± 0.016 (11)	4 ± 1.52 (3)
<i>Cicindela sexguttata</i>	12.78 ± 0.18 (20)	22.48 ± 0.85 (18)	2.07 ± 0.032 (18)	0.26 ± 0.0080 (18)	1.5 ± 0.5 (2)
<i>Clivina fossor</i>	6.01 ± 0.055 (30)	3.47 ± 0.19 (30)	1.91 ± 0.065 (30)	0.30 ± 0.19 (30)	4.33 ± 0.72 (12)
<i>Diplocheila obtusa</i>	10.70 ± 0.11 (20)	20.19 ± 7.69 (20)	1.41 ± 0.045 (20)	0.46 ± 0.18 (20)	7.16 ± 2.63 (6)
<i>Harpalus affinis</i>	10.65 ± 0.10 (30)	12.64 ± 0.68 (30)	1.30 ± 0.023 (30)	0.35 ± 0.018 (30)	2.08 ± 0.35 (12)
<i>Harpalus pensylvanicus</i>	14.93 ± 0.098 (30)	31.94 ± 2.14 (30)	1.86 ± 0.055 (30)	0.60 ± 0.042 (30)	3.4 ± 0.67 (20)
<i>Poecilus lucublandus</i>	11.38 ± 0.095 (30)	14.64 ± 1.20 (30)	1.23 ± 0.019 (30)	0.37 ± 0.032 (30)	2.5 ± 0.44 (20)
<i>Pterostichus melanarius</i>	17.2 ± 0.19 (30)	39.42 ± 1.82 (30)	0.12 ± 0.005 (30)	5.53 ± 0.26 (30)	2.9 ± 0.56 (20)
<i>Stenolophus comma</i>	7.14 ± 0.25 (19)	1.6 ± 0.29 (6)	2.32 ± 0.16 (6)	0.082 ± 0.014 (6)	2 ± 1 (4)

Table 2. Model summaries of cross-species relationships between the scale of effect (i.e., the relationship between species abundance and habitat amount) and standardised predictors body length, relative wing size, and log (mean eggs) for all species with egg counts (13 species). Each regression is weighted by the inverse of the standard errors of the slope coefficients of the best model (i.e., the model with the largest positive slope coefficient) from single species regressions for the scale of effect (Appendix D). Models are ranked in order of increasing AICc.

Model	Predictor	β	SE	Model R^2	w_i	$\Delta AICc$	AICc
1	log (mean eggs)	-273.54	114.73	0.34	0.273	0	193.82
2	body length	91.27	50.44	0.503	0.197	0.65	194.47
	log (mean eggs)	-217.25	108.98				
3	body length	119.97	54.48	0.305	0.196	0.67	194.49
4	intercept only	720.48	78.51	0	0.103	1.95	195.77
5	relative wing size	-66.44	46.91	0.45	0.103	1.96	195.78
	log (mean eggs)	-233.06	113.48				
6	relative wing size	-90.7	51.61	0.219	0.091	2.2	196.02
7	body length	100.65	86.69	0.311	0.024	4.89	198.71
	relative wing size	-22.87	77.43				
8	body length	78.52	78.32	0.506	0.013	6.16	199.98
	relative wing size	-15.32	69.28				
	log (mean eggs)	-215.78	114.75				

Table 3. Model weights (w_i) for individual predictor variables (i.e., body length, RWS, and log (mean eggs)) for carabids with egg counts (13 species) from analyses predicting the scale of effect from carabid species traits. Model weights for each predictor variable are summed from the model weights of all models including a given species trait.

Model	Akaike Weights for Predictors		
	Body Length	RWS	Log (Mean Eggs)
soe ~ body length	0.196	-	-
soe ~ RWS	-	0.091	-
soe ~ log (mean eggs)	-	-	0.273
soe ~ body length + RWS	0.024	0.024	-
soe ~ body length + log (mean eggs)	0.197	-	0.197
soe ~ RWS + log (mean eggs)	-	0.103	0.103
soe ~ body length + RWS + log (mean eggs)	0.013	0.013	0.013
Sum of Model Weights	0.430	0.231	0.586

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Appendix A: Definitions of border and field cover types in which pitfall traps were installed.

Border Cover Types		Definition of Cover Type
Abandoned		Abandoned agriculture with at least partially overgrown with woody vegetation
Fallow		Arable land not planted with crop in 2011/2012
Grass		Edge with greater than 75% grass and/or weeds
Mixed Shrub		Edge with less than 75% grass or trees, and largely shrubby
Treed		Edge with great than 75% tree cover
Field Cover Types		
Abandoned		Abandoned agriculture with at least partially overgrown with woody vegetation
Cereal		Arable field planted with cereal crops (mostly spring wheat, barley, or oats)
Corn		Arable field planted with corn
Fallow		Arable land not planted with crop in 2011/2012
Hay		Agricultural field with greater than 75% hay
Legume		Arable field planted with alfalfa or clover
Mixed Vegetable		Arable field planted with vegetables
Pasture		Pastural land with animal grazing evident
Soybean		Arable field planted with soybean
Winter Wheat		Arable field planted with winter wheat
Note: Winter wheat separate from “cereal” category due to higher proportion of traps in winter wheat compared to other cereal crops		

Appendix B: Summary of the total number of individual ground beetles captured within all trapping locations, the number of edge and field trapping sites that a given species was captured in, and the total number of clusters of sampling sites where a species was trapped. Bolded species were captured in 8 or more landscapes, and were used in analyses to determine the scale of effect.

Species	Number of Individuals	Number of Border Sites	Number of Field Sites	Total Number of Sites	Total Number of Clusters
<i>Agonum cupripenne</i>	21	9	7	16	12
<i>Agonum gratiosum</i>	7	3	1	4	4
<i>Agonum melanarium</i>	13	8	2	10	9
<i>Agonum muelleri</i>	12	5	3	8	6
<i>Agonum nutans</i>	1	1	0	1	1
<i>Agonum octopunctatum</i>	4	1	0	1	1
<i>Agonum palustre</i>	9	4	0	4	4
<i>Agonum placidum</i>	8	3	4	7	7
<i>Agonum thoreyi</i>	20	6	3	9	8
<i>Amara aenea</i>	478	44	22	66	38
<i>Amara angustatoides</i>	5	2	1	3	3
<i>Amara apricaria</i>	6	4	2	6	6
<i>Amara familiaris</i>	2	1	0	1	1
<i>Amara lunicollis</i>	10	4	4	8	7
<i>Amara obesa</i>	3	2	0	2	2
<i>Amara otiosa</i>	4	1	3	4	4
<i>Amara pallipes</i>	2	0	2	2	2
<i>Amara patruelis</i>	3	1	1	2	2
<i>Amara rubrica</i>	1	0	1	1	1
<i>Anisodactylus harrisii</i>	3	3	0	3	3
<i>Anisodactylus rusticus</i>	16	4	1	5	4
<i>Anisodactylus sanctaecrucis</i>	558	34	16	50	37

Appendix B continued

Species	Number of Individuals	Number of Border Sites	Number of Field Sites	Total Number of Sites	Total Number of Clusters
<i>Badister notatus</i>	2	2	0	2	2
<i>Bembidion frontale</i>	1	0	1	1	1
<i>Bembidion inaequale</i>	1	0	1	1	1
<i>Bembidion mimus</i>	27	14	10	24	17
<i>Bembidion obtusum</i>	9	3	2	5	5
<i>Bembidion quadrimaculatum</i>	1031	135	81	216	77
<i>Biemus discus</i>	5	2	1	3	3
<i>Bradycellus nigriceps</i>	1	0	1	1	1
<i>Bradycellus rupestris</i>	3	3	0	3	3
<i>Carabus granulatus</i>	14	6	3	9	7
<i>Carabus nemoralis</i>	10	6	3	9	8
<i>Chlaenius emarginatus</i>	1	1	0	1	1
<i>Chlaenius pusillus</i>	24	14	7	21	17
<i>Chlaenius sericeus</i>	28	14	2	16	13
<i>Chlaenius tricolor</i>	442	57	19	76	76
<i>Cicindela punctulata</i>	22	9	4	13	10
<i>Cicindela sexguttata</i>	44	25	3	28	20
<i>Clivina collaris</i>	2	1	0	1	1
<i>Clivina fossor</i>	159	28	18	46	46
<i>Cymindis borealis</i>	2	1	0	1	1
<i>Diplocheila obtusa</i>	26	14	4	18	15
<i>Elaphropus incurvus</i>	7	0	1	1	1

Appendix B continued

Species	Number of Individuals	Number of Border Sites	Number of Field Sites	Total Number of Sites	Total Number of Clusters
<i>Harpalus affinis</i>	79	31	6	37	23
<i>Harpalus caliginosus</i>	3	1	1	2	2
<i>Harpalus erraticus</i>	426	11	11	22	9
<i>Harpalus erythropus</i>	11	6	2	8	8
<i>Harpalus herbivagus</i>	118	53	12	65	42
<i>Harpalus pensylvanicus</i>	4418	83	2	85	85
<i>Harpalus pusillus</i>	1	0	1	1	1
<i>Harpalus rubripes</i>	9	4	3	7	6
<i>Harpalus rufipes</i>	5	3	2	5	4
<i>Harpalus somnulentus</i>	2	2	0	2	1
<i>Lebia atriventris</i>	1	1	0	1	1
<i>Loricera pilicornis</i>	2	2	0	2	2
<i>Notiobia terminata</i>	12	3	1	4	3
<i>Notiophilus semistriatus</i>	5	4	1	5	4
<i>Ophonus puncticeps</i>	49	12	0	12	12
<i>Oxypselaphus pusillus</i>	1	1	0	1	1
<i>Paratychus proximus</i>	4	1	3	4	4
<i>Patrobus longicornis</i>	205	32	26	58	30
<i>Poecilus chalcites</i>	7	3	3	6	6
<i>Poecilus lucublandus</i>	396	83	62	145	74
<i>Pterostichus caudicalis</i>	1	0	1	1	1
<i>Pterostichus commutabilis</i>	32	9	8	17	13

Appendix B continued

Species	Number of Individuals	Number of Border Sites	Number of Field Sites	Total Number of Sites	Total Number of Clusters
<i>Pterostichus melanarius</i>	13298	226	231	457	89
<i>Pterostichus patruelis</i>	4	1	2	3	3
<i>Selenophorus hylacis</i>	6	4	0	4	4
<i>Stenolophus comma</i>	42	9	7	16	13
<i>Stenolophus fuliginosus</i>	1	1	0	1	1
<i>Syntomus americanus</i>	1	1	0	1	1
<i>Xestonotus lugubris</i>	1	0	1	1	1

Appendix C: The proportion of individuals of a given species captured within each of the thirteen cover types, and the proportion of pitfall traps located within each cover type. Bolded values indicate where the proportion of individuals of a species in a given cover type was equal to or greater than the proportion of pitfall traps located within a given cover type. The bolded values were used to select the potential habitat on a per species basis.

Species	Abandoned	Cereal	Corn	Fallow	Grass	Hay	Legumes	MS	MV	Pasture	Soybean	Treed	WW
<i>Agonum cupripenne</i>	0.000	0.000	0.000	0.095	0.333	0.143	0.000	0.190	0.000	0.000	0.143	0.095	0.000
<i>Agonum melanarium</i>	0.077	0.000	0.000	0.000	0.154	0.077	0.000	0.385	0.000	0.000	0.000	0.308	0.000
<i>Agonum thoreyi</i>	0.000	0.000	0.050	0.000	0.250	0.050	0.000	0.100	0.000	0.000	0.050	0.500	0.000
<i>Amara aenea</i>	0.040	0.002	0.002	0.002	0.370	0.098	0.103	0.054	0.000	0.000	0.059	0.270	0.000
<i>Anisodactylus sanctaerucis</i>	0.000	0.301	0.013	0.030	0.475	0.045	0.000	0.059	0.000	0.000	0.041	0.036	0.000
<i>Bembidion minus</i>	0.037	0.000	0.222	0.000	0.259	0.037	0.000	0.148	0.000	0.037	0.074	0.148	0.037
<i>Bembidion quadrimaculatum</i>	0.017	0.004	0.090	0.004	0.403	0.026	0.015	0.196	0.001	0.002	0.079	0.163	0.000
<i>Carabus nemoralis</i>	0.000	0.000	0.000	0.000	0.100	0.000	0.000	0.500	0.000	0.000	0.100	0.300	0.000
<i>Chlaenius pusillus</i>	0.000	0.000	0.125	0.000	0.375	0.000	0.000	0.167	0.000	0.000	0.250	0.083	0.000
<i>Chlaenius sericeus</i>	0.000	0.000	0.000	0.036	0.679	0.000	0.000	0.179	0.000	0.000	0.071	0.036	0.000
<i>Chlaenius tricolor</i>	0.007	0.000	0.124	0.002	0.301	0.032	0.018	0.122	0.002	0.002	0.324	0.059	0.007
<i>Cicindela punctulata</i>	0.045	0.000	0.045	0.000	0.318	0.045	0.273	0.182	0.000	0.000	0.000	0.091	0.000
<i>Cicindela sexguttata</i>	0.000	0.000	0.023	0.000	0.386	0.000	0.045	0.364	0.000	0.000	0.000	0.182	0.000
Proportion of Traps in Cover Type	0.011	0.011	0.200	0.012	0.249	0.064	0.042	0.140	0.002	0.005	0.157	0.102	0.005

Notes: MS=Mixed Shrub, MV=Mixed Vegetable, and WW=Winter Wheat

Appendix C continued

Species	Abandoned	Cereal	Corn	Fallow	Grass	Hay	Legumes	MS	MV	Pasture	Soybean	Treed	WW
<i>Clivina fossor</i>	0.000	0.019	0.057	0.057	0.138	0.208	0.101	0.075	0.031	0.000	0.258	0.057	0.000
<i>Diplocheila obtusa</i>	0.000	0.000	0.000	0.000	0.615	0.038	0.115	0.154	0.000	0.000	0.000	0.077	0.000
<i>Harpalus affinis</i>	0.000	0.000	0.063	0.000	0.671	0.076	0.000	0.101	0.000	0.000	0.013	0.076	0.000
<i>Harpalus erraticus</i>	0.000	0.002	0.054	0.000	0.624	0.012	0.000	0.235	0.000	0.000	0.068	0.005	0.000
<i>Harpalus erythropus</i>	0.000	0.000	0.000	0.000	0.364	0.091	0.091	0.364	0.000	0.000	0.000	0.091	0.000
<i>Harpalus herbivagus</i>	0.025	0.000	0.059	0.000	0.381	0.017	0.008	0.322	0.008	0.000	0.059	0.119	0.000
<i>Harpalus pensylvanicus</i>	0.012	0.015	0.148	0.092	0.366	0.015	0.014	0.146	0.000	0.000	0.090	0.099	0.002
<i>Ophonus puncticeps</i>	0.020	0.000	0.000	0.000	0.184	0.000	0.000	0.633	0.000	0.000	0.000	0.163	0.000
<i>Patrobus longicornis</i>	0.005	0.000	0.151	0.010	0.283	0.024	0.000	0.180	0.000	0.000	0.263	0.083	0.000
<i>Poecilus lucublandus</i>	0.000	0.003	0.045	0.013	0.371	0.167	0.076	0.098	0.000	0.000	0.081	0.144	0.003
<i>Pterostichus commutabilis</i>	0.031	0.000	0.031	0.000	0.500	0.156	0.031	0.000	0.000	0.094	0.000	0.156	0.000
<i>Pterostichus melanarius</i>	0.035	0.004	0.320	0.002	0.289	0.014	0.022	0.092	0.007	0.000	0.169	0.043	0.002
<i>Stenolophus comma</i>	0.000	0.357	0.024	0.214	0.119	0.000	0.000	0.071	0.048	0.000	0.071	0.095	0.000
Proportion of Traps in Cover Type	0.011	0.011	0.200	0.012	0.249	0.064	0.042	0.140	0.002	0.005	0.157	0.102	0.005

Notes: MS=Mixed Shrub, MV=Mixed Vegetable, and WW=Winter Wheat

Appendix D: Sample of habitat amounts calculated for *Amara aenea* with every second spatial scale represented and a subset of 20 pitfall trapping locations (of 563 trapping locations) shown. The dataset of habitat amount per spatial scale for each trapping location is too large for adequate representation of all species and trapping locations. The Excel file containing all habitat amount data for all scales and carabid species can be downloaded at: https://www.dropbox.com/s/5jay5p2syzamnnn/100879398_Kallio_S_Appendix_D.xlsx?dl=0

Trap ID	50m	150m	250m	350m	450m	550m	650m	750m	850m	950m
H_H_1_E_1	0.480828	0.436546	0.408341	0.411383	0.402758	0.399946	0.419839	0.423765	0.423843	0.427884
H_H_1_E_2	0.514563	0.492541	0.481702	0.46294	0.435386	0.455486	0.45865	0.44792	0.423283	0.418801
H_H_1_E_3	0.016509	0.310247	0.377503	0.406489	0.359234	0.323961	0.317007	0.326102	0.342532	0.360295
H_H_1_F_1	0.814659	0.487162	0.439598	0.406856	0.406806	0.406736	0.423093	0.420449	0.418	0.424556
H_H_1_F_2	0.208921	0.392584	0.440564	0.450154	0.434797	0.452515	0.455464	0.448036	0.42303	0.417808
H_H_1_F_3	0.016377	0.317766	0.384283	0.405596	0.364539	0.32575	0.314972	0.320447	0.335528	0.353312
H_H_10_E_1	0.181444	0.098085	0.092688	0.149848	0.21866	0.243521	0.278988	0.313545	0.336582	0.338052
H_H_10_E_2	0.115125	0.032014	0.084392	0.113281	0.120163	0.146784	0.186873	0.203464	0.225168	0.253119
H_H_10_E_4	0.036594	0.06999	0.056065	0.087987	0.128581	0.117875	0.116351	0.124363	0.137806	0.140702
H_H_10_F_1	0.137741	0.099339	0.102581	0.160071	0.227966	0.255584	0.291921	0.324016	0.344145	0.336622
H_H_10_F_2	0.096332	0.032067	0.079791	0.10846	0.11708	0.141284	0.180348	0.200479	0.224694	0.253594
H_H_10_F_4	0.031962	0.064943	0.063779	0.116321	0.141684	0.123306	0.124576	0.131934	0.141683	0.144952
H_H_11_E_1	0.5275	0.477769	0.310517	0.226233	0.193036	0.16272	0.133416	0.110639	0.100193	0.094874
H_H_11_E_2	0.071546	0.118965	0.135124	0.105949	0.135049	0.16505	0.175819	0.167916	0.137794	0.11496
H_H_11_E_5	0.501904	0.460822	0.262859	0.274446	0.265424	0.21375	0.166883	0.140139	0.133052	0.12039
H_H_11_F_1	0.220571	0.403163	0.317481	0.234036	0.196468	0.164036	0.13457	0.112531	0.10295	0.098844
H_H_11_F_2	0.063016	0.141635	0.141451	0.11002	0.157703	0.168009	0.170348	0.167026	0.138017	0.115131
H_H_11_F_5	0.200079	0.387086	0.283113	0.306628	0.270863	0.214754	0.166759	0.136518	0.129688	0.118882
H_H_12_E_3	0	0.012667	0.316298	0.430097	0.450968	0.439354	0.40354	0.369936	0.376195	0.376276
H_H_12_E_4	0	0.010005	0.059079	0.161591	0.230476	0.295639	0.368001	0.402012	0.420556	0.434329

Appendix E: Morphometric measurements and eggs counts for Carabid beetles.

Appendix E1: Morphometric measurements and egg counts for *Agonum cupripenne*.

Vial ID	Sex	Body Length (mm)	Elytra Length (mm)	Elytra Width (mm)	Elytra Size (mm)	Wing Length (mm)	Wing Width (mm)	Wing Size (mm ²)
27.5.B.G.R2	F	10.15	6.02	1.79	10.7758	6.78	2.25	15.255
31.5.C.G.R2	F	10.25	6.93	2.17	15.0381	7.04	2.26	15.9104
87.1.B.G.R2	F	9.96	6.54	2.15	14.061	7.53	2.69	20.2557
203.2.C.G.R1	M	10.97	7.26	2.57	18.6582	8.58	2.93	25.1394
40.1.B.G.R1	U	7.81	4.86	1.57	7.6302	6.35	2.19	13.9065
58.2 B.G.R2	M	8.28						

Total Wing Size (mm ²)	Relative Wing Size	Wing Type	# of Eggs	Dry Mass (mg)	Index of Wing Loading (mg/mm ²)	Year
30.51	1.415672	M	0	15	0.491642	2012
31.8208	1.058006	M	0	19.3	0.606522	2012
40.5114	1.440559	M	0	10.4	0.256718	2012
50.2788	1.347365	M	0	12.2	0.242647	2012
27.813	1.82256	M	0	11	0.395499	2012
		M	0			2011

Appendix E2: Morphometric measurements and egg counts for *Agonum melanarium*.

Vial ID	Sex	Body Length (mm)	Elytra Length (mm)	Elytra Width (mm)	Elytra Size (mm)	Wing Length (mm)	Wing Width (mm)	Wing Size (mm ²)
211.6.B.G.R1	F	8.98	5.3	1.84	9.752	7.67	2.38	18.2546
211.6.B.G.R1	F	8.85	5.49	1.87	10.2663	7.52	2.21	16.6192
39.1.B.G.R1	M	7.98	5.25	1.76	9.24	7.22	2.2	15.884
40.1.B.G.R1	M	7.89	5.18	1.75	9.065	7.26	2.16	15.6816
40.5.B.G.R1	F	8.67	5.66	1.87	10.5842	7.65	2.41	18.4365
202.3.B.G.R1	M	8.01	5.31	1.8	9.558	7.57	2.33	17.6381

Total Wing Size (mm ²)	Relative Wing Size	Wing Type	# of Eggs	Dry Mass (mg)	Index of Wing Loading (mg/mm ²)	Year
36.5092	1.871883	M	0	8.9	0.000243774	2012
33.2384	1.618811	M	0	3.8	0.000114326	2012
31.768	1.719048	M	0	7.4	0.000232939	2012
31.3632	1.729906	M	0	7.7	0.000245511	2012
36.873	1.741889	M	0	8.8	0.000238657	2012
35.2762	1.845376	M	0	8.1	0.000229617	2012

Appendix E3: Morphometric measurements and egg counts for *Amara aenea*.

Vial ID	Sex	Body Length (mm)	Elytra Length (mm)	Elytra Width (mm)	Elytra Size (mm)	Wing Length (mm)	Wing Width (mm)	Wing Size (mm ²)
202.3.C.G.R1	M	8.37	5.6	2.04	11.424	6.18	2.35	14.523
202.3.C.G.R1	M	8.23	5.4	2.03	10.962	6.05	2.16	13.068
202.3.C.G.R1	F	8.1	5.02	1.86	9.3372	5.98	2.19	13.0962
202.3.C.G.R1	F	7.89	4.95	1.81	8.9595	5.7	2.06	11.742
202.3.C.G.R1	F	8.66	5.25	2.07	10.8675	5.9	2.21	13.039
202.3.C.G.R1	F	8.04	5.55	2.21	12.2655	6.23	2.26	14.0798
202.3.C.G.R1	U	7.99	4.88	1.82	8.8816	6.27	1.8	11.286
202.3.C.G.R1	F	8.01	5.37	2.1	11.277	6.67	2.6	17.342
202.3.C.G.R1	U	7.85	4.83	1.89	9.1287	6.07	2.56	15.5392
202.3.C.G.R1	U	8.35	5.27	2.22	11.6994	6.17	2.26	13.9442
92.4.B.G.R1	F	7.05	4.66	1.71	7.9686	4.86	1.8	8.748
92.4.B.G.R1	F	7.18	4.97	2	9.94	4.9	2.08	10.192
6.6.B.G.R1	F	7.87	4.82	1.88	9.0616	6.45	2.05	13.2225
207.4.B.G.R1	F	7.97	4.93	1.98	9.7614	6.11	2.03	12.4033
207.4.B.G.R1	M	8.02	5.08	1.91	9.7028	6.08	2.02	12.2816
202.3.B.G.R1	M	7.76	5.16	1.77	9.1332	6.16	2.33	14.3528
202.3.B.G.R1	F	8.36	5.18	2	10.36	6.07	2.15	13.0505
211.6.C.G.R2	F	8.16	5.4	1.85	9.99	5.8	2.22	12.876
3.2.C.G.R1	M	8.67	5.83	1.63	9.5029	7.81	2.43	18.9783
18.4.B.G.R2	M	8.63	5.38	1.77	9.5226	5.86	1.86	10.8996
18.4.B.G.R2	M	7.96	4.97	1.79	8.8963	6.1	1.97	12.017
18.4.B.G.R2	F	8.94	5.44	1.91	10.3904	6.5	2.08	13.52
18.4.B.G.R2	F	8.88	5.26	2.02	10.6252	5.89	2.03	11.9567
18.4.B.G.R2	M	8	5.15	1.89	9.7335	6.34	1.9	12.046
3.1.C.G.R1	F	8.36	5.03	1.92	9.6576	5.92	1.97	11.6624

Appendix E3 continued

Total Wing Size (mm ²)	Relative Wing Size	Wing Type	# of Eggs	Dry Mass (mg)	Index of Wing Loading (mg/mm ²)	Year
29.046	1.271271	M	0	6.2	0.213455	2012
26.136	1.192118	M	0	7.1	0.271656	2012
26.1924	1.402583	M	5	6.1	0.232892	2012
23.484	1.310564	M	0	5.5	0.234202	2012
26.078	1.199816	M	0	5.6	0.21474	2012
28.1596	1.147919	M	0	8.1	0.287646	2012
22.572	1.270717	M	0	7.8	0.345561	2012
34.684	1.53782	M	0	7.3	0.210472	2012
31.0784	1.702236	M	0	8.4	0.270284	2012
27.8884	1.191873	M	0	12.7	0.455386	2012
17.496	1.097809	M	0	3.1	0.177183	2012
20.384	1.025352	M	0	0.7	0.034341	2012
26.445	1.459179	M	2	5.8	0.219323	2012
24.8066	1.270648	M	1	11.6	0.467617	2012
24.5632	1.265779	M	0	7.1	0.28905	2012
28.7056	1.571497	M	0	8.6	0.299593	2012
26.101	1.259701	M	0	8.3	0.317995	2012
25.752	1.288889	M	3	9.3	0.361137	2012
37.9566	1.997106	M	0	7.3	0.192325	2012
21.7992	1.144603	M	0	10.3	0.472494	2012
24.034	1.350786	M	0	8.7	0.361987	2012
27.04	1.301201	M	2	4.6	0.170118	2012
23.9134	1.125315	M	0	6.5	0.271814	2012
24.092	1.237582	M	0	5.5	0.228292	2012
23.3248	1.207588	M	6	5.4	0.231513	2012

Appendix E3 continued

Vial ID	Sex	Body Length (mm)	Elytra Length (mm)	Elytra Width (mm)	Elytra Size (mm)	Wing Length (mm)	Wing Width (mm)	Wing Size (mm ²)
3.1.C.G.R1	M	8.34	5.14	1.99	10.2286	6.66	2.13	14.1858
3.1.C.G.R1	F	8.67	5.36	2.01	10.7736	5.85	2.21	12.9285
3.1.C.G.R1	M	8.14	5.03	1.74	8.7522	5.82	1.89	10.9998
3.1.C.G.R1	M	8.23	5.26	1.99	10.4674	6.04	2.22	13.4088
27.5.C.G.R1	F	8.3	5.14	1.71	8.7894	5.92	2.02	11.9584
18.1.B.G.R2	F							
18.3.B.G.R2	F							
26.3.B.G.R1	F							
27.5.B.G.R2	F							
207.4.B.G.R1	F							
207.4.B.G.R1	F							
40.1.C.G.R2	F							
40.5.B.G.R1	F							
59.4.B.G.R2	F							
72.7.B.G.R1	F							
82.2.B.G.R1	F							
82.2.B.G.R1	F							

Appendix E3 continued

Total Wing Size (mm ²)	Relative Wing Size	Wing Type	# of Eggs	Dry Mass (mg)	Index of Wing Loading (mg/mm ²)	Year
28.3716	1.386876	M	0	8.3	0.292546	2012
25.857	1.200017	M	1	6.8	0.262985	2012
21.9996	1.256804	M	0	6.3	0.286369	2012
26.8176	1.281006	M	0	8.1	0.30204	2012
23.9168	1.360548	M	0	5.8	0.242507	2012
		M	8			2012
		M	4			2012
		M	9			2012
		M	1			2012
		M	2			2012
		M	1			2012
		M	1			2012
		M	1			2012
		M	5			2012
		M	1			2012
		M	3			2012
		M	2			2012

Appendix E4. Morphometric measurements and egg counts for *Anisodactylus sanctaecrucis*.

Vial ID	Sex	Body Length (mm)	Elytra Length (mm)	Elytra Width (mm)	Elytra Size (mm)	Wing Length (mm)	Wing Width (mm)	Wing Size (mm ²)
24.1.C.G.R1	M	11.93	6.23	2.31	14.3913	8.22	3.01	24.7422
24.1.C.G.R1	M	12.35	6.18	2.19	13.5342	8.07	3.08	24.8556
24.1.C.G.R1	M	11.66	5.98	2.12	12.6776	8.17	2.69	21.9773
24.1.C.G.R1	M	11.2	5.9	2.04	12.036	7.81	2.87	22.4147
8.4.C.G.R1	M	10.8	5.81	2.06	11.9686	7.95	2.75	21.8625
36.3.B.G.R2	F	12.08	6.31	2.53	15.9643	8.16	2.93	23.9088
39.1.B.G.R1	F	11.54	6.15	2.25	13.8375	8.46	2.86	24.1956
39.1.B.G.R1	M	10.62	5.74	2.04	11.7096	8.03	2.56	20.5568
73.2.C.G.R2	M	10.8	5.76	1.97	11.3472	7.86	2.44	19.1784
73.2.C.G.R2	M	10.79	5.67	2.02	11.4534	7.81	2.74	21.3994
22.4.B.G.R2	F	10.59	5.75	2.21	12.7075	7.84	2.7	21.168
22.4.B.G.R2	F	11.13	5.84	2.15	12.556	8.24	2.87	23.6488
22.4.B.G.R2	M	10.72	5.75	2.18	12.535	7.92	2.74	21.7008
22.4.B.G.R1	F	11.73	6.01	2.24	13.4624	8.33	2.91	24.2403
39.1.B.G.R2	M	9.64	6.46	2.31	14.9226	9.05	3.29	29.7745
36.3.B.G.R1	M	11.11	6.32	2.02	12.7664	7.64	2.67	20.3988
36.3.B.G.R1	U	10.63	6.03	1.99	11.9997	7.25	2.44	17.69
22.4.B.G.R2	M	9.27	5.56	1.93	10.7308	6.42	2.12	13.6104
22.4.B.G.R2	M	8.64	5.14	1.82	9.3548	5.69	1.71	9.7299
22.4.B.G.R2	U	9.29	5.67	1.95	11.0565	6.11	2.34	14.2974
36.4.B.G.R2	F	10.24	6.49	2.59	16.8091	7.43	2.8	20.804
211.6.C.G.R2	M	10.35	6.42	2.31	14.8302	7.11	2.54	18.0594
211.6.C.G.R2	F	10.51	6.81	2.34	15.9354	7.43	2.25	16.7175
3.2.C.G.R1	M	8.56	4.76	1.52	7.2352	5.85	2.38	13.923
92.4.B.G.R2	M	9.64	5.55	1.84	10.212	7.46	2.57	19.1722

Appendix E4 continued

Total Wing Size (mm ²)	Relative Wing Size	Wing Type	# of Eggs	Dry Mass (mg)	Index of Wing Loading (mg/mm ²)	Year
49.4844	1.719247	M	0	13.2	0.266751	2012
49.7112	1.836503	M	0	11.5	0.231336	2012
43.9546	1.733554	M	0	9	0.204757	2012
44.8294	1.862305	M	0	9.8	0.218607	2012
43.725	1.826655	M	0	5.6	0.128073	2012
47.8176	1.497642	M	0	12.6	0.263501	2012
48.3912	1.748553	M	4	88	1.818512	2012
41.1136	1.755551	M	0	12.2	0.296739	2012
38.3568	1.690144	M	0	3.7	0.096463	2012
42.7988	1.868388	M	0	3.7	0.086451	2012
42.336	1.665788	M	0	6.3	0.14881	2012
47.2976	1.883466	M	0	7.6	0.160685	2012
43.4016	1.731217	M	0	6.7	0.154372	2012
48.4806	1.800593	M	2	13.5	0.278462	2012
59.549	1.995262	M	0	13.5	0.226704	2012
40.7976	1.597851	M	0	18.1	0.443654	2012
35.38	1.474204	M	0	16.1	0.455059	2012
27.2208	1.268349	M	0	5.7	0.209399	2012
19.4598	1.040097	M	0	3.9	0.200413	2012
28.5948	1.293122	M	0	7.6	0.265783	2012
41.608	1.237663	M	0	9.4	0.225918	2012
36.1188	1.217745	M	0	3.9	0.107977	2012
33.435	1.049079	M	0	5.1	0.152535	2012
27.846	1.924342	M	0	2.7	0.096962	2012
38.3444	1.877419	M	0	10.1	0.263402	2012

Appendix E4 continued

Vial ID	Sex	Body Length (mm)	Elytra Length (mm)	Elytra Width (mm)	Elytra Size (mm)	Wing Length (mm)	Wing Width (mm)	Wing Size (mm ²)
92.4.B.G.R2	M	9.85	6.02	2	12.04	7.81	2.49	19.4469
217.2.B.G.R2	M	8.75	5.14	1.91	9.8174	7.11	2.38	16.9218
203.4.B.G.R2	F	10.87	6.34	2.24	14.2016	8.16	2.89	23.5824
118.2.C.G.R2	M	9.11	5.49	1.82	9.9918	8.02	2.55	20.451
118.2.B.G.R2	M	10.02	6.17	2.07	12.7719	8.13	2.64	21.4632
208.2.B.G.R2	F							
24.4.B.G.R1	F							
7.4.B.G.R1	F							
7.4.B.G.R2	F							
207.2.B.G.R2	F							
118.2.B.G.R1	F							
118.2.B.G.R2	F							
1.2.B.G.R2	F							
1.2.B.G.R2	F							
1.2.B.G.R2	F							
1.2.B.G.R2	F							
1.2.B.G.R2	F							
1.2.B.G.R2	F							
1.2.B.G.R2	F							
58.2.C.G.R2	F							
58.2.B.G.R2	F							
1.2.B.G.R2	F							
65.3.B.G.R2	F							

Appendix E4 continued

Total Wing Size (mm ²)	Relative Wing Size	Wing Type	# of Eggs	Dry Mass (mg)	Index of Wing Loading (mg/mm ²)	Year
38.8938	1.615191	M	0	11.5	0.295677	2012
33.8436	1.723654	M	0	9.8	0.289567	2012
47.1648	1.660545	M	0	11.3	0.239585	2012
40.902	2.046778	M	0	9.8	0.239597	2012
42.9264	1.680502	M	0	9.2	0.21432	2012
		M	1			2012
		M	1			2012
		M	5			2012
		M	3			2012
		M	1			2012
		M	1			2012
		M	2			2012
		M	1			2011
		M	1			2011
		M	1			2011
		M	1			2011
		M	1			2011
		M	1			2011
		M	1			2011
		M	1			2011
		M	1			2011
		M	2			2011
		M	3			2011

Appendix E5: Morphometric measurements and egg counts for *Carabus nemoralis*.

Vial ID	Sex	Body Length (mm)	Elytra Length (mm)	Elytra Width (mm)	Elytra Size (mm)	Wing Length (mm)	Wing Width (mm)	Wing Size (mm ²)
31.5.C.G.R2	U	23.53	14.41	5.09	73.3469	0	0	0
105.1.B.G.R1	M	22.08	13.66	4.45	60.787	0	0	0
75.4.B.G.R1	M	21.06	13.51	4.66	62.9566	0	0	0
92.1.B.G.R1	F	22.4	14.17	5.71	80.9107	0	0	0
31.5.C.G.R1	M	21.38	13.71	4.24	58.1304	0	0	0
100.1.B.G.R2	M	22.31						

Total Wing Size (mm ²)	Relative Wing Size	Wing Type	# of Eggs	Dry Mass (mg)	Index of Wing Loading (mg/mm ²)	Year
0		N	0	153.3		2012
0		N	0	70.3		2012
0		N	0	61.1		2012
0		N	0	75.2		2012
		N	0	83.9		2012
		N	0			2011

Appendix E6: Morphometric measurements and egg counts for *Chlaenius pusillus*.

Vial ID	Sex	Body Length (mm)	Elytra Length (mm)	Elytra Width (mm)	Elytra Size (mm)	Wing Length (mm)	Wing Width (mm)	Wing Size (mm ²)
7.1.B.G.R1	F	9.36	4.29	1.69	7.2501	6.86	1.85	12.691
36.3.B.G.R1	M	8.21	4.22	1.43	6.0346	6.15	1.67	10.2705
214.2.C.G.R2	F	8.56	4.6	1.63	7.498	5.87	1.96	11.5052
31.5.C.G.R2	F	8.43	4.62	1.51	6.9762	5.75	1.75	10.0625
59.1.B.G.R1	F	9.45	5.14	1.64	8.4296	6.14	1.87	11.4818
59.1.C.G.R1	M	8.38	4.27	1.55	6.6185	5.63	1.79	10.0777
214.2.B.G.R2	M	7.95	4.3	1.4	6.02	5.47	1.65	9.0255
6.2.B.G.R1	M	8.05	4.26	1.47	6.2622	5.44	1.64	8.9216
82.3.B.G.R1	F	9.07	4.72	1.68	7.9296	6.24	1.73	10.7952
13.3.C.G.R2	M	8.17						
69.3.C.G.R2	M	8.95						
69.3.C.G.R2	M	9.04						

Total Wing Size (mm ²)	Relative Wing Size	Wing Type	# of Eggs	Dry Mass (mg)	Index of Wing Loading (mg/mm ²)	Year
25.382	1.750459	M	0	4.7	0.185171	2012
20.541	1.701936	M	0	3.2	0.155786	2012
23.0104	1.534436	M	0	3.7	0.160797	2012
20.125	1.442404	M	7	6.1	0.303106	2012
22.9636	1.362081	M	0	5.5	0.239509	2012
20.1554	1.522656	M	0	5.1	0.253034	2012
18.051	1.499252	M	0	5.6	0.310232	2012
17.8432	1.424675	M	0	5.5	0.308241	2012
21.5904	1.36138	M	5	4.3	0.199163	2012
		M	0			2011
		M	0			2011
		M	0			2011

Appendix E7: Morphometric measurements and egg counts for *Chlaenius sericeus*.

Vial ID	Sex	Body Length (mm)	Elytra Length (mm)	Elytra Width (mm)	Elytra Size (mm)	Wing Length (mm)	Wing Width (mm)	Wing Size (mm ²)
102.3.B.G.R1	M	14.03	8.77	3.13	27.4501	12.74	3.65	46.501
203.2.B.G.R2	F	14.79	8.93	3.58	31.9694	12.91	3.71	47.8961
75.4.C.G.R1	M	14.55	8.76	3.45	30.222	12.37	3.6	44.532
75.4.C.G.R1	F	15.38	9.16	3.62	33.1592	12.85	3.97	51.0145
79.1.B.G.R2	F	15.32	8.99	3.62	32.5438	12.61	3.56	44.8916
22.4.B.G.R1	M	12.66	7.44	2.42	18.0048	12.31	3.58	44.0698
67.4.B.G.R2	M	14.51						
67.4.B.G.R2	F	15.77						

Total Wing Size (mm ²)	Relative Wing Size	Wing Type	# of Eggs	Dry Mass (mg)	Index of Wing Loading (mg/mm ²)	Year
93.002	1.694019	M	0	45.9	0.493538	2012
95.7922	1.498186	M	0	59	0.615917	2012
89.064	1.473496	M	0	44.8	0.503009	2012
102.029	1.538472	M	0	35.3	0.34598	2012
89.7832	1.379421	M	0	71.4	0.795249	2012
88.1396	2.44767	M	0	21.9	0.248469	2012
		M	0			2011
		M	0			2011

Appendix E8: Morphometric measurements and egg counts for *Chlaenius tricolor*.

Vial ID	Sex	Body Length (mm)	Elytra Length (mm)	Elytra Width (mm)	Elytra Size (mm)	Wing Length (mm)	Wing Width (mm)	Wing Size (mm ²)
217.1.B.G.R1	F	13.15	7.75	2.56	19.84	9.92	3.94	39.0848
5.2.B.G.R1	M	13.29	7.96	2.66	21.1736	12.16	3.8	46.208
5.2.B.G.R1	F	12.71	7.57	2.67	20.2119	12.2	3.54	43.188
36.4.B.G.R2	M	12.9	7.74	2.43	18.8082	11.66	4.06	47.3396
211.4.C.G.R1	F	12.68	7.12	2.33	16.5896	12.2	3.47	42.334
26.4.C.G.R2	M	12.73	7.55	2.64	19.932	10.15	3.32	33.698
26.4.C.G.R2	F	12.72	7.76	2.84	22.0384	10.69	3.42	36.5598
26.4.C.G.R2	M	12.55	7.72	2.68	20.6896	10.12	3.19	32.2828
26.4.C.G.R2	F	13.14	7.82	2.84	22.2088	11.23	3.83	43.0109
26.4.C.G.R2	M	12.42	7.63	2.61	19.9143	10.33	3.31	34.1923
22.4.B.G.R1	M	12.46	7.89	2.51	19.8039	11.13	3.23	35.9499
22.4.B.G.R1	M	12.34	7.62	2.61	19.8882	11.01	3.15	34.6815
22.4.B.G.R1	F	13.52	8.23	3.12	25.6776	11.75	3.42	40.185
22.4.B.G.R1	F	12.89	8.08	2.86	23.1088	11.66	3.6	41.976
5.2.C.G.R1	M	12.42	7.89	2.65	20.9085	10.78	3.41	36.7598
5.2.C.G.R1	F	12.87	8.27	2.72	22.4944	10.91	3.52	38.4032
5.2.C.G.R1	M	12.4	8.12	2.65	21.518	11.25	3.29	37.0125
203.1.B.G.R2	M	12.13	7.64	2.53	19.3292	11.15	3.27	36.4605
203.1.B.G.R2	F	12.78	8.41	2.88	24.2208	10.95	3.66	40.077
203.1.B.G.R2	M	11.87	7.71	2.6	20.046	10.32	3.18	32.8176
203.1.B.G.R2	F	12.24	8.24	2.79	22.9896	11.04	3.47	38.3088
203.1.B.G.R2	M	12.58	8.11	2.89	23.4379	11	3.22	35.42
203.1.C.G.R2	F	13.14	8.4	2.89	24.276	11.41	3.41	38.9081
203.1.C.G.R2	M	12.34	7.63	2.56	19.5328	10.52	3.19	33.5588
203.1.C.G.R2	M	12.19	7.85	2.61	20.4885	10.57	3.33	35.1981

Appendix E8 continued

Total Wing Size (mm ²)	Relative Wing Size	Wing Type	# of Eggs	Dry Mass (mg)	Index of Wing Loading (mg/mm ²)	Year
78.1696	1.97	M	0	23.8	0.304466	2012
92.416	2.18234	M	0	26.8	0.289993	2012
86.376	2.136761	M	0	20.1	0.232704	2012
94.6792	2.516966	M	0	14.7	0.155261	2012
84.668	2.55184	M	0	19.3	0.227949	2012
67.396	1.690648	M	0	18.5	0.274497	2012
73.1196	1.658914	M	0	8.7	0.118983	2012
64.5656	1.560339	M	0	19.8	0.306665	2012
86.0218	1.93666	M	2	19	0.220874	2012
68.3846	1.716972	M	0	15.9	0.232508	2012
71.8998	1.815294	M	0	21.2	0.294855	2012
69.363	1.743823	M	0	7.8	0.112452	2012
80.37	1.564983	M	0	24.2	0.301107	2012
83.952	1.816451	M	3	28.7	0.341862	2012
73.5196	1.758127	M	0	22.6	0.307401	2012
76.8064	1.707234	M	0	22.2	0.289038	2012
74.025	1.720072	M	0	20.4	0.275583	2012
72.921	1.886291	M	0	22.2	0.304439	2012
80.154	1.654652	M	0	23	0.286948	2012
65.6352	1.637115	M	0	19.7	0.300144	2012
76.6176	1.666353	M	0	14.4	0.187946	2012
70.84	1.511228	M	0	23.6	0.333145	2012
77.8162	1.602739	M	0	24.7	0.317415	2012
67.1176	1.718074	M	0	21.9	0.326293	2012
70.3962	1.717944	M	0	26.1	0.370759	2012

Appendix E8 continued

Vial ID	Sex	Body Length (mm)	Elytra Length (mm)	Elytra Width (mm)	Elytra Size (mm)	Wing Length (mm)	Wing Width (mm)	Wing Size (mm ²)
203.1.C.G.R2	F	12.59	8.27	2.61	21.5847	10.83	3.21	34.7643
203.1.C.G.R2	M	11.16	7.7	2.63	20.251	10.67	3.15	33.6105
203.1.C.G.R2	F	13.02	8.09	2.78	22.4902	12.2	3.26	39.772
203.1.C.G.R2	F	12.67	7.85	2.72	21.352	11.16	3.54	39.5064
203.1.C.G.R2	M	12.44	8.08	2.79	22.5432	11.25	3.24	36.45
2.2.B.G.R1	F							
2.2.B.G.R1	F							
24.1.C.G.R1	F							
24.1.C.G.R1	F							
24.3.C.G.R1	F							
24.3.C.G.R1	F							
26.4.C.G.R1	F							
6.6.C.G.R1	F							
6.6.C.G.R1	F							
76.2.C.G.R2	F							
69.5.C.G.R2	F							
48.1.B.G.R2	F							
69.5.C.G.R2	F							
69.4.B.G.R2	F							
69.3.C.G.R2	F							
21.1.B.G.R2	F							
69.5.C.G.R2	F							
76.3.B.G.R2	F							

Appendix E8 continued

Total Wing Size (mm ²)	Relative Wing Size	Wing Type	# of Eggs	Dry Mass (mg)	Index of Wing Loading (mg/mm ²)	Year
69.5286	1.610599	M	0	20.2	0.290528	2012
67.221	1.659696	M	0	9.1	0.135374	2012
79.544	1.768415	M	0	15.9	0.199889	2012
79.0128	1.850244	M	0	13.1	0.165796	2012
72.9	1.616896	M	0	18.2	0.249657	2012
		M	1			2012
		M	1			2012
		M	6			2012
		M	2			2012
		M	4			2012
		M	1			2012
		M	1			2012
		M	2			2012
		M	2			2012
		M	1			2011
		M	1			2011
		M	1			2011
		M	2			2011
		M	3			2011
		M	3			2011
		M	10			2011
		M	11			2011
		M	16			2011

Appendix E9: Morphometric measurements and egg counts for *Cicindela punctulata*.

Vial ID	Sex	Body Length (mm)	Elytra Length (mm)	Elytra Width (mm)	Elytra Size (mm)	Wing Length (mm)	Wing Width (mm)	Wing Size (mm ²)
92.4.C.G.R1	F	11.46	6.53	2.07	13.5171	10.38	3.04	31.5552
92.4.C.G.R2	F	12.04	7.16	2.42	17.3272	10.84	3.31	35.8804
92.4.C.G.R2	F	11.47	6.71	2.3	15.433	10.66	3.3	35.178
92.4.C.G.R2	M	11.26	6.67	2.16	14.4072	10.24	3.04	31.1296
92.4.C.G.R2	M	11.21	6.56	2.11	13.8416	10.2	3.01	30.702
92.4.C.G.R2	F	11.42	6.65	2.23	14.8295	10.23	3.11	31.8153
203.1.B.G.R2	U	11.21	6.43	2.21	14.2103	10.16	3.17	32.2072
203.1.B.G.R2	U	11.41	6.84	2.38	16.2792	10.27	3.03	31.1181
20.3.B.G.R2	U	11.22	6.47	2.28	14.7516	10.05	2.95	29.6475
20.3.B.G.R2	U	11.4	6.5	2.28	14.82	10.31	3.11	32.0641
20.3.B.G.R2	U	11.06	6.32	2.03	12.8296	10.03	3.02	30.2906
101.4.B.G.R2	U	10.89						
101.4.B.G.R2	M	11.45						
52.4.B.G.R2	M	11.18						
96.2.B.G.R2	M	11.64						
101.4.B.G.R2	M	10.76						

Appendix E9 continued

Total Wing Size (mm ²)	Relative Wing Size	Wing Type	# of Eggs	Dry Mass (mg)	Index of Wing Loading (mg/mm ²)	Year
63.1104	2.334465	M	3	11.4	0.180636	2012
71.7608	2.070756	M	0	14.6	0.203454	2012
70.356	2.279401	M	7	25.1	0.356757	2012
62.2592	2.160697	M	0	13.8	0.221654	2012
61.404	2.218096	M	0	11.7	0.190541	2012
63.6306	2.145406	M	2	13.2	0.207447	2012
64.4144	2.266469	M	0	11.1	0.172322	2012
62.2362	1.911525	M	0	14.9	0.239411	2012
59.295	2.009782	M	0	14.1	0.237794	2012
64.1282	2.16357	M	0	12.2	0.190244	2012
60.5812	2.360993	M	0	10.2	0.168369	2012
		M	0			2011
		M	0			2011
		M	0			2011
		M	0			2011
		M	0			2011

Appendix E10: Morphometric measurements and egg counts for *Cicindela sexguttata*.

Vial ID	Sex	Body Length (mm)	Elytra Length (mm)	Elytra Width (mm)	Elytra Size (mm)	Wing Length (mm)	Wing Width (mm)	Wing Size (mm ²)
208.1.B.G.R2	U	12.46	7.29	2.62	19.0998	10.25	3.93	40.2825
24.1.B.G.R1	U	12.56	7.3	2.78	20.294	11.07	4.07	45.0549
24.1.B.G.R1	U	12.33	6.97	2.62	18.2614	10.69	3.83	40.9427
24.1.B.G.R1	U	13	7.63	2.63	20.0669	11.36	4.07	46.2352
5.4.B.G.R1	M	13.15	7.94	2.73	21.6762	10.53	3.82	40.2246
5.5.B.G.R1	M	12.62	7.82	2.49	19.4718	11.24	3.71	41.7004
36.3.B.G.R1	M	12.12	7.72	2.59	19.9948	11.08	3.61	39.9988
36.3.C.G.R1	F	13.8	8.02	2.7	21.654	12.05	3.96	47.718
36.4.B.G.R1	F	12.82	7.81	2.59	20.2279	11.39	3.43	39.0677
87.3.B.G.R1	U	14.02	8.34	2.76	23.0184	12.54	4.05	50.787
118.2.B.G.R1	U	12.81	7.73	2.44	18.8612	11.38	3.41	38.8058
118.2.B.G.R1	M	12.72	7.6	2.48	18.848	11.27	3.61	40.6847
5.2.B.G.R1	U	13.84	8.71	2.74	23.8654	11.4	3.88	44.232
118.5.C.G.R1	U	13.01	7.88	2.68	21.1184	12.21	3.55	43.3455
203.1.B.G.R1	F	13.24	7.92	2.62	20.7504	12.2	3.5	42.7
203.1.B.G.R2	U	13.18	7.77	2.65	20.5905	12.17	3.45	41.9865
36.3.B.G.R1	U	13.13	8.67	2.56	22.1952	12.11	3.43	41.5373
36.4.B.G.R1	M	12.64	7.93	2.65	21.0145	11.93	3.52	41.9936
96.2.B.G.R2	M	12.2						
101.4.C.G.R2	M	10.02						

Appendix E10 continued

Total Wing Size (mm ²)	Relative Wing Size	Wing Type	# of Eggs	Dry Mass (mg)	Index of Wing Loading (mg/mm ²)	Year
80.565	2.109053	M	0	23.3	0.289207	2012
90.1098	2.220109	M	0	19	0.210854	2012
81.8854	2.242035	M	0	17.4	0.212492	2012
92.4704	2.304053	M	0	21.1	0.228181	2012
80.4492	1.855703	M	0	22.4	0.278437	2012
83.4008	2.141579	M	0	22.2	0.266184	2012
79.9976	2.00046	M	0	17.7	0.221257	2012
95.436	2.203658	M	0	24.4	0.255669	2012
78.1354	1.931377	M	1	21.5	0.275163	2012
101.574	2.206365	M	0	32.5	0.319964	2012
77.6116	2.057441	M	0	21.9	0.282174	2012
81.3694	2.158569	M	0	24.3	0.298638	2012
88.464	1.853394	M	0	28.1	0.317643	2012
86.691	2.052499	M	0	22.4	0.258389	2012
85.4	2.057792	M	2	20.6	0.241218	2012
83.973	2.03912	M	0	20.6	0.245317	2012
83.0746	1.871454	M	0	25	0.300934	2012
83.9872	1.998315	M	0	20.3	0.241703	2012
		M	0			2011
		M	0			2011

Appendix E11: Morphometric measurements and egg counts for *Clivina fossor*.

Vial ID	Sex	Body Length (mm)	Elytra Length (mm)	Elytra Width (mm)	Elytra Size (mm)	Wing Length (mm)	Wing Width (mm)	Wing Size (mm ²)
82.2.B.G.R2	M	6.23	3.58	0.69	2.4702	3.81	1.13	4.3053
82.2.B.G.R2	M	5.85	3.21	0.86	2.7606	4.16	1.59	6.6144
82.2.B.G.R2	F	6.49	3.41	0.99	3.3759	4.25	1.64	6.97
82.2.B.G.R2	F	6.09	3.26	0.98	3.1948	4.14	1.3	5.382
202.3.C.G.R2	F	5.58	3.47	0.89	3.0883	3.98	1.74	6.9252
211.6.B.G.R1	M	5.46	3.44	0.82	2.8208	4.01	1.23	4.9323
72.8.C.G.R1	F	6.1	3.62	1.49	5.3938	3.95	1.53	6.0435
18.1.C.G.R2	M	5.79	3.41	0.81	2.7621	4.11	1.43	5.8773
18.3.B.G.R2	M	5.55	3.37	0.79	2.6623	3.86	1.37	5.2882
18.3.C.G.R2	M	5.8	3.45	0.82	2.829	4.09	1.36	5.5624
19.6.C.G.R2	F	6.32	3.61	1.14	4.1154	4.21	1.58	6.6518
24.4.B.G.R1	F	6.14	3.54	0.98	3.4692	4.14	1.54	6.3756
27.C.G.R2	M	6.01	3.44	0.82	2.8208	3.83	1.2	4.596
3.1.C.G.R1	F	6.25	3.45	0.93	3.2085	4.21	1.63	6.8623
3.1.C.G.R1	F	6.25	3.6	0.85	3.06	4.25	1.59	6.7575
3.1.C.G.R1	F	6.37	3.49	0.92	3.2108	4.19	1.51	6.3269
3.1.C.G.R1	M	5.84	3.38	0.82	2.7716	3.98	1.44	5.7312
3.2.C.G.R1	M	5.59	3.19	0.77	2.4563	4.14	1.56	6.4584
3.2.C.G.R1	M	5.64	3.44	0.68	2.3392	3.15	1.32	4.158
3.2.C.G.R1	F	6.22	3.51	0.95	3.3345	4.15	1.43	5.9345
3.2.C.G.R1	F	6.41	3.55	1.02	3.621	4.22	1.58	6.6676
3.2.C.G.R1	M	6.11	3.45	0.88	3.036	4.22	1.47	6.2034
215.3.C.G.R2	F	6.22	3.44	1.01	3.4744	4.26	1.49	6.3474
215.3.C.G.R2	F	6.24	3.5	0.95	3.325	4.17	1.35	5.6295
102.2.B.G.R2	F	6.23	3.25	0.92	2.99	4.15	1.24	5.146

Appendix E11 continued

Total Wing Size (mm ²)	Relative Wing Size	Wing Type	# of Eggs	Dry Mass (mg)	Index of Wing Loading (mg/mm ²)	Year
8.6106	1.742895	M	0	2.8	0.325181	2012
13.2288	2.396001	M	0	1.2	0.090711	2012
13.94	2.064635	M	3	1.5	0.107604	2012
10.764	1.684612	M	5	1.1	0.102192	2012
13.8504	2.242399	M	0	2.1	0.15162	2012
9.8646	1.748547	M	0	1.7	0.988257	2012
12.087	1.120453	M	0	4.7	3.537026	2012
11.7546	2.127838	M	0	2.2	0.187161	2012
10.5764	1.986328	M	0	2.7	0.255285	2012
11.1248	1.966207	M	0	1.9	0.17079	2012
13.3036	1.616319	M	0	1.8	0.135302	2012
12.7512	1.837772	M	4	3.7	0.290169	2012
9.192	1.629325	M	0	4.1	3.095274	2012
13.7246	2.138788	M	2	2.9	0.211299	2012
13.515	2.208333	M	11	3.4	0.251572	2012
12.6538	1.970506	M	0	1.8	0.14225	2012
11.4624	2.067831	M	0	1.7	0.148311	2012
12.9168	2.629321	M	0	2.4	1.426025	2012
8.316	1.777531	M	0	4.2	0.505051	2012
11.869	1.779727	M	0	3.3	0.278035	2012
13.3352	1.84137	M	4	3.5	0.262463	2012
12.4068	2.043281	M	0	2.2	1.730376	2012
12.6948	1.826905	M	2	3.4	0.267826	2012
11.259	1.693083	M	5	4.1	0.364153	2012
10.292	1.72107	M	6	3.6	0.349786	2012

Appendix E11 continued

Vial ID	Sex	Body Length (mm)	Elytra Length (mm)	Elytra Width (mm)	Elytra Size (mm)	Wing Length (mm)	Wing Width (mm)	Wing Size (mm ²)
75.4.C.G.R2	F	6.44	3.57	0.84	2.9988	4.14	1.32	5.4648
75.3.C.G.R2	M	5.84	3.44	0.83	2.8552	4.02	1.23	4.9446
211.6.B.G.R2	M	5.59	3.51	0.9	3.159	4.2	1.35	5.67
204.4.B.G.R2	M	6.01	3.55	0.89	3.1595	3.96	1.21	4.7916
102.4.C.G.R1	M	5.65	3.21	0.78	2.5038	4.3	1.54	6.622
53.3.C.G.R2	F							
28.4.C.G.R2	F							

Total Wing Size (mm ²)	Relative Wing Size	Wing Type	# of Eggs	Dry Mass (mg)	Index of Wing Loading (mg/mm ²)	Year
10.9296	1.822329	M	5	2.8	0.256185	2012
9.8892	1.731788	M	0	4	0.404482	2012
11.34	1.794872	M	0	3.5	0.308642	2012
9.5832	1.516569	M	0	2.7	0.281743	2012
13.244	2.64478	M	0	2.5	0.188765	2012
		M	2			2011
		M	3			2011

Appendix E12: Morphometric measurements and egg counts for *Diplocheila obtusa*.

Vial ID	Sex	Body Length (mm)	Elytra Length (mm)	Elytra Width (mm)	Elytra Size (mm)	Wing Length (mm)	Wing Width (mm)	Wing Size (mm ²)
5.4.B.G.R1	F	10.88	6.28	2.24	14.0672	8.42	3.09	26.0178
5.4.B.G.R1	F	9.34	5.87	2.31	13.5597	8.41	3.05	25.6505
36.3.B.G.R1	M	11.16	6.4	2.46	15.744	8.53	3.24	27.6372
73.2.B.G.R2	F	11.05	7.05	2.36	16.638	8.04	2.99	24.0396
73.2.B.G.R2	F	11.04	6.99	2.46	17.1954	8	2.91	23.28
74.2.B.G.R2	F	10.62	6.93	2.38	16.4934	7.88	2.77	21.8276
207.4.B.G.R1	M	10.93	6.67	2.42	16.1414	8.03	2.67	21.4401
118.5.B.G.R2	F	10.98	6.98	2.48	17.3104	8.04	3.02	24.2808
207.4.B.G.R1	F	10.94	6.69	2.35	15.7215	8.06	2.45	19.747
92.4.C.G.R1	F	11.12	6.9	2.36	16.284	8	3.08	24.64
24.4.B.G.R1	M	10.47	6.11	2.31	14.1141	7.85	2.73	21.4305
207.4.B.G.R1	M	10.13	6.52	2.25	14.67	7.88	2.25	17.73
36.4.B.G.R1	M	9.87	6.32	2.26	14.2832	7.23	2.59	18.7257
59.2.B.G.R2	M	10.3	6.48	2.3	14.904	7.77	2.68	20.8236
216.4.B.G.R1	F	11.15	7.03	2.43	17.0829	8.12	2.95	23.954
73.1.B.G.R1	F	11.18	7.11	2.59	18.4149	8.15	2.92	23.798
73.2.B.G.R2	F	10.98	6.91	2.43	16.7913	7.91	2.85	22.5435
26.2.C.G.R1	M	10.95	6.69	2.46	16.4574	7.92	2.63	20.8296
6.6.B.G.R1	M	10.66	6.56	2.34	15.3504	7.24	2.49	18.0276
8.4.B.G.R1	M	10.33	6.13	1.97	12.0761	7.16	2.22	15.8952

Appendix E12 continued

Total Wing Size (mm ²)	Relative Wing Size	Wing Type	# of Eggs	Dry Mass (mg)	Index of Wing Loading (mg/mm ²)	Year
52.0356	1.849537	M	15	9.6	0.184489	2012
51.301	1.891672	M	0	11.9	0.231964	2012
55.2744	1.755412	M	0	10.5	0.189961	2012
48.0792	1.444861	M	0	14	0.291186	2012
46.56	1.35385	M	0	13.5	0.289948	2012
43.6552	1.323414	M	1	9.9	0.226777	2012
42.8802	1.328268	M	0	166	3.871251	2012
48.5616	1.402671	M	15	16.1	0.331538	2012
39.494	1.256051	M	0	10.8	0.273459	2012
49.28	1.513142	M	4	14.8	0.300325	2012
42.861	1.518375	M	0	8.7	0.202982	2012
35.46	1.208589	M	0	11.9	0.335589	2012
37.4514	1.31103	M	0	11.7	0.312405	2012
41.6472	1.397182	M	0	14.8	0.355366	2012
47.908	1.402221	M	7	16	0.333973	2012
47.596	1.292323	M	1	14.1	0.296243	2012
45.087	1.34257	M	0	14.1	0.312729	2012
41.6592	1.265668	M	0	15.2	0.364865	2012
36.0552	1.174406	M	0	11.5	0.318955	2012
31.7904	1.316253	M	0	8.7	0.273668	2012

Appendix E13: Morphometric measurements and egg counts for *Harpalus affinis*.

Vial ID	Sex	Body Length (mm)	Elytra Length (mm)	Elytra Width (mm)	Elytra Size (mm)	Wing Length (mm)	Wing Width (mm)	Wing Size (mm ²)
36.4.C.G.R2	M	10.31	6.72	2.32	15.5904	7.01	2.51	17.5951
36.4.B.G.R2	F	11.37	6.85	2.36	16.166	7.51	2.66	19.9766
36.4.B.G.R2	M	10.4	6.26	2.08	13.0208	7.26	2.19	15.8994
36.4.B.G.R2	M	10.53	6.11	2.11	12.8921	7.45	2.47	18.4015
82.3.B.G.R2	F	11.7	6.76	2.27	15.3452	7.88	3.08	24.2704
82.3.B.G.R2	M	10.16	6.09	2.09	12.7281	7.28	2.45	17.836
217.1.B.G.R1	M	10.18	6.07	2.12	12.8684	7.14	2.31	16.4934
5.2.B.G.R1	F	9.48	5.11	2.28	11.6508	6.77	2.6	17.602
3.2.C.G.R1	F	9.12	5.96	1.98	11.8008	6.54	2	13.08
36.3.B.G.R2	M	10.95	5.92	2.3	13.616	6.52	2.44	15.9088
22.2.B.G.R2	M	10.11	6.35	2.27	14.4145	7.15	2.43	17.3745
24.4.B.G.R2	M	9.89	6.15	2.22	13.653	7.01	2.44	17.1044
27.3.G.G.R2	F	11.31	6.88	2.25	15.48	7.45	2.7	20.115
5.2.B.G.R2	M	10.22	6.21	2.19	13.5999	7.36	2.31	17.0016
5.4.B.G.R1	F	11.21	6.85	2.34	16.029	7.92	3.01	23.8392
5.5.B.G.R1	F	10.89	5.88	2.11	12.4068	7.82	2.44	19.0808
6.2.B.G.R2	F	10.96	6.12	2.24	13.7088	7.81	2.35	18.3535
7.1.B.G.R2	M	9.87	5.75	2.16	12.42	7.16	2.26	16.1816
7.4.B.G.R2	F	10.99	6.23	2.32	14.4536	7.34	2.66	19.5244
215.3.B.G.R2	M	10.25	6.12	2.28	13.9536	6.99	2.21	15.4479
36.3.B.G.R1	F	11.11	6.77	2.31	15.6387	7.54	2.51	18.9254
36.3.B.G.R1	F	11.2	6.54	2.22	14.5188	7.49	2.52	18.8748
82.4.B.G.R1	F	11.18	6.55	2.24	14.672	7.51	2.55	19.1505
82.4.B.G.R1	F	10.97	6.32	2.19	13.8408	7.42	2.43	18.0306
75.4.C.G.R2	M	10.54	6.11	2.08	12.7088	7.22	2.21	15.9562

Appendix E13 continued

Total Wing Size (mm ²)	Relative Wing Size	Wing Type	# of Eggs	Dry Mass (mg)	Index of Wing Loading (mg/mm ²)	Year
35.1902	1.128586	M	0	8.5	0.241545	2012
39.9532	1.235717	M	0	17.4	0.43551	2012
31.7988	1.221077	M	0	17.3	0.544046	2012
36.803	1.427347	M	0	12.9	0.350515	2012
48.5408	1.581628	M	3	18.6	0.383183	2012
35.672	1.401309	M	0	15.2	0.426105	2012
32.9868	1.281698	M	0	15.9	0.482011	2012
35.204	1.510798	M	0	11.8	0.335189	2012
26.16	1.108399	M	2	7.9	0.301988	2012
31.8176	1.16839	M	0	17.6	0.553153	2012
34.749	1.205349	M	0	8.6	0.247489	2012
34.2088	1.252794	M	0	9.7	0.283553	2012
40.23	1.299419	M	1	12.5	0.310713	2012
34.0032	1.250127	M	0	17.7	0.520539	2012
47.6784	1.487254	M	0	9.8	0.205544	2012
38.1616	1.537931	M	0	8.6	0.225357	2012
36.707	1.338812	M	1	17.4	0.474024	2012
32.3632	1.302866	M	0	7.9	0.244104	2012
39.0488	1.350833	M	3	15.6	0.3995	2012
30.8958	1.107091	M	0	12.3	0.398112	2012
37.8508	1.210165	M	1	8.6	0.227208	2012
37.7496	1.300025	M	3	16.8	0.445038	2012
38.301	1.305241	M	4	17.7	0.462129	2012
36.0612	1.302714	M	1	13.6	0.377137	2012
31.9124	1.255524	M	0	9.6	0.300824	2012

Appendix E13 continued

Vial ID	Sex	Body Length (mm)	Elytra Length (mm)	Elytra Width (mm)	Elytra Size (mm)	Wing Length (mm)	Wing Width (mm)	Wing Size (mm ²)
75.4.C.G.R2	M	10.88	5.99	2.07	12.3993	7.26	2.35	17.061
75.3.C.G.R2	M	10.79	5.84	1.98	11.5632	7.11	2.17	15.4287
211.6.C.G.R2	F	11.24	6.25	2.24	14	7.24	2.2	15.928
102.3.C.G.R1	M	10.81	5.73	2	11.46	6.79	2.19	14.8701
102.3.C.G.R1	M	10.78	5.73	1.95	11.1735	6.98	2.22	15.4956
14.3.B.G.R2	F							
12.4.C.G.R2	F							
101.1.B.G.R2	F							

Total Wing Size (mm ²)	Relative Wing Size	Wing Type	# of Eggs	Dry Mass (mg)	Index of Wing Loading (mg/mm ²)	Year
34.122	1.375965	M	0	8.5	0.249106	2012
30.8574	1.334293	M	0	10.8	0.349997	2012
31.856	1.137714	M	0	12.2	0.382973	2012
29.7402	1.297565	M	0	8.9	0.299258	2012
30.9912	1.386817	M	0	9.3	0.300085	2012
		M	1			2011
		M	4			2011
		M	1			2011

Appendix E14: Morphometric measurements and egg counts for *Harpalus erythropus*.

Vial ID	Sex	Body Length (mm)	Elytra Length (mm)	Elytra Width (mm)	Elytra Size (mm)	Wing Length (mm)	Wing Width (mm)	Wing Size (mm ²)
36.4.B.G.R2	F	11.48	8.19	2.59	21.2121	12.59	3.47	43.6873
5.2.B.G.R2	M	10.35	7.35	2.22	16.317	12.13	2.89	35.0557
72.7.B.G.R1	M	10.42	7.37	2.27	16.7299	12.06	2.91	35.0946
72.7.B.G.R1	M	10.41	7.41	2.31	17.1171	12.15	3.02	36.693
202.2.B.G.R1	F	11.55	8.24	2.57	21.1768	12.63	3.46	43.6998
211.3.C.G.R2	M	10.38	7.37	2.28	16.8036	12.27	3.11	38.1597

Total Wing Size (mm ²)	Relative Wing Size	Wing Type	# of Eggs	Dry Mass (mg)	Index of Wing Loading (mg/mm ²)	Year
87.3746	2.059546	M	0	19.8	0.22661	2012
70.1114	2.148416	M	0	15.7	0.223929	2012
70.1892	2.097717	M	0	16.1	0.22938	2012
73.386	2.143646	M	0	18.8	0.25618	2012
87.3996	2.06357	M	0	19.5	0.223113	2012
76.3194	2.270924	M	0	18.4	0.241092	2012

Appendix E15: Morphometric measurements and egg counts for *Harpalus pensylvanicus*.

Vial ID	Sex	Body Length (mm)	Elytra Length (mm)	Elytra Width (mm)	Elytra Size (mm)	Wing Length (mm)	Wing Width (mm)	Wing Size (mm ²)
87.1.B.G.R2	F	15.16	9.41	3.28	30.8648	13.32	4.68	62.3376
87.1.B.G.R2	F	15.1	9.34	3.21	29.9814	13.39	4.34	58.1126
87.1.B.G.R2	F	15.01	9.31	3.14	29.2334	13.27	4.45	59.0515
87.1.B.G.R2	F	14.99	9.72	3.25	31.59	12.97	4.53	58.7541
87.1.B.G.R2	F	15.13	9.59	3.53	33.8527	12.44	4.65	57.846
39.1.B.G.R2	M	14.62	9.14	2.81	25.6834	13.1	4.15	54.365
39.1.B.G.R2	M	14.2	8.72	2.76	24.0672	12.48	3.85	48.048
39.1.B.G.R2	F	14.97	8.79	2.79	24.5241	12.14	3.89	47.2246
39.1.B.G.R2	M	15.1	8.83	2.89	25.5187	13.04	4.35	56.724
39.1.B.G.R2	F	15.11	9.02	2.98	26.8796	12.87	4.43	57.0141
27.5.C.G.R2	U	15.22	9.3	3.31	30.783	11.96	3.55	42.458
27.5.B.G.R2	U	14.98	9.07	2.87	26.0309	12.15	4.17	50.6655
87.1.B.G.R2	U	15.31	9.93	3.47	34.4571	14.27	4.93	70.3511
87.1.B.G.R2	U	15.08	9.57	3.18	30.4326	13.1	4.57	59.867
87.1.B.G.R2	U	15.15	9.07	3	27.21	13.17	4.28	56.3676
40.1.B.G.R2	F	15.24	9.44	3.01	28.4144	13.32	4.38	58.3416
40.1.B.G.R2	F	14.59	9.05	2.92	26.426	12.84	4.05	52.002
2.2.B.G.R2	F	14.97	9.61	3.36	32.2896	11.81	3.56	42.0436
2.2.B.G.R2	M	14.7	9.37	3.21	30.0777	11.63	3.77	43.8451
2.2.B.G.R2	F	16.39	9.43	3.34	31.4962	12.01	4.1	49.241
36.3.B.G.R1	M	15.85	9.37	3.05	28.5785	11.75	4.84	56.87
203.1.B.G.R2	F	14.96	9.08	3.09	28.0572	11.78	3.37	39.6986
203.1.B.G.R2	F	13.85	9.04	2.92	26.3968	11.5	3.22	37.03
20.3.B.G.R2	F	15.03	9.42	3.16	29.7672	12.52	3.49	43.6948
31.5.C.G.R2	M	14.45	8.89	2.89	25.6921	11	3.16	34.76

Appendix E15 continued

Total Wing Size (mm ²)	Relative Wing Size	Wing Type	# of Eggs	Dry Mass (mg)	Index of Wing Loading (mg/mm ²)	Year
124.6752	2.019699	M	0	40.4	0.648084	2012
116.2252	1.938288	M	0	23.3	0.400946	2012
118.103	2.020001	M	5	44	0.745112	2012
117.5082	1.859896	M	1	31.4	0.534431	2012
115.692	1.708756	M	3	42.1	0.727794	2012
108.73	2.116737	M	0	21.1	0.388117	2012
96.096	1.99641	M	0	23.8	0.495338	2012
94.4492	1.92564	M	0	29.4	0.622557	2012
113.448	2.222841	M	0	22.9	0.403709	2012
114.0282	2.121092	M	0	27.5	0.482337	2012
84.916	1.379268	M	0	39.7	0.935042	2012
101.331	1.94636	M	0	46.2	0.911863	2012
140.7022	2.041701	M	0	48.9	0.695085	2012
119.734	1.9672	M	0	38.9	0.649774	2012
112.7352	2.071577	M	0	25.5	0.452388	2012
116.6832	2.053241	M	0	6.5	0.111413	2012
104.004	1.967835	M	0	6.6	0.126918	2012
84.0872	1.302079	M	3	37.4	0.889553	2012
87.6902	1.457728	M	0	29	0.661419	2012
98.482	1.563395	M	1	60.7	1.232713	2012
113.74	1.989957	M	0	36.6	0.643573	2012
79.3972	1.414917	M	0	25.1	0.632264	2012
74.06	1.402822	M	0	16.8	0.453686	2012
87.3896	1.467884	M	7	32.4	0.741507	2012
69.52	1.352945	M	0	29.3	0.842923	2012

Appendix E15 continued

Vial ID	Sex	Body Length (mm)	Elytra Length (mm)	Elytra Width (mm)	Elytra Size (mm)	Wing Length (mm)	Wing Width (mm)	Wing Size (mm ²)
22.4.B.G.R2	M	14.97	9.1	3.16	28.756	13.72	4.12	56.5264
22.4.B.G.R2	F	14.56	9.26	3.19	29.5394	13.05	4.4	57.42
22.4.B.G.R2	M	13.38	9.11	2.74	24.9614	13.26	4.67	61.9242
22.4.B.G.R2	F	15.02	9.5	3.44	32.68	13.9	4.86	67.554
22.4.B.G.R2	F	14.84	9.29	3.24	30.0996	13.48	4.68	63.0864
35.3.B.G.R2	F							
35.3.B.G.R2	F							
5.2.B.G.R2	F							
59.2.B.G.R2	F							
100.1.B.G.R2	F							
100.1.B.G.R2	F							
100.1.B.G.R2	F							
100.1.B.G.R2	F							
100.1.B.G.R2	F							
100.1.B.G.R2	F							
100.1.B.G.R2	F							
100.1.B.G.R2	F							

Appendix E15 continued

Total Wing Size (mm ²)	Relative Wing Size	Wing Type	# of Eggs	Dry Mass (mg)	Index of Wing Loading (mg/mm ²)	Year
113.0528	1.965725	M	0	30	0.530725	2012
114.84	1.943844	M	1	35.7	0.621735	2012
123.8484	2.480798	M	0	31.3	0.505457	2012
135.108	2.067136	M	2	45.7	0.676496	2012
126.1728	2.095922	M	0	30	0.475538	2012
		M	4			2012
		M	2			2012
		M	1			2012
		M	3			2012
		M	1			2011
		M	2			2011
		M	2			2011
		M	2			2011
		M	3			2011
		M	3			2011
		M	11			2011
		M	11			2011

Appendix E16: Morphometric measurements and egg counts for *Poecilus lucublandus*.

Vial ID	Sex	Body Length (mm)	Elytra Length (mm)	Elytra Width (mm)	Elytra Size (mm)	Wing Length (mm)	Wing Width (mm)	Wing Size (mm ²)
40.1.B.G.R2	F	11.62	6.34	2.41	15.2794	7.14	2.57	18.3498
40.1.B.G.R2	F	11.65	6.36	2.49	15.8364	7.22	2.49	17.9778
40.1.B.G.R2	F	11.87	6.87	2.58	17.7246	7.29	2.78	20.2662
40.1.B.G.R2	M	11.28	6.22	2.23	13.8706	7.11	2.58	18.3438
40.1.B.G.R2	M	11.26	5.94	1.95	11.583	7.18	2.22	15.9396
40.1.B.G.R1	F	10.79	5.87	1.97	11.5639	7.01	2.26	15.8426
22.4.B.G.R1	M	11.63	6.85	2.31	15.8235	7.85	2.56	20.096
22.4.B.G.R1	F	12.09	7.33	2.35	17.2255	7.78	2.87	22.3286
22.4.B.G.R2	M	11.16	7.07	2.24	15.8368	8.03	2.76	22.1628
22.4.B.G.R2	F	11.86	7.34	2.42	17.7628	8.1	2.87	23.247
22.4.B.G.R1	M	11.89	7.07	2.3	16.261	7.92	2.78	22.0176
22.4.B.G.R2	F	11.79	7.03	2.28	16.0284	7.8	2.59	20.202
36.4.B.G.R1	M	10.82	6.57	2.21	14.5197	6.8	2.35	15.98
202.1.B.G.R1	M	10.55	5.97	2.26	13.4922	7.18	2.26	16.2268
31.5.B.G.R2	M	10.53	7.37	2.41	17.7617	7.47	2.44	18.2268
31.5.B.G.R2	F	11.5	7.58	2.61	19.7838	8.15	2.7	22.005
31.5.B.G.R2	M	10.88	7.41	2.53	18.7473	8.39	2.55	21.3945
31.5.B.G.R2	F	12.35	7.47	2.6	19.422	8.72	2.98	25.9856
31.5.B.G.R2	F	12	7.07	2.17	15.3419	7.69	2.5	19.225
31.5.B.G.R2	M	10.75	6.95	2.23	15.4985	7.46	2.63	19.6198
87.3.C.G.R2	M	11.13	7.13	2.41	17.1833	7.87	2.84	22.3508
87.3.C.G.R2	M	10.9	6.76	2.11	14.2636	6.97	2.27	15.8219
87.3.C.G.R2	M	11.11	6.92	2.31	15.9852	7.39	2.41	17.8099
87.3.C.G.R2	M	10.87	6.8	2.33	15.844	7.14	2.37	16.9218
87.3.C.G.R2	F	11.69	7.06	2.48	17.5088	7.84	2.88	22.5792

Appendix E16 continued

Total Wing Size (mm ²)	Relative Wing Size	Wing Type	# of Eggs	Dry Mass (mg)	Index of Wing Loading (mg/mm ²)	Year
36.6996	1.20095	M	0	31.7	0.86377	2012
35.9556	1.13522	M	0	12.6	0.350432	2012
40.5324	1.143394	M	0	32.9	0.811696	2012
36.6876	1.322495	M	0	16.2	0.441566	2012
31.8792	1.37612	M	0	6.9	0.216442	2012
31.6852	1.370005	M	0	22.1	0.697487	2012
40.192	1.27001	M	0	17.4	0.432922	2012
44.6572	1.296253	M	0	16.9	0.378438	2012
44.3256	1.399449	M	0	21.6	0.487303	2012
46.494	1.308746	M	0	9.9	0.212931	2012
44.0352	1.354013	M	0	17.2	0.390597	2012
40.404	1.260388	M	0	8.9	0.220275	2012
31.96	1.100574	M	0	11.4	0.356696	2012
32.4536	1.20268	M	0	14	0.431385	2012
36.4536	1.026186	M	0	11	0.301753	2012
44.01	1.112274	M	0	16.1	0.365826	2012
42.789	1.141204	M	0	15.3	0.357569	2012
51.9712	1.337947	M	0	10.8	0.207807	2012
38.45	1.253104	M	2	23.1	0.60078	2012
39.2396	1.265916	M	0	7.7	0.19623	2012
44.7016	1.300728	M	0	3.7	0.082771	2012
31.6438	1.10925	M	0	12.5	0.395022	2012
35.6198	1.114149	M	0	9.5	0.266706	2012
33.8436	1.068026	M	0	11	0.325025	2012
45.1584	1.289592	M	1	8.5	0.188226	2012

Appendix E16 continued

Vial ID	Sex	Body Length (mm)	Elytra Length (mm)	Elytra Width (mm)	Elytra Size (mm)	Wing Length (mm)	Wing Width (mm)	Wing Size (mm ²)
87.3.C.G.R2	M	10.9	6.81	2.3	15.663	6.98	2.37	16.5426
87.3.C.G.R2	F	12.21	7.24	2.35	17.014	7.91	2.95	23.3345
87.3.C.G.R2	M	10.94	6.69	2.26	15.1194	7.35	2.74	20.139
18.1.C.G.R2	F	11.45	6.68	2.48	16.5664	7.35	2.8	20.58
18.4.C.G.R1	F	11.87	6.87	2.54	17.4498	7.28	2.84	20.6752
2.3.C.G.R1	F							
22.3.B.G.R2	F							
22.3.B.G.R2	F							
22.3.B.G.R2	F							
24.4.C.G.R2	F							
27.3.B.G.R2	F							
27.3.B.G.R2	F							
27.3.B.G.R2	F							
27.3.C.G.R2	F							
67.5.B.G.R2	F							
101.B.G.R2	F							
101.B.G.R2	F							
98.2.B.G.R2	F							
101.1.B.G.R2	F							
101.1.C.G.R2	F							

Appendix E16 continued

Total Wing Size (mm ²)	Relative Wing Size	Wing Type	# of Eggs	Dry Mass (mg)	Index of Wing Loading (mg/mm ²)	Year
33.0852	1.056158	M	0	12.2	0.368745	2012
46.669	1.371488	M	6	11	0.235703	2012
40.278	1.331997	M	0	15.4	0.382343	2012
41.16	1.242274	M	6	14.5	0.352284	2012
41.3504	1.184839	M	1	17.2	0.415957	2012
		M	1			2012
		M	1			2012
		M	2			2012
		M	4			2012
		M	2			2012
		M	1			2012
		M	1			2012
		M	5			2012
		M	7			2012
		M	2			2011
		M	3			2011
		M	1			2011
		M	2			2011
		M	1			2011
		M	1			2011

Appendix E17: Morphometric measurements and egg counts for *Pterostichus commutabilis*.

Vial ID	Sex	Body Length (mm)	Elytra Length (mm)	Elytra Width (mm)	Elytra Size (mm)	Wing Length (mm)	Wing Width (mm)	Wing Size (mm ²)
211.6.C.G.R2	M	8.39	4.7	1.65	7.755	5.75	1.85	10.6375
211.4.C.G.R1	F	8.83	4.12	1.69	6.9628	5.69	1.83	10.4127
75.3.C.G.R1	M	8.05	4.68	1.57	7.3476	5.46	1.81	9.8826
36.3.B.G.R1	M	8.07	4.34	1.58	6.8572	5.44	1.77	9.6288
105.2.B.G.R1	M	8.22	4.66	1.63	7.5958	5.61	1.85	10.3785
40.1.B.G.R2	M	8.34	4.35	1.61	7.0035	5.45	1.74	9.483

Total Wing Size (mm ²)	Relative Wing Size	Wing Type	# of Eggs	Dry Mass (mg)	Index of Wing Loading (mg/mm ²)	Year
21.275	1.371696	M	0	4.6	0.216216	2012
20.8254	1.495476	M	0	5.2	0.249695	2012
19.7652	1.345011	M	0	3.8	0.192257	2012
19.2576	1.404188	M	0	3.5	0.181746	2012
20.757	1.366347	M	0	3.8	0.183071	2012
18.966	1.354037	M	0	4.2	0.221449	2012

Appendix E18: Morphometric measurements and egg counts for *Pterostichus melanarius*.

Vial ID	Sex	Body Length (mm)	Elytra Length (mm)	Elytra Width (mm)	Elytra Size (mm)	Wing Length (mm)	Wing Width (mm)	Wing Size (mm ²)
27.5.C.G.R2	F	19.11	9.7	3.1	30.07	3.91	0.83	3.2453
27.5.C.G.R2	F	19.02	9.66	3.09	29.8494	4.02	0.78	3.1356
27.5.C.G.R2	F	16.76	8.77	3.01	26.3977	4.4	1.19	5.236
27.5.C.G.R2	F	18.24	9.85	3.45	33.9825	4.17	0.98	4.0866
27.5.C.G.R2	F	18.2	10.11	3.41	34.4751	3.81	0.84	3.2004
27.5.C.G.R2	F	17.21	9.51	3.2	30.432	3.45	1.01	3.4845
27.5.C.G.R2	F	15.44	8.62	2.82	24.3084	3.71	0.99	3.6729
27.5.C.G.R2	F	16.66	9.09	3.19	28.9971	3.13	0.79	2.4727
40.1.B.G.R1	F	18.5	10.18	3.19	32.4742	3.64	0.9	3.276
40.1.B.G.R1	F	17.41	10.34	2.08	21.5072	3.81	1.05	4.0005
40.5.B.G.R2	F	16.95	9.78	3.02	29.5356	3.24	0.89	2.8836
2.2.B.G.R1	F	16.12	9.86	3.28	32.3408	3.95	0.92	3.634
2.2.B.G.R2	F	18.51	10.18	3.39	34.5102	4.12	1.02	4.2024
72.8.C.G.R1	F	17.35	10.41	3.43	35.7063	4.15	1.01	4.1915
72.8.C.G.R1	F	18.23	9.87	3.43	33.8541	4.01	1.07	4.2907
208.1.B.G.R2	F	17.89	10.03	3.42	34.3026	4.24	1.03	4.3672
5.2.B.G.R1	F	17.37	9.99	3.35	33.4665	4.05	0.98	3.969
5.2.B.G.R1	F	17.86	10.48	3.15	33.012	4.08	1.35	5.508
5.2.B.G.R1	M	17.39	9.3	2.81	26.133	3.19	0.8	2.552
5.4.B.G.R1	M	16.14	9.32	3.09	28.7988	3.76	0.7	2.632
5.4.B.G.R1	M	15.45	9.22	2.75	25.355	2.67	1.09	2.9103
5.4.B.G.R1	M	15.07	9.19	2.74	25.1806	3.28	0.85	2.788
5.5.B.G.R1	M	15.96	10.05	3.17	31.8585	4.16	0.86	3.5776
36.3.B.G.R1	M	16.92	9.11	3.05	27.7855	3.29	0.97	3.1913
36.3.B.G.R1	M	17.25	9.39	2.93	27.5127	3.69	1.08	3.9852

Appendix E18 continued

Total Wing Size (mm ²)	Relative Wing Size	Wing Type	# of Eggs	Dry Mass (mg)	Index of Wing Loading (mg/mm ²)	Year
6.4906	0.107925	B	3	58.2	8.966814	2012
6.2712	0.105047	B	2	25.5	4.066207	2012
10.472	0.198351	B	1	38.9	3.714668	2012
8.1732	0.120256	B	1	41.3	5.0531	2012
6.4008	0.092832	B	1	46	7.186602	2012
6.969	0.114501	B	0	35.8	5.137035	2012
7.3458	0.151096	B	2	36.1	4.914373	2012
4.9454	0.085274	B	0	31.6	6.389776	2012
6.552	0.10088	B	3	44.6	6.807082	2012
8.001	0.186007	B	0	51.7	6.461692	2012
5.7672	0.097631	B	2	50.9	8.825773	2012
7.268	0.112366	B	0	40.6	5.586131	2012
8.4048	0.121773	B	1	52	6.186941	2012
8.383	0.117438	B	3	49.1	0.556534	2012
8.5814	0.126741	B	2	44.1	5.139022	2012
8.7344	0.127314	B	0	50.8	5.816084	2012
7.938	0.118596	B	0	39.9	5.026455	2012
11.016	0.166848	B	1	39.9	3.622004	2012
5.104	0.097654	B	0	26.7	5.231191	2012
5.264	0.091393	B	0	13.7	2.602584	2012
5.8206	0.114782	B	0	21.4	3.676597	2012
5.576	0.11072	B	0	39.1	7.012195	2012
7.1552	0.112297	B	0	36.4	5.087209	2012
6.3826	0.114855	B	0	38.3	6.000689	2012
7.9704	0.144849	B	0	37.3	4.679815	2012

Appendix E18 continued

Vial ID	Sex	Body Length (mm)	Elytra Length (mm)	Elytra Width (mm)	Elytra Size (mm)	Wing Length (mm)	Wing Width (mm)	Wing Size (mm ²)
118.2.B.G.R1	M	16.43	8.97	2.81	25.2057	3.6	0.96	3.456
118.2.B.G.R1	M	18.18	9.92	2.87	28.4704	3.88	1.23	4.7724
118.2.B.G.R1	M	17.52	9.21	2.81	25.8801	3.82	0.97	3.7054
118.2.B.G.R1	M	16.1	9.6	2.98	28.608	3.53	0.8	2.824
72.8.C.G.R1	M	16.84	9.48	3.11	29.4828	3.97	0.89	3.5333
203.1.B.G.R2	M							
214.2.C.G.R2	M							
20.3.B.G.R2	U							
20.3.B.G.R2	U							
20.3.B.G.R2	U							
22.4.B.G.R1	U							
22.4.B.G.R1	U							

Total Wing Size (mm ²)	Relative Wing Size	Wing Type	# of Eggs	Dry Mass (mg)	Index of Wing Loading (mg/mm ²)	Year
6.912	0.137111844	B	0	30.9	4.470486	2012
9.5448	0.167626728	B	0	42.9	4.494594	2012
7.4108	0.143175645	B	0	41.5	5.599935	2012
5.648	0.098713647	B	0	39.3	6.958215	2012
7.0666	0.119842756	B	4	38.2	5.405711	2012
		B	9			2012
		B	2			2012
		B	2			2012
		B	1			2012
		B	9			2012
		B	2			2012
		B	7			2012

Appendix E19: Morphometric measurements and egg counts for *Stenolophus comma*.

Vial ID	Sex	Body Length (mm)	Elytra Length (mm)	Elytra Width (mm)	Elytra Size (mm)	Wing Length (mm)	Wing Width (mm)	Wing Size (mm ²)
36.4.C.G.R2	F	7.36	4.76	1.17	5.5692	6.39	1.92	12.2688
36.4.C.G.R2	F	7.12	4.2	1.2	5.04	6.23	1.87	11.6501
105.4.B.G.R1	M	6.33	3.95	1.13	4.4635	6.14	1.66	10.1924
3.2.C.G.R1	F	6.25	3.15	0.78	2.457	6.2	1.16	7.192
203.1.C.G.R2	M	6.41	3.87	1.16	4.4892	6.15	1.25	7.6875
79.2.B.G.R2	M	6.35	3.79	0.98	3.7142	6.12	1.54	9.4248
65.3.B.G.R2	F	8.9						
65.3.B.G.R2	F	9.27						
58.2.C.G.R2	F	8.4						
58.2.C.G.R2	F	6.6						
58.2.C.G.R2	F	6.56						
58.2.C.G.R2	F	6.22						
58.2.C.G.R2	M	6.23						
58.2.C.G.R2	F	5.9						
58.2.C.G.R2	F	6.82						
58.2.C.G.R2	F	8.06						
45.4.B.G.R2	F	9.35						
45.4.B.G.R2	M	6.48						
109.6.B.G.R2	F	7.14						

Appendix E19 continued

Total Wing Size (mm ²)	Relative Wing Size	Wing Type	# of Eggs	Dry Mass (mg)	Index of Wing Loading (mg/mm ²)	Year
24.5376	2.202973	M	0	1.1	0.044829	2012
23.3002	2.311528	M	1	1.7	0.072961	2012
20.3848	2.283499	M	0	3	0.147168	2012
14.384	2.927147	M	0	1.3	0.090378	2012
15.375	1.712443	M	0	1.4	0.091057	2012
18.8496	2.537505	M	0	1.1	0.058357	2012
		M	5			2011
		M	1			2011
		M	0			2011
		M	0			2011
		M	0			2011
		M	0			2011
		M	0			2011
		M	0			2011
		M	0			2011
		M	0			2011
		M	0			2011
		M	1			2011

Appendix F: Summary of carabid beetle species traits for carabids without eggs dissected. All morphometric traits and egg counts include the mean value for the trait and the standard error. The number in parentheses indicates the sample size for the given species trait.

Species	Body Length (mm)	Dry Mass (mg)	Relative Wing Size	Index of Wing Loading (mg/mm ²)	Mean Eggs
<i>Agonum cupripenne</i>	9.57 ± 0.50 (6)	13.58 ± 1.63 (5)	1.41 ± 0.12 (5)	0.39 ± 0.069 (5)	-
<i>Agonum melanarium</i>	8.39 ± 0.20 (6)	7.45 ± 0.76 (6)	1.75 ± 0.037 (6)	0.00021 ± 2.07E ⁻⁵ (6)	-
<i>Carabus nemoralis</i>	22.13 ± 0.32 (6)	88.76 ± 0.017 (5)	-	-	-
<i>Chlaenius sericeus</i>	14.62 ± 0.34 (8)	46.38 ± 7.09 (6)	1.67 ± 0.16 (6)	0.50 ± 0.079 (6)	-
<i>Harpalus erythropus</i>	10.76 ± 0.23 (6)	18.05 ± 0.71 (6)	2.13 ± 0.032 (6)	0.23 ± 0.0052 (6)	-
<i>Pterostichus commutabilis</i>	8.31 ± 0.11 (6)	4.18 ± 0.25 (6)	1.38 ± 0.022 (6)	0.20 ± 0.010 (6)	-

Appendix G: Model summaries for the scale at which habitat amount best predict species abundance (i.e., the scale of effect). Species where the largest absolute slope coefficient was negative have their scales of effect in parentheses, but were not used in subsequent analyses.

Species	Radius of Best Scale (m)	β	SE	SE ⁻¹	Z Value	P Value	Nagelkerke R ²
<i>Agonum cupripenne</i>	1000	8.547	2.954	0.339	2.89	0.003	0.056
<i>Agonum melanarium</i>	800	4.504	1.324	0.755	3.40	<0.001	0.104
<i>Agonum thoreyi</i>	(100)	-14.771	6.955	0.143	-2.12	0.033	0.035
<i>Amara aenea</i>	950	4.814	0.257	3.891	18.72	<0.001	0.465
<i>Anisodactylus sanctaerucis</i>	1000	10.891	0.853	1.172	12.76	<0.001	0.208
<i>Bembidion minus</i>	(1000)	-2.786	1.269	0.788	-2.19	0.028	0.031
<i>Bembidion quadrimaculatum</i>	(650)	-2.296	0.311	3.215	-7.37	<0.001	0.104
<i>Carabus nemoralis</i>	100	15.891	5.413	0.185	2.93	0.003	0.100
<i>Chlaenius pusillus</i>	450	1.483	0.844	1.185	1.75	0.078	0.020
<i>Chlaenius sericeus</i>	1000	8.637	4.604	0.217	1.87	0.060	0.014
<i>Chlaenius tricolor</i>	1000	2.030	0.353	2.833	5.74	<0.001	0.056
<i>Cicindela punctulata</i>	300	1.626	1.222	0.818	1.33	0.184	0.010
<i>Cicindela sexguttata</i>	500	1.669	1.042	0.960	1.60	0.109	0.011
<i>Clivina fossor</i>	50	1.762	0.267	3.745	6.59	<0.001	0.123
<i>Diplocheila obtusa</i>	50	1.316	0.676	1.479	1.94	0.051	0.019
<i>Harpalus affinis</i>	600	2.677	1.130	0.885	2.36	0.017	0.015
<i>Harpalus erraticus</i>	(700)	-93.443	6.770	0.147	-13.80	<0.001	0.372
<i>Harpalus erythropus</i>	1000	10.49	3.798	0.263	2.76	0.005	0.087
<i>Harpalus herbivagus</i>	(250)	-2.710	1.350	0.740	-2.00	0.044	0.012
<i>Harpalus pensylvanicus</i>	700	4.406	0.172	5.814	25.54	<0.001	0.627
<i>Ophonus puncticeps</i>	(500)	-1.817	1.373	0.728	-0.88	0.375	0.002
<i>Patrobis longicornis</i>	(1000)	-5.408	0.803	1.245	-6.73	<0.001	0.103
<i>Poecilus lucublandus</i>	650	2.751	0.269	3.717	10.22	<0.001	0.168
<i>Pterostichus commutabilis</i>	600	3.448	0.702	1.425	4.90	<0.001	0.097
<i>Pterostichus melanarius</i>	850	1.734	0.046	21.739	36.98	<0.001	0.914
<i>Stenolophus comma</i>	1000	9.261	3.091	0.324	2.99	0.002	0.028

Appendix H: Pitfall trap locations and their respective species and individual carabid counts.
Sample site ID and trap ID codes used only to identify site and trap locations for this study.

Sample Site ID	Trap ID	Location	Species	Individuals	Sample Site ID	Trap ID	Location	Species	Individuals
H_H_1	1_C_1	Field	7	27	H_H_21	21_C_3	Field	1	1
H_H_1	1_C_1	Border	2	12	H_H_21	21_C_3	Field	1	1
H_H_1	1_C_2	Field	5	5	H_H_21	21_C_4	Border	1	1
H_H_1	1_C_2	Field	6	125	H_H_21	21_C_4	Field	2	3
H_H_1	1_C_2	Field	3	6	H_H_21	21_C_4	Border	2	3
H_H_1	1_C_2	Border	9	195	H_H_23	23_C_1	Field	2	3
H_H_1	1_C_3	Field	8	18	H_H_23	23_C_1	Field	1	4
H_H_1	1_C_3	Border	1	10	H_H_23	23_C_2	Field	5	8
H_H_10	10_C_1	Border	2	33	H_H_23	23_C_2	Border	2	2
H_H_10	10_C_1	Border	1	3	H_H_23	23_C_2	Field	4	44
H_H_10	10_C_1	Border	1	24	H_H_23	23_C_2	Field	1	21
H_H_10	10_C_1	Field	1	1	H_H_23	23_C_3	Border	1	1
H_H_10	10_C_2	Border	1	1	H_H_23	23_C_3	Border	1	10
H_H_10	10_C_2	Field	2	3	H_H_23	23_C_4	Border	4	35
H_H_10	10_C_2	Field	3	15	H_H_23	23_C_4	Field	3	3
H_H_10	10_C_4	Field	1	5	H_H_23	23_C_4	Field	3	57
H_H_10	10_C_4	Field	4	8	H_H_23	23_C_4	Field	1	12
H_H_12	12_C_3	Border	4	19	H_H_25	25_C_4	Field	3	10
H_H_12	12_C_3	Border	1	1	H_H_25	25_C_4	Field	1	1
H_H_12	12_C_3	Field	5	58	H_H_25	25_C_4	Field	1	4
H_H_12	12_C_3	Border	3	35	H_H_25	25_C_5	Border	2	30
H_H_12	12_C_4	Field	4	15	H_H_25	25_C_5	Border	2	3
H_H_12	12_C_4	Border	2	14	H_H_25	25_C_5	Border	1	33
H_H_12	12_C_4	Border	4	39	H_H_25	25_C_5	Field	2	17
H_H_12	12_C_4	Border	5	95	H_H_25	25_C_7	Border	1	2
H_H_12	12_C_6	Field	4	41	H_H_25	25_C_7	Field	2	9
H_H_12	12_C_6	Border	3	23	H_H_28	28_C_1	Field	6	22
H_H_12	12_C_6	Field	2	45	H_H_28	28_C_1	Field	6	29
H_H_12	12_C_6	Field	3	23	H_H_28	28_C_1	Border	3	9
H_H_13	13_C_2	Field	1	1	H_H_28	28_C_1	Border	4	10
H_H_13	13_C_2	Field	2	10	H_H_28	28_C_3	Border	3	5
H_H_13	13_C_2	Border	1	4	H_H_28	28_C_3	Field	1	1
H_H_13	13_C_2	Field	1	20	H_H_28	28_C_3	Field	3	22
H_H_13	13_C_3	Field	1	1	H_H_28	28_C_3	Border	4	28
H_H_13	13_C_3	Field	1	2	H_H_28	28_C_4	Field	4	24
H_H_13	13_C_3	Border	1	3	H_H_28	28_C_4	Field	4	11
H_H_13	13_C_3	Field	2	32	H_H_28	28_C_4	Border	4	18
H_H_13	13_C_4	Border	1	6	H_H_28	28_C_4	Border	3	14
H_H_13	13_C_4	Field	2	2	H_H_30	30_C_1	Field	4	15
H_H_13	13_C_4	Field	2	26	H_H_30	30_C_1	Field	1	7
H_H_14	14_C_3	Border	3	14	H_H_30	30_C_1	Border	2	10
H_H_14	14_C_3	Border	4	5	H_H_30	30_C_3	Border	2	2
H_H_14	14_C_3	Border	5	29	H_H_30	30_C_3	Border	1	1
H_H_14	14_C_3	Border	3	12	H_H_30	30_C_3	Field	2	2
H_H_14	14_C_4	Field	3	47	H_H_30	30_C_4	Field	1	18
H_H_14	14_C_4	Border	4	7	H_H_30	30_C_4	Border	1	13
H_H_14	14_C_4	Border	4	23	H_H_30	30_C_4	Field	4	25
H_H_14	14_C_4	Field	1	3	H_H_30	30_C_4	Border	2	32
H_H_14	14_C_5	Field	6	43	H_H_4	4_C_1	Field	1	1
H_H_14	14_C_5	Border	5	30	H_H_4	4_C_1	Field	1	3
H_H_14	14_C_5	Field	1	1	H_H_4	4_C_1	Border	5	14
H_H_14	14_C_5	Field	2	9	H_H_4	4_C_5	Field	2	12
H_H_16	16_C_1	Border	3	4	H_H_4	4_C_5	Field	2	22
H_H_16	16_C_1	Border	3	16	H_H_4	4_C_5	Field	1	56
H_H_16	16_C_1	Field	1	8	H_H_4	4_C_5	Field	2	4
H_H_16	16_C_3	Field	2	2	H_H_4	4_C_6	Border	7	23
H_H_16	16_C_3	Field	1	1	H_H_4	4_C_6	Border	4	6
H_H_16	16_C_3	Border	1	1	H_H_4	4_C_6	Border	3	15
H_H_16	16_C_3	Field	3	5	H_H_4	4_C_6	Border	2	23
H_H_16	16_C_4	Border	2	3	H_L_32	32_C_2	Field	1	1
H_H_16	16_C_4	Border	3	23	H_L_32	32_C_2	Field	4	14
H_H_16	16_C_4	Field	1	4	H_L_32	32_C_3	Border	1	1
H_H_16	16_C_4	Field	2	8	H_L_32	32_C_3	Border	3	8
H_H_21	21_C_1	Border	2	2	H_L_32	32_C_3	Border	1	4
H_H_21	21_C_1	Field	3	12	H_L_32	32_C_4	Border	2	3
H_H_21	21_C_1	Field	1	1	H_L_32	32_C_4	Border	2	2
H_H_21	21_C_1	Field	2	5	H_L_32	32_C_4	Border	1	1
H_H_21	21_C_3	Border	3	6	H_L_33	33_C_2	Border	3	3
H_H_21	21_C_3	Border	2	12	H_L_33	33_C_2	Border	1	1

Appendix H continued

Sample Site ID	Trap ID	Location	Species	Individuals
H L 33	33 C 2	Field	2	5
H L 33	33 C 2	Border	1	1
H L 33	33 C 3	Border	6	66
H L 33	33 C 3	Field	4	27
H L 33	33 C 3	Field	3	18
H L 33	33 C 3	Field	4	44
H L 33	33 C 4	Field	4	17
H L 33	33 C 4	Field	4	10
H L 33	33 C 4	Field	1	1
H L 33	33 C 4	Border	5	36
H L 37	37 C 1	Field	2	2
H L 37	37 C 1	Border	1	4
H L 37	37 C 1	Border	1	1
H L 37	37 C 2	Border	7	25
H L 37	37 C 2	Border	3	3
H L 37	37 C 2	Border	3	4
H L 37	37 C 2	Field	1	5
H L 37	37 C 4	Field	5	25
H L 37	37 C 4	Border	3	14
H L 37	37 C 4	Field	1	1
H L 37	37 C 4	Field	5	5
H L 43	43 C 1	Border	2	2
H L 43	43 C 1	Field	4	170
H L 43	43 C 1	Field	2	10
H L 43	43 C 2	Border	1	1
H L 43	43 C 2	Field	3	103
H L 43	43 C 2	Field	3	12
H L 43	43 C 4	Field	6	9
H L 43	43 C 4	Field	1	1
H L 44	44 C 1	Field	5	25
H L 44	44 C 1	Border	5	8
H L 44	44 C 1	Border	4	6
H L 44	44 C 4	Field	3	23
H L 44	44 C 4	Border	4	22
H L 44	44 C 4	Field	4	14
H L 44	44 C 5	Border	3	4
H L 44	44 C 5	Border	4	24
H L 44	44 C 5	Field	4	5
H L 44	44 C 5	Field	2	8
H L 45	45 C 1	Border	1	2
H L 45	45 C 1	Border	2	5
H L 45	45 C 2	Field	6	6
H L 45	45 C 2	Border	5	37
H L 45	45 C 2	Field	6	35
H L 45	45 C 2	Field	1	18
H L 45	45 C 3	Border	1	1
H L 45	45 C 4	Border	4	16
H L 45	45 C 4	Field	1	1
H L 48	48 C 1	Border	4	11
H L 48	48 C 1	Border	5	14
H L 48	48 C 1	Border	2	4
H L 48	48 C 2	Field	2	36
H L 48	48 C 2	Border	2	7
H L 48	48 C 2	Field	2	24
H L 48	48 C 2	Border	2	11
H L 48	48 C 3	Border	1	1
H L 48	48 C 3	Field	2	2
H L 48	48 C 3	Border	3	3
H L 51	51 C 1	Border	2	343
H L 51	51 C 1	Field	1	153
H L 51	51 C 1	Border	1	355
H L 51	51 C 1	Field	1	12
H L 51	51 C 2	Field	5	17
H L 51	51 C 2	Border	1	16
H L 51	51 C 2	Border	2	55
H L 51	51 C 2	Field	1	54
H L 51	51 C 3	Field	1	3
H L 51	51 C 6	Field	4	46
H L 51	51 C 6	Border	1	52
H L 52	52 C 1	Border	5	10
H L 52	52 C 1	Field	2	2
H L 52	52 C 2	Border	4	7
H L 52	52 C 2	Field	3	10
H L 52	52 C 2	Border	3	3

Sample Site ID	Trap ID	Location	Species	Individuals
H L 52	52 C 2	Border	3	18
H L 52	52 C 4	Border	2	2
H L 52	52 C 4	Field	3	5
H L 52	52 C 4	Field	1	1
H L 53	53 C 2	Border	10	89
H L 53	53 C 2	Field	3	7
H L 53	53 C 2	Field	1	2
H L 53	53 C 3	Border	10	27
H L 53	53 C 3	Field	10	52
H L 53	53 C 3	Border	6	18
H L 53	53 C 4	Field	9	59
H L 53	53 C 4	Field	5	6
H L 53	53 C 4	Field	3	6
H L 56	56 C 1	Field	5	38
H L 56	56 C 1	Border	3	3
H L 56	56 C 1	Field	1	8
H L 56	56 C 1	Field	1	15
H L 56	56 C 5	Field	3	9
H L 56	56 C 5	Field	5	153
H L 56	56 C 5	Field	3	15
H L 56	56 C 5	Border	1	17
H L 56	56 C 6	Field	2	8
H L 56	56 C 6	Field	3	7
H L 56	56 C 6	Border	1	3
H L 58	58 C 2	Border	6	11
H L 58	58 C 2	Field	5	88
H L 58	58 C 2	Field	9	24
H L 58	58 C 2	Field	2	14
H L 58	58 C 3	Border	2	18
H L 58	58 C 3	Field	2	9
H L 58	58 C 3	Field	5	70
H L 58	58 C 4	Field	3	15
H L 58	58 C 4	Field	1	1
H L 58	58 C 4	Border	3	67
H L 58	58 C 4	Border	2	14
L H 63	63 C 1	Border	2	11
L H 63	63 C 1	Field	2	7
L H 63	63 C 1	Field	1	9
L H 63	63 C 2	Field	2	8
L H 63	63 C 2	Border	3	14
L H 63	63 C 2	Field	1	2
L H 63	63 C 2	Field	2	12
L H 63	63 C 3	Field	3	25
L H 63	63 C 3	Field	3	4
L H 63	63 C 3	Field	2	7
L H 63	63 C 3	Border	2	8
L H 65	65 C 1	Border	2	13
L H 65	65 C 1	Field	3	17
L H 65	65 C 1	Border	1	3
L H 65	65 C 1	Border	1	1
L H 65	65 C 3	Field	4	20
L H 65	65 C 3	Border	2	9
L H 65	65 C 3	Border	1	2
L H 65	65 C 4	Border	3	8
L H 65	65 C 4	Border	1	2
L H 65	65 C 4	Border	4	5
L H 67	67 C 2	Border	1	2
L H 67	67 C 2	Border	3	3
L H 67	67 C 2	Border	1	1
L H 67	67 C 4	Border	1	1
L H 67	67 C 4	Border	2	6
L H 67	67 C 4	Field	2	3
L H 67	67 C 4	Field	4	20
L H 67	67 C 5	Border	5	10
L H 67	67 C 5	Border	4	22
L H 67	67 C 5	Field	2	8
L H 67	67 C 5	Border	2	21
L H 68	68 C 1	Field	2	43
L H 68	68 C 1	Border	3	37
L H 68	68 C 1	Border	2	63
L H 68	68 C 1	Field	3	120
L H 68	68 C 3	Field	3	123
L H 68	68 C 3	Border	4	47
L H 68	68 C 3	Field	1	156

Appendix H continued

Sample Site ID	Trap ID	Location	Species	Individuals
L_H_68	68_C_3	Border	2	29
L_H_68	68_C_4	Field	3	11
L_H_68	68_C_4	Field	3	15
L_H_68	68_C_4	Field	1	43
L_H_68	68_C_4	Border	2	42
L_H_69	69_C_3	Field	3	27
L_H_69	69_C_3	Field	1	6
L_H_69	69_C_3	Border	2	15
L_H_69	69_C_3	Field	3	55
L_H_69	69_C_4	Border	2	2
L_H_69	69_C_4	Border	2	15
L_H_69	69_C_4	Field	2	37
L_H_69	69_C_4	Field	1	3
L_H_69	69_C_5	Border	2	2
L_H_69	69_C_5	Field	2	2
L_H_69	69_C_5	Field	2	76
L_H_76	76_C_2	Field	2	5
L_H_76	76_C_2	Border	5	6
L_H_76	76_C_2	Border	1	6
L_H_76	76_C_2	Border	0	0
L_H_76	76_C_3	Border	5	17
L_H_76	76_C_3	Border	3	9
L_H_76	76_C_3	Border	2	2
L_H_76	76_C_3	Field	2	8
L_H_76	76_C_4	Field	3	6
L_H_76	76_C_4	Field	4	10
L_H_76	76_C_4	Field	4	10
L_H_76	76_C_4	Border	3	26
L_H_77	77_C_1	Border	3	43
L_H_77	77_C_1	Border	1	11
L_H_77	77_C_1	Field	1	3
L_H_77	77_C_1	Field	1	14
L_H_77	77_C_2	Field	1	1
L_H_77	77_C_2	Border	2	2
L_H_77	77_C_2	Field	2	4
L_H_77	77_C_3	Field	1	1
L_H_77	77_C_3	Field	1	2
L_H_77	77_C_3	Border	3	4
L_H_77	77_C_3	Field	3	15
L_H_78	78_C_1	Border	5	19
L_H_78	78_C_1	Border	2	2
L_H_78	78_C_1	Field	3	9
L_H_78	78_C_1	Field	2	2
L_H_78	78_C_4	Border	3	4
L_H_78	78_C_4	Field	2	2
L_H_78	78_C_4	Field	2	4
L_H_78	78_C_6	Border	1	1
L_H_78	78_C_6	Border	1	7
L_H_78	78_C_6	Field	2	9
L_H_85	85_C_1	Border	2	52
L_H_85	85_C_1	Border	0	0
L_H_85	85_C_1	Border	0	0
L_H_85	85_C_2	Border	2	3
L_H_85	85_C_2	Field	2	4
L_H_85	85_C_2	Border	1	1
L_H_85	85_C_4	Border	2	13
L_H_85	85_C_4	Border	1	4
L_H_86	86_C_2	Border	4	42
L_H_86	86_C_2	Field	2	80
L_H_86	86_C_2	Field	1	25
L_H_86	86_C_2	Border	3	100
L_H_86	86_C_3	Field	5	167
L_H_86	86_C_3	Border	2	127
L_H_86	86_C_3	Field	1	36
L_H_86	86_C_3	Border	2	64
L_H_86	86_C_4	Border	2	109
L_H_86	86_C_4	Field	4	112
L_H_86	86_C_4	Field	4	41
L_H_86	86_C_4	Field	1	9
L_H_88	88_C_1	Field	2	14
L_H_88	88_C_1	Border	3	14
L_H_88	88_C_1	Border	5	21
L_H_88	88_C_1	Border	3	6
L_H_88	88_C_4	Field	1	3

Sample Site ID	Trap ID	Location	Species	Individuals
L_H_88	88_C_4	Border	3	5
L_H_88	88_C_4	Border	2	3
L_H_88	88_C_4	Border	4	19
L_H_88	88_C_7	Border	3	6
L_H_88	88_C_7	Border	3	6
L_H_88	88_C_7	Border	3	3
L_H_88	88_C_7	Field	2	9
L_L_100	100_C_1	Field	12	36
L_L_100	100_C_1	Field	7	121
L_L_100	100_C_1	Border	4	7
L_L_100	100_C_1	Border	5	176
L_L_100	100_C_3	Border	3	16
L_L_100	100_C_3	Border	3	8
L_L_100	100_C_3	Field	1	6
L_L_100	100_C_4	Border	6	12
L_L_100	100_C_4	Border	2	3
L_L_100	100_C_4	Border	7	27
L_L_100	100_C_4	Field	4	8
L_L_101	101_C_1	Border	4	12
L_L_101	101_C_1	Border	4	57
L_L_101	101_C_1	Border	5	11
L_L_101	101_C_1	Field	3	9
L_L_101	101_C_2	Border	2	6
L_L_101	101_C_2	Border	2	17
L_L_101	101_C_2	Border	1	19
L_L_101	101_C_2	Border	2	25
L_L_101	101_C_4	Border	4	23
L_L_101	101_C_4	Field	3	56
L_L_101	101_C_4	Field	3	15
L_L_104	104_C_1	Border	4	7
L_L_104	104_C_1	Border	3	5
L_L_104	104_C_2	Field	1	1
L_L_104	104_C_2	Border	1	2
L_L_104	104_C_4	Border	1	2
L_L_106	106_C_3	Field	4	17
L_L_106	106_C_3	Border	3	4
L_L_106	106_C_3	Field	2	2
L_L_106	106_C_4	Field	1	1
L_L_106	106_C_4	Field	2	3
L_L_106	106_C_4	Border	1	1
L_L_106	106_C_4	Border	1	1
L_L_106	106_C_7	Border	1	1
L_L_106	106_C_7	Border	1	1
L_L_107	107_C_3	Field	3	3
L_L_107	107_C_3	Field	2	5
L_L_107	107_C_4	Border	1	2
L_L_107	107_C_4	Field	3	3
L_L_107	107_C_6	Field	2	14
L_L_107	107_C_6	Field	2	16
L_L_107	107_C_6	Field	2	3
L_L_107	107_C_6	Border	2	2
L_L_108	108_C_3	Border	3	18
L_L_108	108_C_3	Field	3	5
L_L_108	108_C_3	Field	4	10
L_L_108	108_C_3	Field	3	22
L_L_108	108_C_4	Border	2	6
L_L_108	108_C_4	Field	6	9
L_L_108	108_C_4	Field	1	2
L_L_108	108_C_4	Field	2	9
L_L_108	108_C_5	Field	4	79
L_L_108	108_C_5	Field	3	9
L_L_108	108_C_5	Field	2	37
L_L_108	108_C_5	Border	2	14
L_L_109	109_C_4	Border	3	21
L_L_109	109_C_5	Border	7	97
L_L_109	109_C_5	Border	1	8
L_L_109	109_C_5	Field	3	37
L_L_109	109_C_5	Field	2	34
L_L_109	109_C_6	Field	8	26
L_L_109	109_C_6	Field	2	6
L_L_109	109_C_6	Border	5	20
L_L_109	109_C_6	Field	1	1
L_L_110	110_C_2	Border	3	12
L_L_110	110_C_2	Field	5	22

Appendix H continued

Sample Site ID	Trap ID	Location	Species	Individuals
L_L_110	110_C_2	Border	3	9
L_L_110	110_C_2	Border	1	4
L_L_110	110_C_3	Field	3	75
L_L_110	110_C_3	Field	3	9
L_L_110	110_C_3	Border	6	99
L_L_110	110_C_3	Border	3	6
L_L_110	110_C_7	Field	3	5
L_L_110	110_C_7	Field	1	2
L_L_96	96_C_1	Border	4	4
L_L_96	96_C_1	Field	1	2
L_L_96	96_C_1	Field	2	2
L_L_96	96_C_2	Field	6	7
L_L_96	96_C_2	Field	2	2
L_L_96	96_C_6	Field	2	4
L_L_96	96_C_6	Field	4	5
L_L_97	97_C_2	Field	3	8
L_L_97	97_C_2	Field	4	16
L_L_97	97_C_2	Field	5	21
L_L_97	97_C_3	Border	1	1
L_L_97	97_C_3	Border	1	2
L_L_97	97_C_4	Field	1	1
L_L_97	97_C_4	Border	2	4
L_L_97	97_C_4	Border	3	8
L_L_97	97_C_4	Field	2	4
L_L_98	98_C_2	Border	2	3
L_L_98	98_C_2	Border	2	2
L_L_98	98_C_2	Field	1	1
L_L_98	98_C_2	Field	1	1
L_L_98	98_C_5	Border	2	3
L_L_98	98_C_5	Field	2	34
L_L_98	98_C_5	Border	1	1
L_L_98	98_C_5	Field	5	49
L_L_98	98_C_6	Border	2	25
L_L_98	98_C_6	Field	3	7
L_L_98	98_C_6	Border	1	2
L_L_98	98_C_6	Field	2	12
H_H_11	11_C_1	Border	3	11
H_H_11	11_C_1	Border	1	1
H_H_11	11_C_1	Border	4	29
H_H_11	11_C_1	Border	1	7
H_H_11	11_C_2	Field	1	5
H_H_11	11_C_2	Border	2	28
H_H_11	11_C_2	Border	1	1
H_H_11	11_C_2	Field	2	15
H_H_11	11_C_5	Field	4	29
H_H_11	11_C_5	Field	2	56
H_H_11	11_C_5	Field	4	24
H_H_18	18_C_1	Field	2	7
H_H_18	18_C_1	Border	3	4
H_H_18	18_C_1	Field	2	9
H_H_18	18_C_1	Border	5	34
H_H_18	18_C_3	Field	2	15
H_H_18	18_C_3	Field	4	15
H_H_18	18_C_3	Border	1	23
H_H_18	18_C_3	Border	3	9
H_H_18	18_C_4	Field	1	7
H_H_18	18_C_4	Field	4	21
H_H_18	18_C_4	Border	3	12
H_H_18	18_C_4	Field	1	13
H_H_19	19_C_1	Border	4	26
H_H_19	19_C_1	Field	1	4
H_H_19	19_C_1	Border	3	55
H_H_19	19_C_3	Border	1	3
H_H_19	19_C_3	Field	1	2
H_H_19	19_C_5	Field	2	13
H_H_19	19_C_5	Border	2	5
H_H_19	19_C_6	Border	3	18
H_H_19	19_C_6	Border	2	3
H_H_19	19_C_7	Border	1	4
H_H_19	19_C_7	Field	1	10
H_H_2	2_C_2	Border	3	4
H_H_2	2_C_2	Field	4	33
H_H_2	2_C_2	Border	2	4
H_H_2	2_C_2	Field	2	59

Sample Site ID	Trap ID	Location	Species	Individuals
H_H_2	2_C_3	Border	4	6
H_H_2	2_C_3	Border	3	26
H_H_2	2_C_3	Field	3	24
H_H_2	2_C_3	Border	2	23
H_H_2	2_C_6	Border	3	7
H_H_2	2_C_6	Border	1	6
H_H_2	2_C_6	Field	1	3
H_H_2	2_C_6	Field	0	0
H_H_208	208_C_1	Border	2	8
H_H_208	208_C_1	Border	4	84
H_H_208	208_C_1	Border	1	6
H_H_208	208_C_1	Field	3	34
H_H_208	208_C_2	Field	3	7
H_H_208	208_C_2	Border	1	1
H_H_208	208_C_2	Field	3	8
H_H_208	208_C_2	Field	4	91
H_H_208	208_C_3	Field	2	5
H_H_208	208_C_3	Border	1	31
H_H_208	208_C_3	Border	3	6
H_H_22	22_C_2	Field	3	22
H_H_22	22_C_2	Field	3	14
H_H_22	22_C_2	Border	1	14
H_H_22	22_C_2	Border	2	13
H_H_22	22_C_3	Field	4	12
H_H_22	22_C_3	Field	2	13
H_H_22	22_C_3	Field	2	4
H_H_22	22_C_4	Border	7	36
H_H_22	22_C_4	Field	6	81
H_H_22	22_C_4	Border	2	2
H_H_22	22_C_4	Field	3	29
H_H_24	24_C_1	Border	4	14
H_H_24	24_C_1	Border	3	13
H_H_24	24_C_1	Border	2	29
H_H_24	24_C_3	Border	2	15
H_H_24	24_C_3	Border	1	7
H_H_24	24_C_3	Border	2	8
H_H_24	24_C_3	Border	2	5
H_H_24	24_C_4	Field	7	117
H_H_24	24_C_4	Border	4	134
H_H_24	24_C_4	Field	1	82
H_H_24	24_C_4	Border	5	264
H_H_26	26_C_1	Field	2	4
H_H_26	26_C_2	Field	1	1
H_H_26	26_C_2	Border	1	1
H_H_26	26_C_3	Field	2	3
H_H_26	26_C_4	Field	1	2
H_H_26	26_C_4	Field	2	5
H_H_26	26_C_4	Border	2	3
H_H_26	26_C_4	Field	2	27
H_H_27	27_C_3	Border	4	95
H_H_27	27_C_3	Border	5	44
H_H_27	27_C_3	Field	3	532
H_H_27	27_C_3	Border	6	53
H_H_27	27_C_5	Border	3	12
H_H_27	27_C_5	Field	5	77
H_H_27	27_C_5	Field	2	9
H_H_27	27_C_5	Field	2	9
H_H_27	27_C_6	Border	2	19
H_H_27	27_C_6	Border	3	7
H_H_27	27_C_6	Field	2	38
H_H_27	27_C_6	Field	2	8
H_H_29	29_C_2	Border	1	2
H_H_29	29_C_2	Border	3	21
H_H_29	29_C_2	Field	1	1
H_H_29	29_C_2	Field	1	4
H_H_29	29_C_3	Border	1	1
H_H_29	29_C_3	Field	4	13
H_H_29	29_C_3	Border	1	1
H_H_29	29_C_3	Border	1	14
H_H_29	29_C_4	Border	3	11
H_H_29	29_C_4	Border	1	5
H_H_29	29_C_4	Field	2	6
H_H_29	29_C_4	Border	2	11
H_H_3	3_C_1	Border	2	11

Appendix H continued

Sample Site ID	Trap ID	Location	Species	Individuals
H_H_3	3_C_1	Field	2	2
H_H_3	3_C_1	Border	6	23
H_H_3	3_C_1	Border	2	8
H_H_3	3_C_2	Field	2	23
H_H_3	3_C_2	Border	8	101
H_H_3	3_C_2	Border	3	52
H_H_3	3_C_3	Border	4	36
H_H_3	3_C_3	Field	3	7
H_H_3	3_C_3	Field	2	9
H_H_3	3_C_3	Border	1	16
H_H_5	5_C_2	Field	4	22
H_H_5	5_C_2	Field	5	23
H_H_5	5_C_2	Field	2	46
H_H_5	5_C_2	Border	2	24
H_H_5	5_C_4	Field	6	16
H_H_5	5_C_4	Border	4	11
H_H_5	5_C_4	Border	1	4
H_H_5	5_C_4	Field	2	20
H_H_5	5_C_5	Field	6	245
H_H_5	5_C_5	Field	2	5
H_H_5	5_C_5	Field	2	69
H_H_5	5_C_5	Border	1	47
H_H_6	6_C_1	Border	1	9
H_H_6	6_C_1	Field	4	9
H_H_6	6_C_1	Field	1	1
H_H_6	6_C_1	Field	3	36
H_H_6	6_C_2	Border	3	3
H_H_6	6_C_2	Border	3	35
H_H_6	6_C_2	Border	1	5
H_H_6	6_C_2	Border	1	31
H_H_6	6_C_6	Field	3	4
H_H_6	6_C_6	Border	3	7
H_H_6	6_C_6	Border	4	21
H_H_7	7_C_1	Border	3	84
H_H_7	7_C_1	Field	2	13
H_H_7	7_C_1	Border	1	26
H_H_7	7_C_1	Border	2	65
H_H_7	7_C_3	Border	2	35
H_H_7	7_C_3	Border	1	2
H_H_7	7_C_3	Border	2	8
H_H_7	7_C_3	Border	3	8
H_H_7	7_C_4	Field	3	249
H_H_7	7_C_4	Field	5	184
H_H_7	7_C_4	Field	1	114
H_H_7	7_C_4	Border	2	70
H_H_8	8_C_1	Border	2	6
H_H_8	8_C_1	Field	1	1
H_H_8	8_C_2	Field	2	2
H_H_8	8_C_2	Border	4	24
H_H_8	8_C_2	Field	1	4
H_H_8	8_C_2	Border	3	5
H_H_8	8_C_4	Border	1	1
H_H_8	8_C_4	Border	4	24
H_H_8	8_C_4	Field	6	10
H_H_9	9_C_1	Border	3	17
H_H_9	9_C_1	Border	4	14
H_H_9	9_C_1	Border	4	19
H_H_9	9_C_1	Border	3	20
H_H_9	9_C_4	Border	4	15
H_H_9	9_C_4	Field	3	20
H_H_9	9_C_4	Border	2	8
H_H_9	9_C_4	Border	4	36
H_H_9	9_C_5	Field	1	1
H_H_9	9_C_5	Border	2	11
H_H_9	9_C_5	Field	4	75
H_H_9	9_C_5	Field	4	32
H_L_207	207_C_1	Border	2	2
H_L_207	207_C_1	Border	5	121
H_L_207	207_C_1	Field	1	1
H_L_207	207_C_1	Field	2	4
H_L_207	207_C_2	Field	3	4
H_L_207	207_C_2	Field	4	51
H_L_207	207_C_2	Field	1	1
H_L_207	207_C_2	Border	3	5

Sample Site ID	Trap ID	Location	Species	Individuals
H_L_207	207_C_4	Field	7	14
H_L_207	207_C_4	Border	1	3
H_L_207	207_C_4	Border	1	3
H_L_207	207_C_4	Field	1	10
H_L_214	214_C_1	Field	3	9
H_L_214	214_C_1	Border	5	8
H_L_214	214_C_1	Border	4	16
H_L_214	214_C_1	Border	1	2
H_L_214	214_C_2	Field	2	2
H_L_214	214_C_2	Field	5	12
H_L_214	214_C_2	Field	3	9
H_L_214	214_C_3	Field	2	2
H_L_214	214_C_3	Field	3	16
H_L_214	214_C_3	Border	3	14
H_L_214	214_C_3	Border	2	35
H_L_215	215_C_1	Field	3	4
H_L_215	215_C_1	Field	5	60
H_L_215	215_C_1	Border	1	2
H_L_215	215_C_1	Field	1	8
H_L_215	215_C_3	Field	3	4
H_L_215	215_C_3	Border	2	12
H_L_215	215_C_3	Field	3	5
H_L_215	215_C_3	Field	2	4
H_L_215	215_C_4	Border	3	4
H_L_215	215_C_4	Border	3	7
H_L_215	215_C_4	Border	2	3
H_L_31	31_C_2	Border	5	34
H_L_31	31_C_2	Border	1	2
H_L_31	31_C_2	Field	3	13
H_L_31	31_C_2	Border	2	8
H_L_31	31_C_4	Field	2	6
H_L_31	31_C_4	Field	3	9
H_L_31	31_C_4	Field	2	9
H_L_31	31_C_4	Border	3	10
H_L_31	31_C_5	Field	1	1
H_L_31	31_C_5	Field	2	95
H_L_31	31_C_5	Field	3	3
H_L_31	31_C_5	Border	6	81
H_L_35	35_C_1	Field	6	51
H_L_35	35_C_1	Border	5	17
H_L_35	35_C_1	Border	2	2
H_L_35	35_C_3	Border	5	38
H_L_35	35_C_3	Border	4	36
H_L_35	35_C_3	Border	2	27
H_L_35	35_C_3	Field	4	18
H_L_35	35_C_4	Field	2	9
H_L_35	35_C_4	Field	5	33
H_L_35	35_C_4	Border	1	6
H_L_35	35_C_4	Border	2	20
H_L_36	36_C_1	Field	3	7
H_L_36	36_C_1	Border	4	7
H_L_36	36_C_1	Border	3	9
H_L_36	36_C_3	Field	11	27
H_L_36	36_C_3	Field	5	60
H_L_36	36_C_3	Border	3	6
H_L_36	36_C_3	Field	3	31
H_L_36	36_C_4	Border	9	15
H_L_36	36_C_4	Field	8	99
H_L_36	36_C_4	Border	2	2
H_L_36	36_C_4	Border	6	127
H_L_39	39_C_1	Field	10	31
H_L_39	39_C_1	Field	5	19
H_L_39	39_C_1	Field	3	11
H_L_39	39_C_2	Field	2	9
H_L_39	39_C_2	Field	2	6
H_L_39	39_C_2	Field	3	10
H_L_39	39_C_2	Border	2	4
H_L_39	39_C_6	Border	5	25
H_L_39	39_C_6	Field	1	6
H_L_39	39_C_6	Border	3	6
H_L_39	39_C_6	Border	4	23
H_L_40	40_C_1	Border	6	7
H_L_40	40_C_1	Field	4	10
H_L_40	40_C_1	Field	1	1

Appendix H continued

Sample Site ID	Trap ID	Location	Species	Individuals
H_L_40	40_C_1	Field	3	13
H_L_40	40_C_5	Field	6	7
H_L_40	40_C_5	Border	4	9
H_L_40	40_C_5	Border	4	13
H_L_40	40_C_6	Border	1	1
H_L_40	40_C_6	Field	3	20
H_L_40	40_C_6	Border	4	11
H_L_59	59_C_1	Border	3	6
H_L_59	59_C_1	Border	3	3
H_L_59	59_C_1	Field	1	5
H_L_59	59_C_2	Border	2	3
H_L_59	59_C_2	Field	4	13
H_L_59	59_C_2	Field	3	3
H_L_59	59_C_2	Field	2	5
H_L_59	59_C_4	Border	2	25
H_L_59	59_C_4	Border	4	10
H_L_59	59_C_4	Border	2	14
L_H_216	216_C_1	Field	2	177
L_H_216	216_C_1	Field	1	148
L_H_216	216_C_1	Field	3	132
L_H_216	216_C_1	Border	3	225
L_H_216	216_C_2	Field	1	6
L_H_216	216_C_2	Border	3	32
L_H_216	216_C_2	Border	1	25
L_H_216	216_C_2	Border	1	43
L_H_216	216_C_4	Field	3	13
L_H_216	216_C_4	Field	1	10
L_H_216	216_C_4	Border	2	20
L_H_216	216_C_4	Border	2	9
L_H_72	72_C_5	Border	3	46
L_H_72	72_C_5	Field	3	21
L_H_72	72_C_5	Field	1	15
L_H_72	72_C_5	Field	2	120
L_H_72	72_C_7	Field	6	53
L_H_72	72_C_7	Field	5	183
L_H_72	72_C_7	Border	2	60
L_H_72	72_C_7	Field	1	62
L_H_72	72_C_8	Border	8	242
L_H_72	72_C_8	Border	4	241
L_H_73	73_C_1	Field	2	3
L_H_73	73_C_1	Border	1	15
L_H_73	73_C_1	Field	2	4
L_H_73	73_C_2	Field	4	13
L_H_73	73_C_2	Field	3	21
L_H_73	73_C_2	Field	3	3
L_H_73	73_C_2	Border	3	13
L_H_73	73_C_3	Border	4	59
L_H_73	73_C_3	Field	1	4
L_H_73	73_C_3	Field	1	66
L_H_73	73_C_3	Border	2	43
L_H_74	74_C_1	Border	2	9
L_H_74	74_C_1	Field	2	38
L_H_74	74_C_1	Field	1	34
L_H_74	74_C_1	Border	1	86
L_H_74	74_C_2	Border	1	14
L_H_74	74_C_2	Border	3	47
L_H_74	74_C_2	Field	1	15
L_H_74	74_C_2	Field	2	5
L_H_74	74_C_4	Border	1	3
L_H_74	74_C_4	Field	1	5
L_H_74	74_C_4	Border	1	2
L_H_74	74_C_4	Border	1	15
L_H_80	80_C_2	Field	2	65
L_H_80	80_C_2	Border	1	7
L_H_80	80_C_2	Field	1	5
L_H_80	80_C_2	Border	1	1
L_H_80	80_C_4	Field	3	10
L_H_80	80_C_4	Field	4	21
L_H_80	80_C_4	Border	2	3
L_H_80	80_C_4	Border	2	11
L_H_80	80_C_5	Border	4	19
L_H_80	80_C_5	Border	3	49
L_H_80	80_C_5	Field	3	20
L_H_80	80_C_5	Field	3	10

Sample Site ID	Trap ID	Location	Species	Individuals
L_H_82	82_C_2	Border	3	9
L_H_82	82_C_2	Border	2	6
L_H_82	82_C_2	Field	3	5
L_H_82	82_C_2	Border	4	7
L_H_82	82_C_3	Field	3	87
L_H_82	82_C_3	Border	2	37
L_H_82	82_C_3	Field	4	7
L_H_82	82_C_3	Border	2	24
L_H_82	82_C_4	Field	4	57
L_H_82	82_C_4	Border	3	68
L_H_82	82_C_4	Border	1	1
L_H_82	82_C_4	Field	3	42
L_H_87	87_C_1	Field	5	6
L_H_87	87_C_1	Border	4	35
L_H_87	87_C_1	Border	4	39
L_H_87	87_C_1	Field	3	23
L_H_87	87_C_2	Field	5	8
L_H_87	87_C_2	Border	3	45
L_H_87	87_C_2	Field	2	22
L_H_87	87_C_3	Border	2	2
L_H_87	87_C_3	Border	2	5
L_H_87	87_C_3	Border	2	17
L_L_102	102_C_2	Border	1	2
L_L_102	102_C_2	Field	4	54
L_L_102	102_C_2	Field	1	1
L_L_102	102_C_2	Border	4	247
L_L_102	102_C_3	Field	6	14
L_L_102	102_C_3	Field	4	70
L_L_102	102_C_3	Border	2	3
L_L_102	102_C_3	Border	2	75
L_L_102	102_C_4	Field	1	1
L_L_102	102_C_4	Field	2	61
L_L_102	102_C_4	Field	4	4
L_L_102	102_C_4	Border	4	36
L_L_105	105_C_1	Field	7	23
L_L_105	105_C_1	Field	1	1
L_L_105	105_C_1	Border	3	15
L_L_105	105_C_2	Field	7	15
L_L_105	105_C_2	Border	1	9
L_L_105	105_C_2	Border	1	2
L_L_105	105_C_4	Field	3	11
L_L_105	105_C_4	Field	4	17
L_L_105	105_C_4	Border	4	39
L_L_105	105_C_4	Field	3	22
L_L_105	105_C_4	Field	4	21
L_L_118	118_C_1	Field	2	17
L_L_118	118_C_1	Border	4	34
L_L_118	118_C_1	Border	1	1
L_L_118	118_C_1	Field	2	15
L_L_118	118_C_2	Border	4	36
L_L_118	118_C_2	Border	5	63
L_L_118	118_C_2	Border	4	16
L_L_118	118_C_5	Border	8	51
L_L_118	118_C_5	Border	4	47
L_L_118	118_C_5	Border	2	40
L_L_118	118_C_5	Border	2	24
L_L_20	20_C_1	Field	3	66
L_L_20	20_C_1	Border	2	12
L_L_20	20_C_1	Border	2	30
L_L_20	20_C_2	Border	2	39
L_L_20	20_C_2	Field	3	5
L_L_20	20_C_2	Border	4	54
L_L_20	20_C_2	Field	2	4
L_L_20	20_C_3	Field	1	1
L_L_20	20_C_3	Field	3	14
L_L_20	20_C_3	Border	2	31
L_L_202	202_C_1	Field	4	6
L_L_202	202_C_1	Border	2	3
L_L_202	202_C_1	Field	1	2
L_L_202	202_C_2	Border	1	1
L_L_202	202_C_2	Field	1	1
L_L_202	202_C_2	Field	1	1
L_L_202	202_C_2	Field	1	1
L_L_202	202_C_3	Field	4	5

Appendix H continued

Sample Site ID	Trap ID	Location	Species	Individuals
L L 202	202 C 3	Border	2	3
L L 202	202 C 3	Border	7	27
L L 202	202 C 3	Field	0	0
L L 203	203 C 1	Border	3	5
L L 203	203 C 1	Border	6	81
L L 203	203 C 1	Field	3	27
L L 203	203 C 1	Field	6	25
L L 203	203 C 2	Field	3	13
L L 203	203 C 2	Border	5	48
L L 203	203 C 2	Border	7	9
L L 203	203 C 2	Field	3	20
L L 203	203 C 4	Border	1	3
L L 203	203 C 4	Border	8	17
L L 203	203 C 4	Border	4	5
L L 204	204 C 2	Field	4	31
L L 204	204 C 2	Field	4	27
L L 204	204 C 2	Border	1	3
L L 204	204 C 2	Field	2	12
L L 204	204 C 3	Field	2	36
L L 204	204 C 3	Border	3	34
L L 204	204 C 3	Field	1	280
L L 204	204 C 3	Border	2	40
L L 204	204 C 4	Border	5	16
L L 204	204 C 4	Field	3	9
L L 204	204 C 4	Border	1	3
L L 204	204 C 4	Field	2	6
L L 211	211 C 3	Field	1	7
L L 211	211 C 3	Border	2	2
L L 211	211 C 4	Field	1	3
L L 211	211 C 4	Field	4	5
L L 211	211 C 6	Border	3	4
L L 211	211 C 6	Field	6	15
L L 211	211 C 6	Field	5	9
L L 217	217 C 1	Border	3	7
L L 217	217 C 1	Border	1	3
L L 217	217 C 1	Border	3	4
L L 217	217 C 1	Border	1	7
L L 217	217 C 2	Field	2	4
L L 217	217 C 2	Border	1	1
L L 217	217 C 2	Field	1	10
L L 217	217 C 3	Border	1	5
L L 217	217 C 3	Border	1	1
L L 217	217 C 3	Field	2	12
L L 75	75 C 2	Border	2	3
L L 75	75 C 2	Border	1	1
L L 75	75 C 3	Border	6	7
L L 75	75 C 3	Field	4	5
L L 75	75 C 3	Border	1	1
L L 75	75 C 4	Border	3	32
L L 75	75 C 4	Field	1	2
L L 75	75 C 4	Border	5	34
L L 75	75 C 4	Field	1	27
L L 79	79 C 1	Border	3	6
L L 79	79 C 1	Field	4	166
L L 79	79 C 1	Field	2	3
L L 79	79 C 2	Border	1	1
L L 79	79 C 2	Border	3	35
L L 79	79 C 2	Field	3	4
L L 79	79 C 2	Border	3	7
L L 79	79 C 4	Field	2	9
L L 79	79 C 4	Field	4	54
L L 79	79 C 4	Border	2	5
L L 79	79 C 4	Border	2	59
L L 91	91 C 1	Border	2	7
L L 91	91 C 1	Border	2	40
L L 91	91 C 1	Border	1	2
L L 91	91 C 1	Field	1	6
L L 91	91 C 5	Field	1	7
L L 91	91 C 5	Border	2	47
L L 91	91 C 5	Border	1	2
L L 91	91 C 5	Border	1	2
L L 92	92 C 1	Border	3	10
L L 92	92 C 1	Field	2	3
L L 92	92 C 1	Border	1	3

Sample Site ID	Trap ID	Location	Species	Individuals
L L 92	92 C 1	Border	3	17
L L 92	92 C 2	Border	3	12
L L 92	92 C 2	Field	1	1
L L 92	92 C 2	Border	3	37
L L 92	92 C 2	Border	3	8
L L 92	92 C 4	Border	3	4
L L 92	92 C 4	Field	4	24
L L 92	92 C 4	Field	2	2
L L 92	92 C 4	Field	4	16
L L 93	93 C 2	Border	1	3
L L 93	93 C 2	Border	6	20
L L 93	93 C 2	Field	1	3
L L 93	93 C 3	Border	3	3
L L 93	93 C 3	Field	3	18
L L 93	93 C 4	Field	1	8
L L 93	93 C 4	Border	2	5
L L 93	93 C 5	Field	2	3

Appendix I: The variance in habitat amount at each spatial buffer (m) for all species with egg counts. Each species shows a decrease in variation in habitat amount with increasing spatial extents.

Species	Scale of Effect (m)	Mean Egg Count	50m	100m	150m	200m	250m	300m	350m	400m	450m	500m
<i>Amara aenea</i>	950	2.9	0.1016	0.0857	0.0720	0.0626	0.0549	0.0491	0.0445	0.0403	0.0368	0.0344
<i>Anisodactylus sanctaecrucis</i>	1000	1.7	0.0323	0.0277	0.0241	0.0202	0.0168	0.0144	0.0123	0.0106	0.0088	0.0075
<i>Chlaenius pusillus</i>	450	6	0.1303	0.1147	0.1028	0.0900	0.0786	0.0687	0.0599	0.0522	0.0457	0.0402
<i>Chlaenius tricolor</i>	1000	3.65	0.1281	0.1129	0.1015	0.0888	0.0774	0.0677	0.0591	0.0515	0.0451	0.0397
<i>Cicindela punctulata</i>	300	4	0.0465	0.0379	0.0319	0.0273	0.0230	0.0196	0.0167	0.0144	0.0123	0.0106
<i>Cicindela sexguttata</i>	500	1.5	0.0464	0.0391	0.0342	0.0307	0.0273	0.0247	0.0226	0.0207	0.0188	0.0174
<i>Clivina fossor</i>	50	4.33	0.1414	0.1223	0.1051	0.0877	0.0743	0.0644	0.0551	0.0472	0.0404	0.0348
<i>Diplocheila obtusa</i>	50	7.16	0.0445	0.0371	0.0316	0.0273	0.0230	0.0196	0.0168	0.0145	0.0123	0.0105
<i>Harpalus affinis</i>	600	2.08	0.0670	0.0578	0.0458	0.0356	0.0282	0.0227	0.0183	0.0148	0.0120	0.0101
<i>Harpalus pensylvanicus</i>	700	3.4	0.0333	0.0285	0.0249	0.0213	0.0180	0.0154	0.0133	0.0116	0.0099	0.0085
<i>Poecilus lucublandus</i>	650	2.5	0.1151	0.0999	0.0843	0.0722	0.0619	0.0541	0.0474	0.0416	0.0366	0.0330
<i>Pterostichus melanarius</i>	850	2.9	0.1299	0.1177	0.1077	0.0972	0.0875	0.0788	0.0713	0.0651	0.0596	0.0547
<i>Stenolophus comma</i>	1000	2	0.0310	0.0269	0.0229	0.0190	0.0157	0.0135	0.0116	0.0099	0.0083	0.0071

Appendix I continued...

Species	Scale of Effect (m)	Mean Egg Count	550m	600m	650m	700m	750m	800m	850m	900m	950m	1000m
<i>Amara aenea</i>	950	2.9	0.0325	0.0312	0.0301	0.0293	0.0286	0.0281	0.0279	0.0281	0.0283	0.0288
<i>Anisodactylus sanctaecrucis</i>	1000	1.7	0.0064	0.0054	0.0044	0.0036	0.0030	0.0025	0.0020	0.0017	0.0014	0.0012
<i>Chlaenius pusillus</i>	450	6	0.0355	0.0315	0.0280	0.0262	0.0232	0.0194	0.0174	0.0157	0.0144	0.0134
<i>Chlaenius tricolor</i>	1000	3.65	0.0350	0.0312	0.0279	0.0248	0.0221	0.0199	0.0179	0.0163	0.0151	0.0141
<i>Cicindela punctulata</i>	300	4	0.0091	0.0079	0.0069	0.0060	0.0054	0.0048	0.0044	0.0040	0.0037	0.0034
<i>Cicindela sexguttata</i>	500	1.5	0.0163	0.0155	0.0150	0.0146	0.0144	0.0144	0.0144	0.0146	0.0148	0.0152
<i>Clivina fossor</i>	50	4.33	0.0303	0.0266	0.0232	0.0201	0.0176	0.0155	0.0139	0.0127	0.0118	0.0110
<i>Diplocheila obtusa</i>	50	7.16	0.0089	0.0076	0.0065	0.0056	0.0049	0.0043	0.0038	0.0033	0.0029	0.0026
<i>Harpalus affinis</i>	600	2.08	0.0087	0.0076	0.0066	0.0058	0.0052	0.0046	0.0042	0.0038	0.0035	0.0032
<i>Harpalus pensylvanicus</i>	700	3.4	0.0073	0.0063	0.0054	0.0046	0.0040	0.0036	0.0033	0.0030	0.0028	0.0027
<i>Poecilus lucublandus</i>	650	2.5	0.0303	0.0282	0.0265	0.0249	0.0238	0.0228	0.0223	0.0220	0.0220	0.0222
<i>Pterostichus melanarius</i>	850	2.9	0.0504	0.0471	0.0444	0.0418	0.0395	0.0373	0.0353	0.0333	0.0317	0.0303
<i>Stenolophus comma</i>	1000	2	0.0061	0.0052	0.0043	0.0035	0.0030	0.0025	0.0021	0.0018	0.0015	0.0013

Appendix J. Predictor variables plotted against each other with Spearman rho correlations (rho in the graphic) and associated P-values for fully winged carabid beetles with egg counts (n=12).

Appendix K. Weighted simple linear regressions of the scale of effect (i.e., the buffer radius at which habitat amount best predicted species abundance) on (a) body length, (b) relative wing size, and (c) log (mean eggs) for the 12 carabid species with fully developed wings and egg counts. Each simple linear regression is weighted by the inverse of the standard errors of the slope coefficient of the best model from the scale of effect analyses; larger circles correspond to data points with lower standard errors (higher weights; Appendix G).

Appendix L. Model summaries of cross-species relationships between the scale of effect (i.e., the relationship between species abundance and habitat amount) and standardised predictors body length, relative wing size, and log (mean eggs) for species with fully developed wings (RWS > 1) and egg counts (12 species). Each regression is weighted by the inverse of the standard errors of the slope coefficients of the best model (i.e., the model with the largest positive slope coefficient) from single species regressions for the scale of effect (Appendix D). Models are ranked in order of increasing AICc. Sample size = 12 carabid beetle species.

Model	Predictor	β	SE	Model R^2	w_i	$\Delta AICc$	AICc
1	log (mean eggs)	-251.44	119.76	0.305	0.387	0	181.46
2	intercept only	617.42	99.47	0	0.27	0.72	182.18
3	body length	111.54	82.04	0.156	0.12	2.35	183.81
4	body length log (mean eggs)	86.22 -226.46	74.37 119.70	0.396	0.084	3.05	184.51
5	relative wing size	-95.89	124.03	0.056	0.061	3.69	185.15
6	relative wing size log (mean eggs)	-68.27 -241.54	110.76 124.69	0.334	0.047	4.22	185.68
7	body length relative wing size	129.35 -131.65	82.63 118.14	0.258	0.025	5.51	186.97
8	body length relative wing size log (mean eggs)	101.93 -100.35 -207.36	76.93 109.10 122.51	0.453	0.007	8.13	189.59

Appendix M. Model weights (w_i) for individual predictor variables (i.e., body length, RWS, and log (mean eggs)) for carabids with fully developed wings ($RWS > 1$) and egg counts (12 species) from analyses predicting the scale of effect from carabid species traits. Model weights for each predictor variable are summed from the model weights of all models including a given species trait.

Akaike Weights for Predictors			
Model	Body Length	RWS	Log (Mean Eggs)
soe ~ body length	0.012	-	-
soe ~ RWS	-	0.061	-
soe ~ log (mean eggs)	-	-	0.387
soe ~ body length + RWS	0.025	0.025	-
soe ~ body length + log (mean eggs)	0.084	-	0.084
soe ~ RWS + log (mean eggs)	-	0.047	0.047
soe ~ body length + RWS + log (mean eggs)	0.007	0.007	0.007
Sum of Model Weights	0.236	0.140	0.525

Appendix N. Model-averaged slope coefficient estimates for standardised species traits (i.e., body length, relative wing size, and log (mean eggs)) predicting the scale of effect and their respective confidence intervals ($\alpha = 0.05$) for all species with fully developed wings (RWS >1) and egg counts. Slope coefficients were averaged across all candidate models containing each individual predictor variable (4 models for each predictor variable) based on the AICc model weights for each predictor. Sample size = 12 carabid species.

Appendix O: Weighted simple linear regressions of the scale of effect (i.e., the buffer radius at which habitat amount best predicted species abundance) on (a) body length and (b) RWS for 17 carabid species. These regressions include all species with fully developed wings. Each simple linear regression is weighted by the inverse of the standard errors of the slope coefficients of the best model from the scale of effect analyses; larger circles correspond to data points with lower standard errors (Appendix G).

Appendix P: Model summaries of cross-species relationships between the scale of effect (i.e., the relationship between species abundance and habitat amount) and the standardised predictors body length and RWS. These regressions include all species with fully developed wings. Each regression is weighted by the inverse of the standard errors of the slope coefficients of the best model (i.e., the model with the largest positive slope coefficient) from single species regressions for the scale of effect (Appendix D). Models are ranked in order of increasing AICc. Sample size = 17 carabid beetle species.

Model	Predictor	β	SE	Model R^2	w_i	$\Delta AICc$	AICc
1	intercept only	631.74	80.06	0	0.408	0	256.64
2	body length	101.00	65.30	0.137	0.322	0.47	257.11
3	body length RWS	118.43 -111.05	65.63 89.09	0.223	0.138	2.17	258.81
4	RWS	-76.82	93.36	0.043	0.133	2.24	258.88

Appendix Q: Model weights (w_i) for individual predictor variables (i.e., body length and RWS) from analyses predicting the scale of effect from carabid species traits for all species with fully developed wings. Model weights for each predictor variable are summed from the model weights of all models including a given species trait. Sample size = 17 carabid beetle species.

Model	Akaike Weights for Predictors	
	Body Length	RWS
soe ~ body length	0.322	-
soe ~ RWS	-	0.133
soe ~ body length + RWS	0.138	0.138
Sum of Model Weights	0.460	0.271

Appendix R: Model-averaged slope coefficient estimates for standardised species traits (i.e., body length and relative wing size) predicting the scale of effect and their respective confidence intervals ($\alpha = 0.05$). Slope coefficients were averaged across all candidate models containing each individual predictor variable (2 models for each predictor variable) based on the AICc model weights for each predictor. Sample size = 17 carabid species.