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1 Effects of hedgerows on bats and bush crickets at different spatial scales

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- 9 10
- 11 Abstract

12 Biodiversity is threatened by the loss and fragmentation of habitats. The role of hedgerows in maintaining biodiversity is well established, but few studies have addressed the importance 13 14 for biodiversity of the intrinsic characteristics of hedgerows and the quality of hedgerow networks along a spatial scale. We examined three quality indices providing information at 15 16 different territorial levels: density in the landscape, structural diversity and wood production. 17 We performed an acoustic survey in a grassland to estimate the species abundance and 18 community composition of bats (9 taxa) and bush crickets (11 species). Using an approach 19 based on species and traits, we assessed how hedgerow quality influenced the activity of these 20 taxa at different spatial scales (from 50 to 1000 meters) and focused on three types of traits: 21 bush cricket mobility ability, bat foraging strategy and habitat specialization. In general, our 22 results showed the importance of hedgerow quality for bats and bush crickets, but the strength 23 of the association between taxa and hedgerows varied substantially among the species and the 24 spatial scales. Although it depends on the taxa, the production, density and structural diversity of hedgerows each had an overall positive effect. Our results suggested that these effects were 25 26 generally more important at large scales. The scale effect of the production index is the best 27 predictor of activity for bat and bush cricket taxa and traits. Our results showed the 28 importance of hedgerow quality for the ecology of bat and bush cricket communities and 29 could be used to improve conservation management.

- 30
- 31 Keywords: hedgerows, scale effect, Chiroptera, Orthoptera, acoustic monitoring, conservation
 - 1

32 Introduction

33 Over the last century, agricultural intensification, particularly the increase in agricultural 34 parcel sizes, has had severe consequences for biodiversity (Robinson and Sutherland 2002). 35 At the landscape scale, one consequence of such intensification is the widespread removal of 36 linear landscape elements in Europe (Robinson 1997; Sklenicka et al. 2009) and also of large patches of semi-natural habitats, such as forests and grasslands, even though the ecological 37 38 importance of hedgerows and linear landscape elements has been known for decades (i.e., 39 Burel 1992; Beier and Noss 1998; Bennett 2003). Hedgerows play a role in the control of 40 water flow, water level and water quality (Mérot 1999; Baudry et al. 2000). They provide 41 breeding habitat, food resources and dispersal pathways for many species of birds (Hinsley 42 and Bellamy 2000), amphibians (Scribner et al. 2001; Rosenberg et al. 1998; Brown et al. 43 2006), mammals (Henderson et al. 1985; Pardini et al. 2005) and invertebrates (Burel 1992; 44 Hannon 2009).

45 However, to our knowledge, the effects of the quality of linear elements, such as hedgerows (e.g., their diversity of structure and wood production), at different scales, on biodiversity 46 47 have been poorly considered in previous studies, except in Pywell et al. (2004) and Dainese et 48 al. (2015). Nevertheless, these effects are of interest because many agri-environmental 49 schemes provide financial support for environmentally sensitive hedgerow management. The 50 effectiveness of such initiatives in terms of both financial costs and biodiversity gains can be 51 improved through a better understanding of the benefits provided by different types of 52 hedgerows in different landscape contexts (Boughey et al. 2011).

In this paper, we present a study of bats and bush crickets, both of which are known to take advantage of the presence of hedgerows, and which have been detected and identified based on their calls, recorded by detectors. Bats (Chiroptera) and bush crickets (Orthoptera) represent complementary ecological indicators of biodiversity quality. Bazelet and Samways (2011) identified bush crickets as good bioindicators for the assessment of the habitat quality 2

58 of ecological networks because they respond strongly to management practices, such as 59 grazing intensity (Jauregui et al. 2008) and mowing regime (Gardiner and Hassall 2009). 60 Bush crickets belong to an invertebrate group that is abundant in grasslands, have a short life 61 cycle and are at a low level in the food chain (mainly herbivore species and some omnivores) 62 compared to bats. Although the importance of linear landscape elements is poorly understood 63 for bush crickets, they have nevertheless been described to be useful for their dispersal behavior (Berggren et al. 2002) and colonization success (Berggren et al. 2001). Thus, we 64 hypothesized that bush crickets could be sensitive to hedgerows at small spatial scales in 65 66 accordance with Reinhardt et al. (2005). Bat species have a long life cycle relative to bush crickets. In the study areas, bats are all nocturnal insectivores at the top of the food chain 67 68 (Dietz et al. 2009). They are considered to be bioindicators (Jones et al. 2009) because they 69 react to several stressors, including the loss of landscape elements, which impacts their 70 abundance, distribution and activity (e.g., Boughey et al. 2011). Moreover, all bat species are 71 protected in Europe (IUCN 2011). The primary predictor of bat abundance is the quality of 72 the habitat, which is positively related to the availability of vegetation corridors (Walsh and 73 Harris 1996; Hein et al. 2009) and to the density of linear elements (Verboom and Huitema 1997). Based on the size of the foraging home range of the bat (see Davidson-Watts and Jones 74 75 2005, Perez-Jorda and Ibañez 1991), we hypothesized that bats could be sensitive to hedgerows at large spatial scales, in accordance with Bellamy et al. (2013) and Frey-76 77 Ehrenbold et al. (2013).

Many studies have been performed on the effects of the density and connectivity of linear landscape elements on the movement and dispersal of species (Erickson et al. 2013; Berggren et al. 2001; Berggren et al. 2002; Diekötter et al. 2007; Boughey et al. 2011). However, little is known about how the quality of linear elements affects their use by bats because the only studies that show such effects are (Boughey et al. 2011) and (Verboom and Huitema 1997), and even less is known about bush crickets; thus, we need to better understand the relationship between biodiversity and the quality of linear landscape elements (Hein et al.2009).

To study linear element quality, we examined three hedgerow characteristics: (1) density 86 87 within the landscape (density) (2) potential wood production (production) and (3) structural 88 diversity (diversity). Indeed, each of these three indices provides information at different land 89 levels and involves different stakeholders. Density reflects the history of successive 90 agricultural policies (changing the division of lands) at the landscape scale, whereas 91 production and structural diversity are more linked to local farming practices. Thus, these 92 three indices provided information on the management of the land at different scales, which is 93 important because spatial processes are known to influence the structure and dynamics of 94 animal populations and communities (Cottenie 2005).

In this study, we used two approaches: 1) a species approach in which we tested the effects of the linear element quality on the activity of the species and 2) a trait based approach in which we tested the same effects on several traits (e.g., habitat specialization, bat foraging strategy and bush cricket mobility ability). The trait approach can provide information on the mechanisms involved in the use of different types of hedgerows by bat and bush cricket communities. Such information is essential for developing effective conservation plans and can be used to improve forest and agriculture management strategies.

102 1 Materials and methods

103 *1.1 Study area*

The study was conducted in western France, in the Loire delta, between the cities Nantes and Saint-Nazaire, in a European network of the protected area "Natura 2000" (Figure 1). The site is mainly composed of extensively managed grassland grazed by cattle and surrounded by a dense network of hedgerows. The grassland was identified as having a high nature conservation value by Veen et al. (2009).

110 We employed a random stratified design in which 51 point counts were sampled in the 111 grassland, the dominant habitat in the studied site. The point counts were positioned according 112 to two criteria: 1) more than 50% of grassland in the 500 m buffer and 2) at three classes of distance from the hedgerow: 23 point counts at 0 meters (i.e., in the hedgerow), 17 at 25 and 113 114 11 at 50 meters from the hedgerow. These two criteria, "proportion of grassland in the buffer" and "distance to the hedgerow", were not correlated (rho = 0.09, p value = 0.378) and were 115 116 therefore included as covariables. To measure the effects of the characteristics of the linear 117 landscape elements at different scales, we used ArcGIS 9.3 and a local landuse database 118 (Geffray 2010). Previous studies linked environmental variables at a few spatial scales with 119 the abundance of bush crickets (Batáry et al. 2007; Braschler et al. 2009; Diekötter et al. 120 2007, Penone et al. 2013b) and bats (Bellamy et al. 2013; Lookingbill et al. 2010; Dixon 121 2012; Hale et al. 2012), and we defined 11 circular buffers (radii of 50 m and every 100 m 122 until 1000 m) around each point count that defined our sampling plots (a correspondence 123 scale of areas depending on the buffer size used in this study and areas obtained with a 124 doubling of surfaces is provided in Appendix C). Within these circular buffers, we extracted landscape characteristics: the proportion of semi-natural habitat area (grasslands) in each plot 125 126 (for 500 m buffers around the 51 point counts, mean = $73.6\% \pm 1.6\%$ SE) and the 3 indices of 127 the quality of linear landscape elements in each plot: 1) the density, i.e., length per unit of 128 studied area, 2) the structural diversity and 3) the wood production.

129

1.3 Linear landscape element and hedgerow indices

We calculated the three indices for each study plot. To describe the density of linear elements, we calculated the sum of their lengths in meters within the buffer zones. To describe the structural diversity, we used Shannon's diversity index (Shannon and Weaver 1949) and a database (Geffray 2010) that described the linear landscape elements in six categories: (1)

134 alignment of trees, (2) riparian vegetation, (3) shrub hedgerows with only shrubs, (4) wooded hedgerows without the presence of shrubs, (5) three-strata hedgerows (tree, shrub and herb). 135 136 The production index is a measure of the wood volume contained by the linear element (in 137 m³). Hereafter in this study, linear landscape elements will be termed hedgerows in 138 accordance with Baudry and Jouin (2003), who defined a hedgerow as a line of trees and / or 139 shrubs. The production index is calculated from the length of the hedgerow and a coefficient of density for the woody elements given by the database (Geffray 2010) (see Appendix A). 140 141 The diversity is not correlated with the production (for 500 m buffer: rho = 0.124, p value = 142 0.215) or the density (for 500 m buffer: rho = 0.117, p value = 0.241), whereas there is a 143 correlation between density and production (for 500 m buffer: rho = 0.961, p value <0.001), which makes sense because the more trees present in an area, the greater the timber 144 145 production. The high value of the last correlation implies the necessity of performing separate 146 analyses of hedgerow indices.

147 *1.4 Bat sampling*

148 Bat activity was assessed by recording bat calls using a Tranquility Transect Bat detector 149 (Courtpan Design Ltd., Cheltenham, UK) with direct and continuous recording on a Zoom H2 150 digital recorder (Zoom Corporation, Tokyo, Japan) at a sampling rate of 96 ks/s in .wav format. From the two possible outputs of the detector, time expansion and high frequency, we 151 152 only used the second output, which did not include a trigger on sound volume. We placed one 153 detector at each station at a height of 1.50 meters above the ground and facing away from the 154 hedgerow. Each station was monitored twice in 2011. The first monitoring session was from June 15th to July 31st, during which female bats are known to give birth and to feed their 155 offspring. The second monitoring session was performed from August 15th to September 30th. 156 157 during which the young are flying and individuals are suspected to be less dependent on their reproductive roost. For each station, we recorded two 30-minute sound samples (one per 158

159 session). This sampling occurred during the bat activity peak, which begins 30 minutes after sunset and spans 4 hours (Roche et al. 2005). Correlation between sampling point 160 161 characteristics (density/diversity/ production) and covariables are presented in Appendix D. 162 The sampling was only performed when weather conditions were favorable, i.e., no rain, low wind speed and temperature higher than 12°C. Hourly cloud cover, temperature and wind 163 164 speed data were retrieved from a local weather station (Météo France 2012). We studied bat calls within bat passes (Thomas and West 1989). Species calls were identified at the species 165 level by the authors using Scan'R (Binary Acoustic Technology, 2010) to isolate each bat 166 vocalization and automate the measurement of relevant parameters and Syrinx software 167 168 version 2.6 (Burt 2006) for spectrogram analyses (for more details see Appendix E and Lacoeuilhe et al. 2014); exceptions included vocalizations of Plecotus austriacus and 169 170 *Plecotus auritus*, which were pooled as *Plecotus* spp., and those of *Myotis myotis*, *Myotis* 171 daubentonii, Myotis mystacinus, Myotis nattereri and Myotis bechsteinii, which were pooled 172 as *Myotis* spp., due to their very low occurrence and some uncertainties in identification. We used the number of calls per 30 minutes as a proxy for the measure of bat activity. We 173 174 distinguished two guilds according to their foraging traits: "gleaning bats" which include 175 Myotis and Plecotus species that mainly eat diurnal brachyceran Diptera and non-volant 176 arthropods, such as weevils, lepidopteran larvae, harvestmen and spiders (Audet 1990; Swift & Racey 2002, Dietz et al. 2009), and "aerial hawking bats" which include Pipistrellus 177 species, *Eptesicus serotinus* and *Nyctalus* species that mainly search the sky for prey 178 (Schnitzler et al. 2003 Holderied, & von Helversen, 2003) (Appendix B1). 179

180 *1.5* Bush cricket sampling

Because bush crickets produce mating calls (Ragge & Reynolds 1998), it is possible to collect large standardized data sets using recording devices (Penone et al. 2013a). Bush cricket calling songs have a role in pre-mating isolation, and their structure is an important

184 component of their mate recognition system (Paterson 1985). Therefore, the analysis of calling songs may allow identification to the species level (Ragge & Reynolds 1998) and even 185 provide reliable information on species abundances (Fischer et al. 1997). Nevertheless, it does 186 187 not give an exact estimation of species abundances mainly because only adult males 188 stridulate. However, this method can provide relative measures of abundance (rather than 189 absolute abundance), which is adequate for detecting spatial changes in species abundances 190 and for detecting anthropogenic pressures on bush cricket communities (Penone et al. 2013b). 191 For species with uninterrupted calls such as Tettigonia viridissima, Ruspolia nitidula, 192 Metrioptera roeselii and Phaneroptera falcata, it was not possible to determine a value of 193 abundance because their syllables are emitted at a continuous and quick rate (10-100 per 194 second), which does not allow the easy distinguishing of several individuals singing 195 simultaneously. Thus, we only noted their presence/absence, while for other species, with 196 interrupted calls, we counted the number of calls of each species in each sample point as a 197 proxy for relative measures of their activities.

198 We detected 11 species from the Tettigoniidae community and distinguished two mobility 199 traits according to Reinhardt et al. (2005) and Marini et al. (2010): mobile (mostly with 200 wings) and sedentary (Appendix B2).

201 *1.6 Mean trait community index*

202 1.6.1 Habitat specialization index

Each species was characterized for habitat specialization through the calculation of a Species Specialization Index (SSI) following the Julliard approach (Julliard et al. 2006). To define habitat specialization for bush crickets, we used the SSI indices assessed by Penone et al. (2013a). For bat SSI calculation, we used an independent data set provided by the national biodiversity monitoring scheme coordinated by the French National Museum of Natural History (http://vigienature.mnhn.fr/; for more details on the data set used, see Appendix F).

The SSI was calculated for each species using the coefficient of variation of the species' abundance across habitats (Appendix B1, B2 and F). We calculated the Community Specialization Index (CSI) as the arithmetic mean of the SSI of the detected species weighted by the abundances (Julliard et al. 2006) (see Appendix F). Because of the lack of SSI for some species, CSI values were calculated on 85% of the total of bush cricket calls, whereas for the bats, all calls contribute to the assessment of CSI.

215 1.6.2 Mobility trait

For dispersal ability of bush crickets, according to Reinhardt et al. (2005) and Marini et al. (2010) we conducted analyses by summing, on the one hand, the abundances of mobile species, and on the other hand, the abundances of sedentary species. Two species (*P. albopunctata* and *M. roeselii*) had intermediate dispersal ability; thus, they were removed from the analyses on this trait, but they represented only 14.4% of the total calls.

221 1.6.3 Foraging strategy trait

Based on Dietz et al. (2009), we conducted analyses by summing, on the one hand, the abundances of aerial hawking species, and on the other hand, the abundances of gleaner species. As *B.barbastellus* (only 0.9% of total calls) had a mixed foraging type, this species was removed from the analyses of this trait.

For the bat community approach (foraging strategy trait and CSI), we corrected the bat activity by their distance of detection (see coefficients of detection in Barataud 2012) before calculating the community indices.

229 1.7 Statistical analysis

230 1.7.1 The influence of hedgerow characteristics on bat and bush cricket species.

We assessed the influence of the three indices of hedgerows (density, diversity and production) on bat and bush cricket species using a generalized linear model (GLM).

The response variables were (i) abundance of bush crickets' stridulations (n = 11 species) or bat foraging calls (n = 9 taxa) and (ii) community traits (for bush crickets: species dispersal abilities and CSI and for bats: foraging type and CSI) per site (n = 51).

In our model, the explanatory variables were density, structural diversity and potential of
wood production. Using some of the some correlations (between production and density, see
2.3), we constructed a model of each explanatory variable.

239 We considered a set of covariables, date, temperature, wind speed, and time after sunset (in minutes), because they could also influence bush cricket or bat activities. To test the effect of 240 241 hedgerow characteristics in taking into account the landscape structure, we also included in 242 the model the distance of each station to the nearest hedgerow and the proportion of seminatural habitat within the 11 buffer zones described above. We took into account the influence 243 244 of covariables to study the hedgerows'characteristic variables. First, we systematically 245 evaluated the correlations among explanatory variables using Spearman's rho for quantitative variables (Crawley 2009) (see Appendix D) to detect obvious correlation. Secondly, we 246 247 performed variance-inflation factor (VIF) on the full models (Fox & Monette 1992); all 248 variables had VIF<5, indicating no problem of multicollinearity in the explanatory variables of our models. To account for spatial autocorrelation, we added an autocovariate (i.e., a 249 250 distance-weighted function of neighboring response values; Dormann et al. 2007) with the 251 autocov_dist function in R (package spdep, Bivand et al. 2011).

Thus, for each species of bat and bush cricket and for each of the 11 buffer zones, our full statistical models were structured as follow:

254 [species activity] $_{i} \sim date$ +time after sunset + temperature + wind speed+ distance to the 255 nearest hedgerow + proportion of grassland $_{i}$ + hedgerow characteristic $_{i}$ + autocovariate $_{i}$

where *i* is the buffer size considered (from 50 m to 1000 m radii) and *hedgerow characteristic*

257 is the characteristic considered (density, structural diversity or potential of wood production).

258 Because of the expected non-normal distribution of bat and bush cricket species calls, and the possible high frequency of zero, we followed Potts and Elith (2006) and Vandelvelde et al.(259 2014) performing four GLMs according to the nature of the response variable (count of bat 260 261 and bush cricket calls) for each tested species: one with a Poisson error distribution (GLM-P), one with a negative binomial distribution (GLM-NB) and two with a zero-inflated GLMs 262 263 (Zuur et al. 2010): one with a Poisson error distribution [ZAP] and one with a negative binomial [ZANB]; R package pscl, Jackman 2012). The zero inflated models were hurdle 264 models (ZAP and ZANB) that consider presence and absence data (with a binomial function) 265 and analyze the presence data in a second step with a count model (Poisson or a negative 266 267 binomial) (Zuur et al. 2009). Finally, based on the patterns of residuals (as recommended by Zuur et al. (2009) to choose the appropriate modeling), we selected ZANB for all species, 268 269 except for *Plecotus* spp., the gleaner group and community specialization indices, for whish 270 we used GLM-NB (see Appendix G). For all species, we used the count model (Zuur et al. 271 2009) of the ZANB to account for their activity; for species with uninterrupted calls 272 (Appendix B2) and species with a very low occurrence (B. barbastellus), we focused on the 273 presence/absence and used the binomial model of the ZANB (Zuur et al. 2009). From the full model, using a buffer size of 500 meters, we performed a backward selection based on 274 275 Akaike's information criterion (AIC). The final models for each species and community are 276 presented in Appendix G; note that, exploratory treatment indicate that the procedure of 277 covariable selection is not sensitive to buffer size. Finally, based on the foraging or mobility 278 traits for each bat and bush cricket species and community, we tested the same model taking 279 into account the covariables and measures of hedgerow quality in the landscape (density, 280 diversity and productivity). We can compare the different explanatory variables (indices) 281 using AIC comparisons.

283 1.7.2.1 Step 1: calculation at a given scale

For a given species and for each of the eleven buffer sizes, from 50 meters to 1000 meters, we 284 285 used the same final model to test the effect of each hedgerow index (density, diversity or production) on the activity of each species or the community index (forage, mobility and 286 287 CSI), taking into account significant co-variables. Because we used the same model to test 288 the effect of each index at all scales, we were able to directly compare the value of the 289 estimate of the effect or goodness of fit of model (AIC) of indices for one species or community between different spatial scales. However, we could not perform direct 290 291 comparisons between species or communities (see Appendix G).

292 1.7.2.2 Step 2: calculation across scales

293 Next, we tested whether the slope of the relationship between the dependent variable (species 294 activities and community traits) and the hedgerow indices changed with the scale. Thus, we 295 tested the effect of the buffer sizes on estimates from previous models using a GLM with a 296 normal error structure because the response variable was normally distributed (hereafter referred to as 'scale analysis') (see Appendix G3). Following the approach of Penone et al. 297 (2013a), we assigned the response variable (i.e., estimate of slope) different weights 298 299 according to the associated standard error (1 per SE²) obtained from the previous analysis. 300 Buffer size effects were adjusted to variables using a type II ANOVA. When we did not detect 301 a linear effect across the buffer size range (from 50 to 1000), we used the exploratory 302 approach of broken-line models. Broken-line models are regression models in which the relationships between the response and explanatory variables are piecewise linear, represented 303 304 here by two straight lines connected at unknown values: these values are usually called 305 breakpoints (Package segmented, Muggeo 2008) (see Appendix H). All p values were 306 corrected for potential over-dispersion according to the Faraway (2006) approach. All 307 analyses were performed with R software (R Development Core Team 2011).

308 **2 Results**

A total of 35 263 bat calls belonging to 14 species were recorded at the 51 point counts during the two periods. The majority of echolocation calls from the 14 bat species came from three *Pipistrellus* bats (*Pipistrellus pipistrellus* (48.5%), *Pipistrellus kuhli* (24.4%) and *Pipistrellus nathusii* (21.2%)). For bush crickets, we detected 101 419 calling songs belonging to 11 species from the Tettigoniidae family (Appendix B2). For more details on average activities of bats and bush crickets, see Appendix I.

315 *2.1 Effect of the wood production of hedgerows*

316 2.1.1 The effect of the wood production of hedgerows on bats

We obtained 104 positive estimates of which 44 were significant and 28 negative estimates of 317 which 3 were significant (see Appendix J3). The activity of bat species was generally 318 319 positively correlated with the wood production of hedgerows, as shown in Figure 2, and the effect was stronger at larger spatial scales (see Appendix J3). In the graph e (Figure 2), we 320 321 present the effect of the density of hedgerows on the aerial bat species. We showed that 1) for 322 example, with the 1000 m buffer, the activity of aerial species is positively correlated with the 323 density of the hedgerow (the estimate reported from the modeling at 1000 meters - with its 324 standard error) is positive, i.e., above zero, and this effect is significant, as indicated by the asterisk; and 2) the scale effect, obtained from the linear regression, from 50 meters to 1000 325 326 meters was significant and is shown by the dotted line. The activity of aerial bat species was 327 significantly and positively correlated with the hedgerow density in a 1000 m buffer. The scale effect obtained from linear regressions was significant and there is a positive scale effect 328

329 for these communities (above zero). When we did not detect a linear scale effect, we assessed

a potential breakpoint value (see also Appendix H).

331 2.1.2 The effect of the wood production of hedgerows on bush crickets

We obtained 108 positive estimates, of which 16 were significant and 56 negative estimates of which 15 were significant (see Appendix J3). The wood production of hedgerows had a positive influence on the activity of all bush cricket species, (see Figure 3) and the influence was greater when the spatial scale was large, except for the sedentary species and *Uromenus rugosicollis*, for which results were the inverse of the other species: wood production was negatively correlated with their activities and this effect was stronger when the spatial scale was large (see Appendix J3).

339 2.2 Effect of the density of hedgerows

340 2.2.1 The effect of the density of hedgerows on bats

341 The density of hedgerows had a generally positive effect on the foraging activity of the 342 studied bat species and communities based on the studied traits. Among the 132 estimates ((9 343 taxa + 3 community indices) x 11 buffer sizes) we generated for bats, we obtained 106 344 positive estimates, of which 33 were significant, and 26 negative estimates, of which only 4 345 were significant (see Appendix J1). The greater the hedgerow density around the point count, 346 the more numerous were the bat calls. We observed this effect at almost all the spatial scales 347 we studied. Moreover, we found that the larger the scale, the stronger the effect (observed in 9 out of 12 cases, see Table 1 and Appendix J1); therefore, we suggest that the density of 348 349 hedgerows significantly and positively influenced the activity of the bat species and the two guilds at increasingly large spatial scales (see Appendix K1). 350

351 2.2.2 The effect of the density of hedgerows on bush crickets

The effect of density on bush crickets' activity was less marked than for bats and depended on the species studied and on their mobility. Among our 154 estimates (((11 taxa + 4 community indices)-(1 non-convergent model)) x 11 buffer sizes), we obtained 96 positive estimates, of which 15 were significant and 68 negative estimates, of which 11 were significant (see Appendix J1).

357 Moreover, the obtained positive effect increased at a large scale (> 500 m) for *Tettigonia* 358 viridissima, Ruspolia nitidula and Pholidoptera griseoaptera, whereas the effect was negative 359 and became stronger at a large scale for Uromenus rugosicollis. Two contrasting patterns were observed for the two communities based on their mobility traits. The activity of mobile 360 species of bush crickets appeared to increase with the density of the hedgerows and to 361 362 increase more strongly at large scales, whereas the opposite effect was observed for sedentary 363 species whose activity decreased in the presence of high-density hedgerows, especially at 364 large scale (see Appendix K2).

2.3 Effect of the diversity of hedgerows

366 2.3.1 The effect of the diversity of hedgerows on bats

We obtained 91 positive estimates, of which 30 were significant and 41 negative estimates, of 367 368 which 12 were significant (see Appendix J2). This effect was weaker at larger scales and had a break point at approximately 500 m (see Appendix L1 and J2). Moreover, we obtained 369 contrasting and opposing patterns for aerial and gleaner species. The latter showed decreased 370 371 activity with increasing hedgerow diversity at all scales, whereas the activity of the aerial 372 species increased until 500 m and then decreased at larger spatial scales. Unlike other gleaner species, the activity of *Myotis* spp. increased with hedgerow diversity, especially at large 373 374 spatial scales (see Appendix J2 and L1).

375 2.3.2 The effect of the diversity of hedgerows on bush crickets

376 Among the 110 estimates (((11 taxa + 4 community indices)-(5 non convergent models)) x 11 buffer sizes), we obtained 88 positive estimates, of which 12 were significant, and 72 negative 377 378 estimates, of which 24 were significant (see Appendix J2). Tettigonia viridissima and 379 Uromenus rugosicollis activities increased with diversity at scales larger than 500 m (see 380 Appendix L2). However, the activities of Ruspolia nitidula and Pholidoptera griseoaptera 381 decreased with hedgerow diversity at all spatial scales, and the effect was stronger at large 382 spatial scales (see Appendix L2). Hedgerow diversity had a positive effect on the activity of 383 the mobile species, but the effect decreased and became negative for buffers of 800 m and 384 larger, whereas the activity of sedentary species increased with the diversity of hedgerows, 385 and this effect was stronger at larger spatial scales (see Appendix L2).

386 *2.4 Comparison between the indices*

According to the AIC value (Table 1), the best model, for each bat and bush cricket species
and for communities based on foraging, mobility and habitat specialization, was the model
with the productivity index.

390 **3 Discussion**

391 To our knowledge, our study is the first to assess the influence of hedgerow quality using three characteristics (density, structural diversity and potential of wood production) on the 392 393 activity of bats and bush crickets, as well as on communities, based on foraging, mobility and 394 habitat specialization. The results of the present study demonstrate the importance of 395 hedgerow quality for bats and bush crickets, but the strength of the association between taxa 396 and hedgerows varied greatly among species and spatial scales. From management and 397 conservation perspectives, we need to understand the characteristics of hedgerows and spatial 398 scales that must be considered to assess the hedgerows' quality for conservation of the

399 different taxa. Indeed, many European bat species use linear features of the landscape for commuting and foraging (Downs and Racey 2006; Entwistle et al. 1996; Limpens and 400 401 Kapteyn 1991, Glendell and Vaughan 2002), and thus the density of hedgerows was 402 particularly correlated with the activity of bats such as Pipistrellus spp. (Verboom and Huitema 1997; Boughey et al. 2011). Some studies have shown that occupancy of bat species 403 404 was positively associated with corridor overstory height (Hein et al. 2009). Merckx et al. 405 (2012) showed that in agricultural landscapes, trees in hedgerows increase the diversity of 406 nocturnal Lepidoptera — which are some of the prey of certain European bats — and can also provide microhabitats, such as dead wood, that also increase invertebrate abundance and 407 408 diversity (DEFRA 2010; Winter and Möller 2008). Moreover, production reflected richly structured habitats with microhabitats (Regnery et al. 2013), that are preferred by many bat 409 410 species such as *P. pipistrellus* (Davidson-Watts et al. 2006) and especially by highly 411 specialized and threatened species such as B. barbastellus (Kusch et al. 2004). Moreover, to 412 reach hunting grounds, species such as Myotis daubentonii forage and commute along wood 413 edges and hedgerows and avoid crossing open areas (Limpens and Kapteyn 1991). Our results 414 were congruent with the literature but showed this relationship at different spatial scales for 9 bat taxa. We also identified a positive effect on groups based on foraging traits, mobility and 415 416 habitat specialization. However, concerning bush cricket activity, few studies have 417 documented hedgerow effects (Berggren et al. 2002). For this group, there were nearly as many significantly negative indices as significantly positive indices. The species we studied 418 419 includedspecies predicted to prefer grasslands and others predicted to prefer forest, which 420 may explain this result.

421 However, our study has several potential limitations. The ultrasound recording time per site 422 may be relatively short for identifying accurate absolute animal activity or abundance. 423 Sampling using recording throughout the entire night would be more appropriate but also 424 more time-consuming. Still, our design focus on the beginning of the night occurred during

425 the bat and bush cricket activity peak. Moreover, our sampling design allows unbiased426 measurement of animal activity among the hedgerow characteristics tested.

427

428 3.1 Scale effect

429 Based on the intensities of bat calls and bush cricket stridulations and on the technical characteristics of the microphones, we did not expect to detect individuals at a distance 430 431 greater than 100 meters from the recording point. However, in our study, the strengths of the 432 correlations tended to be strongest at large scales, suggesting that hedgerows could exert an 433 influence at the scale of the landscape. However, it is worth noting that the influence of 434 hedgerows on activity seems to vary depending the index characterizing the hedgerows and 435 the species, most likely because several processes may be involved at different spatial scales 436 (Bellamy et al. 2013). In fact, as already shown by Hale et al. (2012) for bats, the organisms 437 are sensitive to landscape composition and structural connectivity at multiple spatial scales, 438 and the impact of forest harvesting on habitat use by foraging bats varies with spatial scale 439 (Grindal and Brigham 1999).

440 Based on homerange studies of bats using radio-tracking methods (see ref. Drescher 2004), 441 we expected to detect an effect of hedgerow quality at large spatial scales, and this is what we 442 found. For instance, the positive effect of a hedgerow network was detected in buffers whose 443 radii ranged from 400 m to 1000 m, a range that is comparable to the home range of some 444 individuals of Pipistrellus pipistrellus (Davidson-Watts and Jones 2005) and, Eptesicus 445 serotinus (Perez and Ibañez 1991) or to the mean distance between roost and feeding sites for 446 species such as Pipistrellus nathusii (Flaquer et al. 2009) and Eptesicus serotinus (Robinson 447 and Stebbings 1997).

In addition, our results showed that gleaner species were significantly influenced by thepotential production of hedgerow at small scales (see Figure 2 and Appendix J3), whereas the

450 effect for aerial species was significant only at large scales (Figure 2 and Appendix J3). 451 Boughey et al. (2011) showed that hedgerows of all types were associated with a similar 452 increase in *P. Pipistrellus* incidence; it is interesting to note that in our study, density and 453 production indices had a positive increasing influence with spatial scales on the activity of the 454 aerial hawking guild and the gleaning guild except for the diversity index for this last group 455 (Table 1).

Based on habitat area requirements and the individual bush crickets' perception of the landscape, we hypothesized that the bush crickets were more sensitive to small-scale changes. Arak and Eiriksson (1992) found that males of T. viridissima were regularly spaced with a mean distance of 6 m between nearest-neighbors. However, our results showed that the bush cricket species (i.e., abundances) and community indices were also influenced by landscape structures at large scales (Figure 3 and Table 1).

In addition, we did not identify thresholds beyond which the scale effect no longer increased. This result was congruent with Penone et al. (2013a) and With and Crist (1995) who showed that some bush cricket species were sensitive to large-scale effects. We obtained a contrasting effect for the two bush cricket communities based on mobility: a significant positive scale effect of the production index on the activity of mobile species and a significant negative effect on the activity of sedentary species (See Appendix J and Figure 3 e and . and Table 1).

The habitat of specialized species appeared to benefit from the density of hedgerows composed of old and large trees. For bush crickets and bats, we detected a positive scale effect of the density and production indices on the two communities based on indices of habitat specialization (CSI), whereas the effect of the structural diversity index was not significant (Table 1). The comparison of the AIC of the models, for each quality index and for each species or community, showed that the scale effect of the potential wood production best explained the activity of the bats and bush crickets we studied.

For some taxa (i.e., *N. noctula*, Fig. 2) and communities (i.e., gleaners, Fig. 2), we detected a slope change of approximately 600 m with the scale analysis. This change may be specific to our study site and could be linked to the landscape structuring at the regional scale linked to the Loire River. A non-exclusive hypothesis could be linked to specific biological features of the taxa studied, indicating scale variations of landscape perception, which emphasizes the need to confirm this observed trend with future studies.

482 3.2 Comparison among the 3 indices: density, structural diversity and wood 483 production

There was no correlation between diversity and wood production or between diversity and density, whereas a correlation between the density and wood production was detected. This relationship was logical according to the construction of the production index (see section 2.3) which includes hedgerow density. However, this index includes the information contained in the density index. Even if the wood production index appears globally to be a better predictor of bat and bush cricket activities (according to AIC value, see Table 1), the strong correlation between these two indices prevents identify, with certainty, the best predictor.

We showed that from the landscape perspective, the quality of the hedgerow network was 491 492 better represented by the potential wood production that generally positively influenced the activity of bush crickets and bats. Concerning bats, the production index showed a frequent 493 494 significant positive effect on bat activity. Concerning bush crickets, the production index 495 showed a more frequent significant positive effect (see Appendix J) than the density or diversity indices. We assumed two non-exclusive hypotheses to explain the differences in the 496 497 patterns observed in Figure 3 between the mobile and sedentary species (Figures 3.e and 2.f.). 498 First, the community of a mobile species would be more related to forest edges (i.e., T. 499 viridissima), whereas the community of a sedentary species (C. dorsalis, U. rugosicollis) 500 would be more related to the open areas such as grasslands (Voisin 2003). Thus, we would

have congruence between the traits mobility and habitat selection. Second, the hedgerows may contribute to colonization success in the grasslands, and therefore play a functional role, as Berggren et al. (2001) showed in the case of *Metrioptera roeselii*, which showed higher activity in landscapes with more hedgerows. This result was congruent with our results showing that the activity of this species was influenced positively by the density, diversity, and productivity indices and increased with spatial scale.

507 Through the diversity index, our study provided new evidence regarding the importance of 508 hedgerows. The diversity of the structure of the hedgerows reflected from an ecological perspective, the heterogeneity of habitats in the hedgerows and thus the heterogeneity of 509 510 ecological niches. Although this index shows a generally positive effect on the activity of bats 511 and bush crickets compared to the two other indices (see Appendix J), its influence appeared 512 to be less linear: few linear scale effects were detected (see Appendix L) and broken line 513 analysis indicated a change at approximately 400-600 m. These patterns may be linked to the 514 nature of this variable: the diversity index is calculated using a Shannon index (see 2.3). 515 Indeed, the effects of the diversity index can be reversed according to the scales considered. 516 At a small scale, a high structural diversity indicates a strong heterogeneity of the hedgerow types at a given location, whereas at larger scales, high structural diversity implied a good 517 518 spread of different hedgerows types and a large quantity of each type.

519 3.3 Conclusion and implications for conservation

If habitat is the primary predictor of bat abundance (Müller et al. 2012; Walsh and Harris 1996), hedgerows may play a role in optimal foraging by promoting the dispersal of individuals because, they improved the general quality of habitats by improving the access to resource areas and the dispersion between roosts (particularly maternities) and foraging sites. To manage protected areas and to maximize management efforts (the latter point often focuses on the preservation of habitat patches), efforts should focusing more on the preservation of

526 connected habitats (Lookingbill et al. 2010). Mimet et al. (2013) and Pellissier et al. (2012) suggested that, for land use management, both the composition and the configuration of 527 habitats must be taken into account to maintain suitable conditions for biodiversity and Zeale 528 529 et al. (2012) underline the need to improve the quality and the numbers of ecological corridors. Optimizing the biodiversity gain provided by linear features will maximize the 530 531 effectiveness of these schemes (Boughey et al. 2011). We showed that the wood production 532 index positively influences the variation in the activities of bats and bush crickets. According 533 to Geffray (2010), the wood production index is potentially correlated to tall and old trees and also to a potential ecosystem service of high timber production for land managers and 534 535 farmers. Moreover, hedgerows provide habitats for auxiliary crops (Van Emden & Dabrowski Z.T. 1994), shelter against the wind and cold for crops, and wood production for firewood 536 537 (linked to the European and French energy transition) (Château & Rossetti di Valdalbero, 538 2011). Thus, hedgerows play important roles in the ecosystem and provide many ecosystem 539 services (Altieri 1999). They reconcile agricultural practices and biodiversity. Moreover, tree-540 filled hedgerows could provide substitute environments for forest species; thus, in grassland 541 habitats, such as our study site, we need to encourage hedgerows with large and old trees.

542 Usually, it is recognized that hedgerow density is a heritage of old historical agricultural practices that shaped this landscape structure. Although agricultural practices have been 543 544 largely modified, this network of hedgerows persists today. Currently, this network is 545 influenced by regional, national and even European (common agricultural policy (CAP) agricultural policy. The wood production of hedgerows, however, is linked to management by 546 local farmers. Thus, territorial policy decisions or local practices could influence the quality 547 548 of the biodiversity. The present study examined different scales and different hedgerow 549 indices and its results suggest that landscape planning should be considered both :1) at large 550 scales because they are the ones that are guided by agricultural policies that can increase the 551 density of hedges and 2) at small scales, such as the agricultural parcel level, because it is at

this scale that agro-ecosystem schemes offer subsidies or/and financial tax shelters that could be distributed to farmers and landowners to create, conserve and manage hedgerows to promote longer cutting cycles for old trees with high production. The distribution of agrienvironmental measures (AEM) may be conditional on the hedgerow quality, rather than simply their presence.

557 However, the current European context, with its political pressure regarding wood energy, 558 may not be favorable to shortening cutting cycles for large timber. Because hedgerows 559 provide valuable habitat for many species (Boughey et al. 2011), the diversity index reflected the different types of hedgerows and therefore must be linked with AEM for management. 560 561 The reintroduction of structural elements to increase habitat heterogeneity should become part of agro-ecosystem schemes (Frey-Ehrenbold et al. 2013). Our study site, as with many other 562 563 sites, was in spaces with multiple pruposed including agriculture, hunting, and even wood 564 production through which hedgerows contribute to ecosystem services (Baudry et al. 2000).

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Figure 1: Positions of point counts in the study site (A) and an enlargement showing

832 the 3 distances from the hedgerow (0 m, 25 m and 50 m) (B)



- 835 Figure 2: Effect on bats of the production of hedgerows at different spatial scales. On the Y-
- 836 axis: estimates of the relationships between production and activity of 4 different species and
- 837 activity of aerial and gleaner species. 6 graphs are presented: 4 species (a, b, c, d) with
- 838 various ecologies and 2 traits (e, f). Asterisks indicate significance. The dotted line shows the
- 839 scale effect obtained from linear regressions.
- 840


- 849 Figure 3: Effect on the bush crickets of the hedgerow production at different spatial scales.
- 850 On the Y-axis: estimates of the relationships between production and activity of 4 different
- 851 species, community specialization and activity of mobile and sedentary species (see also
- 852 Appendix H)
- 853



- 861 Table 1: Spatial scale effect of density, diversity and productivity (estimate of GLM) and the
- 862 significance of the GLM (anova, F test) at each spatial scale from 50 to 1000 m.

			Hedgerow density			Hedgerow diversity			Hedgerow production								
		Species	Estimated GLM	SE GLM	P value ANOVA	F ANOVA	AIC GLM	Estimate GLM	SE GLM	P value ANOVA	FANOVA	AIC GLM	Estimate GLM	SE GLM	P value ANOVA	F ANOVA	AIC GLM
	Continuous	T. viridissima	0.028	0.015	0.093	3.52	96.10	0.001	0.001	0.492	0.51	34.70	2.65E-06	4.63E-07	< 0.001	32.80	-132.00
	calls	R. nitidula	-0.005	0.034	0.884	2.25E-02	114.00	-0.004	0.001	0.012	9.82	38.20	8.49E-08	1.30E-06	0.950	0.00	-110.00
		M. roeselii	0.082	0.026	0.013	9.64	109.00	0.004	0.002	0.069	4.27	49.00	2.75E-06	1.34E-06	0.071	4.20	-109.00
		P. falcata	0.003	0.043	0.947	4.62E-03	120.00	0.007	0.002	0.010	10.40	48.80	-1.92E-06	1.96E-06	0.352	0.97	-99.30
s	Non-	P. griseoaptera	0.394	0.072	< 0.001	30.10	133.00	-0.012	0.004	0.009	10.80	68.40	2.47E-05	5.80E-06	0.002	18.20	-74.60
ket	continuous calls	U. rugosicollis	-0.662	0.050	< 0.001	175.00	114.00	0.005	0.002	0.070	4.24	56.80	-4.21E-06	1.59E-06	0.026	7.04	-103.00
cric		P. nana	0.052	0.097	0.610	0.282	127.60	-0.050	0.014	0.005	13.61	90.79	8.93E-06	7.43E-06	0.260	1.44	-72.85
sh (L. punctatissima	0.094	0.022	0.002	18.50	108.00	-0.009	0.001	< 0.001	48.70	41.00	4.54E-06	7.57E-07	< 0.001	35.90	-118.00
Bu		P. albopunctata	1.076	0.487	0.069	4.87	131.14	-0.074	0.010	0.020	49.50	19.00	6.02E-05	4.18E-05	0.188	2.07	-30.05
		C. dorsalis	-0.032	0.039	0.428	0.69	115.00	-0.002	0.002	0.416	0.73	48.40	-7.70E-07	1.29E-06	0.565	0.36	-112.00
		P. tessellata	-0.070	0.017	0.003	16.10	96.90	0.015	0.004	0.007	12.70	60.40	-6.15E-06	1.27E-06	0.001	23.30	-105.00
	Orthoptera	Mobility	0.022	0.001	< 0.001	1610.00	31.00	-2.64E-04	1.71E-04	0.158	2.37	-0.25	1.27E-06	4.81E-08	< 0.001	700.00	-176.00
	mobility trait	Sedentary	-0.066	0.020	0.008	11.40	103.00	0.001	0.001	0.021	7.74	19.20	-6.15E-06	8.36E-07	< 0.001	54.10	-119.00
		Intermediate	-0.036	0.027	0.208	1.84	108.57	-0.001	0.001	0.38	0.86	40.54	-2.05E-06	1.12E-06	0.100	3.35	-112.95
		CSI	0.018	0.009	0.088	3.65	85.33	4.51E-04	3.51E-04	0.23	1.65	9.59	6.10E-07	4.98E-07	0.251	1.50	-131.38
		B. barbastellus	0.158	0.044	0.006	12.90	120.00	0.001	0.001	0.188	2.03	35.23	7.13E-06	1.96E-06	0.005	13.18	-100.17
		Myotis spp.	0.450	0.052	< 0.001	73.60	113.00	0.017	0.003	< 0.001	23.20	64.62	2.13E-05	2.16E-06	< 0.001	97.83	-93.06
		N. noctula	0.064	0.018	0.006	12.50	99.50	-0.001	0.002	0.411	0.74	50.37	2.45E-06	6.14E-07	0.003	15.91	-125.13
		P. pipistrellus	0.051	0.007	< 0.001	52.80	78.30	0.003	0.001	0.060	4.64	39.20	3.03E-06	3.75E-07	< 0.001	65.20	-138.00
		P. kuhlii	0.134	0.030	0.002	20.10	111.00	0.003	0.001	0.043	5.55	35.20	9.69E-06	6.02E-07	< 0.001	258.00	-126.00
ats		P. nathusii	0.154	0.008	< 0.001	411.00	81.60	-0.005	0.002	0.047	0.05	50.90	8.11E-06	2.64E-07	< 0.001	946.00	-144.00
æ		Plecotus spp.	-0.003	0.031	0.920	1.07E-02	113.48	-0.004	0.002	0.057	4.74	48.16	-2.85E-06	3.31E-06	0.412	0.74	-88.43
		E. serotinus	-0.056	0.026	0.060	4.63	113.00	0.006	0.001	< 0.001	93.70	30.60	-8.08E-07	1.47E-06	0.596	0.30	-103.00
		N. leisleri	-0.121	0.034	0.006	12.60	114.00	0.008	0.001	< 0.001	46.40	41.20	-4.28E-06	1.46E-06	0.017	8.57	-108.00
	Bat	Aerial	0.218	0.015	< 0.001	220.30	95.75	0.003	0.002	0.161	2.33	46.28	1.11E-05	2.88E-07	< 0.001	1495.18	-142.59
	trait	Gleaner	0.273	0.084	0.010	10.60	133.69	-0.007	0.002	0.019	8.15	53.11	1.17E-05	3.23E-06	0.005	13.22	-90.37
		CSI	0.015	0.001	<0.001	124.83	48.25	-2.17E-04	3.69E-04	0.57	0.34	10.90	6.20E-07	8.98E-08	< 0.001	47.76	-168.98

863 6 Appendix list

- 864 Appendix A: Proposition of potential production of hedgerows in Loire Valley between
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- Figure L1: Effect of the diversity of linear landscape elements on bats at different spatial scales
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- spatial scales
- 899
- 900

901 7 Appendix A: Potential production of hedgerows in Loire Valley between

902 Saint-Nazaire and Montsoreau in 2010.

903

- 904 The database (Geffray 2010) described the linear landscape elements in five categories:
- 905 (1) Alignment of trees,
- 906 (2) Riparian vegetation,
- 907 (3) Shrub hedgerow (which only correspond to weak productivity)
- 908 (4) Wooded hedgerow without the presence of shrubs
- 909 (5) Three strata hedgerow (tree, shrub and herb)
- 910
- 911

Typology (CORELA 2010)	Productivity in m³/1 hm /year (CORELA prediction)
Shrub hedgerow and alignment of trees with weak productivity	0.22
Hedgerow with trees and riparian vegetation adjacent to rivers with weak productivity	0.74
Wooded hedgerow and alignment of trees with high productivity	1.11
Wooded hedgerow and alignment of trees with medium productivity	0.93
Riparian vegetation adjacent to rivers with high productivity	1.67
Riparian vegetation adjacent to rivers with medium productivity	1.11
Three strata hedgerow with high productivity	1.11
Three strata hedgerow with medium productivity	0.74

912

915 **Reference**

916 Geffray, Olivier, 2010. Le bocage en vallée de la Loire: mise à jour cartographique et estimation des capacités en bois

917 énergie. Conservatoire Régional des Rives de la Loire et de ses Affluents (CORELA), Rapport d'étude, 63 p.

⁹¹³ Note: 1 hm=100 linear meters; MAP = meter apparent of wood planking (2.7 MAP sec/m³ = 1 m³ of wood). 914

919 8 Appendix B1: Indices used for bat community assessment. For assessment of

920 Habitat Specialization Index, see Appendix F and Figure 2.6.

Bat species	Habitat Specialization Index(SSI)	Foraging type
Barbastella barbastellus	3.6	Mixed strategist
Eptesicus serotinus	1.5	Aerial hawking
Myotis spp.(mainly daubentonii)	3.2	Gleaner
Nyctalus leisleri	0.9	Aerial hawking
Nyctalus noctula	1.6	Aerial hawking
Pipistrellus kuhlii	0.7	Aerial hawking
Pipistrellus nathusii	3.1	Aerial hawking
Pipistrellus pipistrellus	0.5	Aerial hawking
Plecotus spp (mainly austriacus)	1.4	Gleaner

924 9 Appendix B2: Bush cricket species specialization and traits: *dispersal ability
925 according to (Reinhardt et al. 2005; Marini et al. 2010); ** the SSI calculation is
926 explained in Appendix F, and see 2.6 and Appendix E for explanations of the
927 identification processes.

Spacios nomo	Dianaraal ability*	CC1**	Species with		
species name	Dispersar ability	221	uninterrupted calls		
Tettigonia viridissima	Mobile	0.42	yes		
Phaneroptera nana	Mobile	0.27	no		
Leptophye punctatissima	Sedentary	0.55	no		
Platycleis tessellata	Sedentary	1.42	no		
Platycleis albopunctata	Intermediate	0.49	no		
Conocephalus dorsalis	Sedentary	NA	no		
Ruspolia nitidula	Mobile	0.52	yes		
Metrioptera roeselii	Intermediate	NA	yes		
Pholidoptera griseoaptera	Sedentary	0.91	no		
Uromenus rugosicollis	Sedentary	NA	no		
Phaneroptera falcata	Mobile	0.27	yes		

- 931 10 Appendix C: Correspondence scale of areas (m²) depending on the buffer size (in
 932 meters)



11 Appendix D: Correlations between variables

Table D1: Correlations between characteristics of hedgerows (density, structural diversity and
 potential wood production) and covariables at each spatial scale. The important correlations

between variables (correlation coefficient $|rho| \ge 0.5$; Freckleton, 2002) are indicated in bold

		time after sunset	date	temperature	wind	distance from hedgerow	Proportion of grassland
	Density	0.023	0.149	0.058	0.156	-0.055	-0.221
50 m	Diversity	-0.193	0.092	0.157	0.142	0.064	0.006
	Production	-0.020	0.132	0.116	0.085	-0.011	-0.277
	Density	0.028	0.269	0.099	0.106	0.156	-0.227
100 m	Diversity	0.061	0.217	0.019	0.117	0.078	-0.171
	Production	-0.069	0.226	0.106	0.042	0.126	-0.254
	Density	-0.020	0.274	0.085	0.037	0.154	-0.025
200 m	Diversity	0.201	0.073	-0.015	-0.008	0.114	0.023
	Production	-0.123	0.198	0.173	0.006	0.219	0.099
	Density	-0.075	0.273	0.192	-0.007	0.139	0.159
300 m	Diversity	0.092	-0.119	-0.014	-0.108	0.055	0.254
	Production	-0.130	0.157	0.209	-0.015	0.177	0.136
	Density	-0.041	0.203	0.159	-0.053	0.131	0.150
400 m	Diversity	0.191	-0.017	0.040	-0.121	0.032	0.418
	Production	-0.083	0.108	0.196	-0.065	0.150	0.175
	Density	-0.051	0.156	0.159	-0.066	0.088	0.208
500 m	Diversity	0.339	0.005	-0.039	-0.092	0.018	0.569
	Production	-0.096	0.072	0.191	-0.095	0.119	0.190
	Density	-0.050	0.183	0.173	-0.060	0.044	0.276
600 m	Diversity	0.389	-0.003	-0.130	-0.093	-0.035	0.535
	Production	-0.088	0.095	0.177	-0.065	0.089	0.234
	Density	-0.100	0.173	0.196	-0.055	0.067	0.219
700 m	Diversity	0.388	-0.020	-0.169	-0.053	-0.075	0.472
	Production	-0.104	0.122	0.187	-0.052	0.088	0.227
	Density	-0.082	0.174	0.164	-0.015	0.077	0.276
800 m	Diversity	0.418	0.005	-0.039	-0.092	0.018	0.584
	Production	-0.103	0.072	0.191	-0.095	0.119	0.166
	Density	-0.029	0.186	0.138	-0.002	0.064	0.387
900 m	Diversity	0.376	0.040	-0.211	0.040	0.060	0.605
	Production	-0.079	0.161	0.159	-0.051	0.045	0.345
	Density	-0.015	0.188	0.106	0.012	0.046	0.496
1000 m	Diversity	0.413	0.055	-0.182	0.043	0.058	0.579
	Production	-0.085	0.172	0.143	-0.048	0.042	0.415

- 943 Table D2: Spearman correlations between characteristics of hedgerows (density, structural diversity
- 944 and potential wood production) for a 500 m buffer.

	Density	Diversity	Production
Density	1	rho= 0.117, p value =0.241	rho= 0.961, p value < 0.001
Diversity	rho= 0.117, p value =0.241	1	rho= 0.124, p value =0.215
Production	rho= 0.961, p value < 0.001	rho= 0.124, p value =0.215	1

References:

Freckleton, R.P., 2002. On the misuse of residuals in ecology: regression of residuals vs. multiple
regression. J. Anim. Ecol. 71, 542–545.

952 12 Appendix E: Sonograms and information on sound files

Orthoptera activities records







Conocephalus dorsalis





Uromenus rugosicollis



- 968
- 969
- 970 Sonograms of the main species detected
- 971 Software: Syrinx; x-axis: time x10 (seconds); y-axis: frequency (KHz)

- 973 Sound files:
- 974 Some samples of Orthoptera sounds of the main species are given in the present zip file.
- 975 To make the recordings audible, the sampling rate has been divided by ten (from
- 976 96000 ks/s to 9600 ks/s).

Species name	File name
Leptophyes punctatissima	LEPPUN.wav
Phaneroptera nana	PHANAN.wav
Pholidoptera griseoaptera	PHOGRI.wav
Platycleis tessellata	PLATES.wav
Ruspolia nitidula	RUSNIT.wav
Tettigonia viridissima	TETVIR.wav

978

979 Bat activity records

980

981 We used Syrinx software version 2.6 (Burt, 2006) for spectrogram and Adobe Audition for spectral 982 analysis, we used Scan'R (Binary Acoustic Technology, 2010) to isolate each bat vocalization and 983 automatethe measurement of relevant parameters (Gannon et al., 2004, Obrist et al., 2004, Barataud 984 2012). Species identification of sounds was performed by Lea Noel and Aurelie Lacoeuilhe, and 985 verified by coordinators of the French Bat Monitoring Program (Jean-François Julien & Christian 986 Kerbiriou) 987 988 The main relevant parameters used were as follows: 989 Call duration (msec) 990 Time elapsed since previous detection (msec) 991 Maximum frequency detected (Fmax, KHz) 992 Minimum frequency detected (Fmin, KHz) 993 Total Bandwidth [Fmax - Fmin] (KHz) 994 Frequency at strongest sound pressure level (KHz) 995 Location of Dominant Frequencies (% of total duration)

996	High end	of characteristic	(KHz) [Similar	to Fk]
-----	----------	-------------------	----------------	--------

- 997 Low end of characteristic (KHz) [Similar to Fc]
- 998 Global slope of the call (KHz per msec)
- 999 Time of the heel or High Fc (percent of duration)
- 1000 Upper slope [start to High Fc] (KHz per msec)
- 1001 Lower slope [High Fc to Low Fc] (KHz per msec)
- 1002 Fundamental frequency (KHz)
- 1003 2nd harmonic frequency (KHz)
- 1004 Curvature measurement as a way to characterize the shape of bat calls (see Jolly 1997)
- 1005 Curve fit error parameter; a measurement of how much error exists between the curvature model
- 1006 and the actual shape of the call
- 1007

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1013

1014	Gannon,	W.L., C)'Farell M.J.,	Corben,	C., Bedrick,	E., 2004.	Call	character	Lexicon and	1 analysi	S
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1021 13 Appendix F: Assessment of Habitat Specialization species index and community

1022 specializations indices

1023

1024 Habitat Specialization species indices were assessed using data from the French Bat Survey

1025

1026 French Bat Survey.

1027 Volunteer-based standardized monitoring schemes have been widely implemented in Europe and
1028 North America (Jiguet et al., 2012). In France, the National Museum of Natural History (MNHN)
1029 initiated the French Bat Survey (BS) in 2006. This scheme offers a dataset of 6774 sites with both
1030 habitat characterizations and bat identifications (28 species and 960 500 bat calls).

1031

1032 Counting methods

1033 The French BS recruits keen volunteers to count bats twice per year: once from 15th June to 31st 1034 July, and a second time from 15th August to 30th September. Two different versions are used: road 1035 survey by car and count point. Count point: this method consists of a square of 2 km per-side 1036 randomly chosen (by the MNHN) within a radius of 10 km from the observer's home, (i.e., in 1037 average one square randomly chosen from among 80 possible squares). Within this square ten point 1038 counts are chosen by the observer with at least five points counts representative of the habitats of 1039 the square and the other being located in 'favorable' places for bats such wetlands, wood edges, etc. 1040 Road survey: the choice of the circuit is delegated to the volunteers because the main constraint is 1041 related to their safety. The circuit must be performed at night at low speed (recording at constant 1042 speed: 30 ± 5 km/h), and this excludes non-paved roads, roads with heavy traffic and high-speed 1043 roads. Only volunteers, with their local knowledge of the field, are able to identify such roads. All 1044 roads are thus of similar size, appriximately 10 meters across. Observers were asked to choose a 1045 road circuit of at least 30 km and located within a 10 km radius around their house. The circuit must

1046 not overlap itself. The second requirement is to design a circuit that crosses, as proportionally as 1047 possible, the different habitats present in the area. To avoid biases in habitat sampling (we assume 1048 that observers would tend to follow rich habitats), the MNHN validates the circuit and randomly 1049 defines a starting point on the circuit. Starting from this point, the circuit is divided into ten 2-km 1050 road segments, separated by 1-km road segments in which no recording is performed. These 1051 sampling designs allow quite good correlations between the habitat proportions sampled and the 1052 habitat proportions present at the national scale ($R^2 = 0.94$), except for urban areas which were 1053 slightly more represented in our sampling.

1054

1055 Assessment of specializations indices

1056 The French national bat monitoring volunteers were involved in collecting habitat variables on a 1057 detailed and adapted basis. Habitat information is recorded on the first reconnaissance visit to the 1058 circuit. The appropriate habitat codes are chosen from an established hierarchical system allowing 1059 the description of more than 950 habitat types, which is very similar to the widely used habitat 1060 codes in bird monitoring schemes (see Crick 1992 for the UK and Barnagaud et al., 2012 for the 1061 French monitoring)but is adapted to account for bat foraging specifics and particularly linear 1062 element (for details about the French Bat monitoring website more see the 1063 [http://vigienature.mnhn.fr/page/releves-d-habitats]). Habitat classes are collected in a radius of 100 1064 m around the sampled point and grouped into 18 classes to obtain sufficient numbers of samples per 1065 class (for more methodological information see Julliard et al., 2006; DeVictor et al., 2008; 1066 Kerbiriou et al. 2010).

1067

1068 Specialization species index (SSI)

We calculated the species specialization index (SSI), which is the degree of habitat specialization
for a species, as the coefficient of variation (SD/mean) of its densities across habitats following the

1071	approach of Julliard et al.(2006). SSI is thus independent of species habitat preferences. However, it
1072	is also possible to assess the species specializations for forest habitats by calculating the average
1073	density of a species inventoried in forest habitats divided by the average density in non-forest
1074	habitats.

Bat species	Habitat Specialization Index
Barbastella barbastellus	3.64
Eptesicus serotinus	1.50
Myotis myotis	NA
Myotis daubentonii	3.48
Myotis mystacinus	3.86
Myotis nattereri	2.40
Nyctalus leisleri	0.95
Nyctalus noctula	1.58
Pipistrellus kuhlii	0.75
Pipistrellus nathusii	3.06
Pipistrellus pipistrellus	0.54
Pipistrellus pygmaeus	1.79
Plecotus spp (mainly austriacus)	1.36
Rhinolophus hipposideros	NA

1077 Table F1: Habitat Specialization Index

1078

1079 Assessment of bat community specializations indices

1080 The Community Specialisation Index (CSI) is calculated as the arithmetic mean of the species 1081 specialization index (SSI) of the species detected, weighted by the abundances (Julliard et al., 2006) 1082 (Eq. (2)).

1083
$$\text{CSI}_{j} = \frac{\sum_{i=1}^{n} a_{ij} (\text{SSI}_{i})}{\sum_{i=1}^{n} a_{ij}}$$
 (2)

1084 where *n* is the total number of species recorded, a_{ij} is the abundance of individuals of species *i* (with 1085 a specialization index SSI) in segment j (Devictor et al., 2008).

1087	To calculate the <i>Myotis</i> group CSI, we used the total number of calls identified as from <i>Myotis</i>
1088	species and the average of the CSI values calculated for identified Myotis species.

1089

1090 The CSI reflects the relative abundance of more or less specialized species in local assemblages 1091 and is therefore expected to decrease following the relative declines of specialists (species with a 1092 high SSI). For the analyses, we used only sites with a non-null abundance (n = 44 for bats and n=331093 for Orthoptera, i.e., 65% and 85% of the respective data sets) because a null CSI does not describe a 1094 generalist community.

1095

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1116 14 Appendix G: Details of the statistical analysis

1117

1118 Appendix G1. Graphical abstract of the calculation at a given scale



- 1119
- 1120
- 1121

1122 Appendix G2 Models used (=final models) for each species and community to assess the

1123 influence of variables density, structural diversity and potential wood production

1124

For all the species and communities, we used a zero-inflated GLM with a negative binomial distribution (ZANB) except for Plecotus spp., both CSI analyses, and the gleaner group for which we used a GLM with a negative binomial distribution (GLM.nb) (Zuur et al. 2010) For some species such as *B. barbastellus* and the Orthopera species that had uninterrupted calls, we reported (pres/abs) for presence/absence and used the binomial model of the ZANB;for the others, we used the count model (Zuur et al 2009).

1131 Thus, our statistical models were structured as follows:

1132 1133 Orthoptera 1134 presence/absence response variable • 1135 *T. viridissima~ date+TAS+temperature+wind+dist_hedgerow+PG+X+autocov* 1136 *R. nitidula* ~ *date*+*TAS*+*temperature*+*wind*+*dist_hedgerow*+*PG*+*X*+*autocov* 1137 *M.* roeselii ~ date+TAS+temperature+wind+dist hedgerow+PG+X+autocov 1138 *P. falcata* ~*dist_hedgerow*+*PG*+*X* 1139 • activity 1140 *P. griseoaptera~ date+TAS+temperature+wind+dist_hedgerow+PG+X+autocov* 1141 U. rugosicollis~ date+TAS+temperature+wind+dist_hedgerow+PG+X+autocov 1142 *P. nana~ dist_hedgerow+PG+X+autocov* 1143 *L. punctassima~ date+TAS+temperature+wind+dist_hedgerow+PG+X+autocov* 1144 *P. albopunctata~dist_hedgerow+PG+X* 1145 C. dorsalis~ date+TAS+temperature+wind+dist_hedgerow+PG+X+autocov 1146 *P. tessellata~ date+TAS+temperature+wind+dist_hedgerow+PG+X+autocov* 1147 *Mobility~ date+TAS+temperature+wind+dist_hedgerow+PG+X+autocov* 1148 *Sedentary~ date+TAS+temperature+wind+dist_hedgerow+PG+X+autocov* 1149 *Intermediate* ~ *date*+*TAS*+*temperature*+*wind*+*dist_hedgerow*+*PG*+*X*+*autocov* 1150 *CSI~ date+TAS+temperature+wind+dist_hedgerow+PG+X+autocov* 1151 1152 ✤ Chiroptera 1153 presence/absence response variable • 1154 *B. barbastellus~ dist_hedgerow+PG+X* 1155 activity • 1156 *Myotis spp.* ~ $date+TAS+temperature+dist_hedgerow+PG+X$ 1157 *N. noctula~date+dist_hedgerow+PG+X* 1158 *P. pipistrellus* ~*date*+*TAS*+*temperature*+*wind*+*dist_hedgerow*+*PG*+*X*+*autocov* 1159 *P. kuhlii~ date+TAS+temperature+wind+dist_hedgerow+PG+X+autocov* 1160 *P. nathusii~ date+TAS+temperature+wind+dist_hedgerow+PG+X+autocov*

- *Plecotus spp.* ~ *date+TAS+temperature+wind+dist_hedgerow+PG+X+autocov*
- 1162 E. Serotinus~ date+TAS+temperature+wind+dist_hedgerow+PG+X+autocov
- 1163 N. leisleri~ date+TAS+temperature+wind+dist_hedgerow+PG+X+autocov
- *Aerial ~date+TAS+temperature+wind+dist_hedgerow+PG+X+autocov*
- *Gleaner~ date+TAS+temperature+wind+dist_hedgerow+PG+X+autocov*
- 1166 CSI~ date+TAS+temperature+wind+dist_hedgerow+PG+X+autocov
- 1168 Where
- *date* is the date in continuous format
- *TAS* is the time after sunset (in minutes)
- *wind* is the wind speed (in km/s)
- *dist_hedgerow* is the distance to the nearest hedgerow
- *PG* is the proportion of grassland
- *X* is replaced by the hedgerows characteristic i.e., density or diversity or productivity index.
- *autocov* is an autocovariate function (i.e., a distance-weighted function of neighboring response
- 1176 values; Dormann et al. 2007) with the autocov_dist function in R (package spdep, Bivand et al.
- 1177 2011).

1179 Appendix G3. Graphical abstract of the calculation across scale

Final model Abundance ~ selected co variables (i.e. autocovariate, Sampling condition, Environmental characteristics) + hedgerow characteristic;



15 Appendix H: Inflection points and slopes for species and groups with segmented method for linear landscape element

density, diversity and production

		Linear l	lands	scape	elemen	t densit	y	Linear l	andsca	pe elei	nent di	versity		Linear l	andsca	pe elei	nent pr	oductivi	ty
Species		Estimat e	SE	t value	CI (95%). 1	CI (95%). u	inflectio n point	Estimat e	SE	t value	CI (95%).l	CI (95%). u	inflectio n point	Estimat e	SE	t value	CI (95%).l	CI (95%).u	inflectio n point
	slope1	-2.90E-04	0.02	-0.011	-0.064	0.064		-0.001	0.002	-0.295	-0.006	0.004	170.00						
1. viridissima	slope2	0.109	0.10	1.091	-0.127	0.344	613.67	0.005	0.004	1.262	-0.004	0.014	479.33						
D	slope1	-1.052	0.22	-4.681	-1.583	-0.521	110 (1							-7.06E-07	2.57E- 06	-0.275	-6.79E- 06	5.38E-06	C10.02
K . nittaula	slope2	0.069	0.02 4	2.879	0.012	0.126	110.61							3.10E-06	1.04E- 05	0.299	-2.14E- 05	2.76E-05	649.03
U.	slope1							0.001	0.002	0.309	-0.005	0.007							
rugosicollis	slope2							0.029	0.009	3.049	0.006	0.051	490.53						
M	slope1							0.001	1.82E- 04	3.299	1.70E- 04	0.001	52(20						
viodinty	slope2							-0.001	3.46E- 04	-4.108	-0.002	-0.001	526.39						
В.	slope1							0.011	0.010	1.117	-0.012	0.035	102.05						
barbastellus	slope2							-0.001	0.001	-0.916	-0.004	0.002	198.95						
	slope1							0.008	0.004	1.778	-0.003	0.018	400.04						
N. noctula	slope2							-0.010	0.006	-1.796	-0.023	0.003	428.84						
D · · · / 11	slope1							0.006	0.001	6.843	0.004	0.008	(22,41						
P. pipistrellus	slope2							-0.013	0.005	-2.702	-0.025	-0.002	633.41						
	slope1							0.006	0.001	5.399	0.003	0.008	520.02						
Aerial	slope2							-0.009	0.003	-2.903	-0.016	-0.002	530.93						
Cleaner	slope1							-0.005	0.003	-2.079	-0.011	0.001	620.60	6.60E-05	1.27E- 05	5.217	3.61E-05	9.60E-05	234 34
Gleaner	slope2							0.005	0.012	0.442	-0.023	0.033	029.00	-1.79E-05	4.61E- 06	-3.876	-2.87E- 05	-6.96E- 06	234.34

16 Appendix I: Average activities of bats and bush-crickets

Figure I1: Bat activities (mean numbers of contacts per minute and per site). *Barbastella barbastellus* (barbar), *Eptesicus serotinus* (eptser), *Myotis spp*. (myossp), *Nyctalus leisleri* (nyclei), *Nyctalus noctula* (nycnoc), *Pipistrellus kuhlii* (pikul), *Pipistrellus nathusii* (pinat), *Pipistrellus pipistrellus* (pippip), *Plecotus spp* (plesp)





Figure I2: Bush-cricket activities (A: mean numbers of contact per minute and per site for species with interrupted calls; *Conocephalus dorsalis* (condor), *Leptophye punctatissima* (leppun), *Phaneroptera nana* (phanan), *Pholidoptera griseoaptera* (phogri), *Platycleis albopunctata* (plaalb), *Platycleis tessellata* (plates), *Uromenus rugosicollis* (urorug). B: occurrence of species with uninterrupted calls *Metrioptera roeselii* (metroe), *Phaneroptera falcata* (phafal), *Ruspolia nitidula* (rusnit), *Tettigonia viridissima* (tevir).



17 Appendix J: Effects of density, diversity and wood production

Table J1: Effect of Density (estimate (Est), SE and p value)

		Species		50 m		1	100 m			200 m			300 m		4	400 m			500 m			600 m			700 m		:	800 m			900 m		1	1000 m	1
		/traits	Est.	SE	Pvalue	Est.	SE	Pvalue	Est.	SE	Pvalue	Est.	SE	Pvalue	Est.	SE	Pvalue	Est.	SE	Pvalue	Est.	SE	Pvalue	Est.	SE	Pvalue	Est.	SE	Pvalue	Est.	SE	Pvalue	Est.	SE	Pvalue
	slle	viridissima	-11.92	24.31	0.62	8.33	32.63	0.80	12.82	45.13	0.78	9.12	53.56	0.86	-11.45	62.18	0.85	-19.00	73.36	0.80	-8.89	79.46	0.91	6.27	81.91	0.94	15.87	84.13	0.85	33.20	90.18	0.71	36.95	83.11	0.66
	us ci	R. nitidula	42.77	32.16	0.18	-9.82	42.84	0.82	-19.01	57.88	0.74	-21.53	67.77	0.75	2.72	79.23	0.97	38.50	96.19	0.69	44.88	108.75	0.68	28.85	111.97	0.80	9.75	114.53	0.93	21.55	123.86	0.86	24.05	114.26	0.83
	tinuc	M. roeselii	-12.24	23.82	0.61	-1.70	32.91	0.96	37.01	45.52	0.42	42.34	54.48	0.44	52.65	63.04	0.40	63.96	75.56	0.40	77.51	86.73	0.37	66.83	89.65	0.46	40.41	92.73	0.66	33.19	99.21	0.74	13.93	94.61	0.88
	con	P. falcata	22.26	76.93	0.77	-25.11	96.61	0.79	-50.19	147.61	0.73	-67.08	157.41	0.67	-45.10	160.13	0.78	-47.48	180.57	0.79	-48.09	202.32	0.81	-50.26	211.34	0.81	4.26	224.53	0.98	43.78	238.00	0.85	70.23	207.94	0.74
	<i>n</i>	L.	5.76	21.67	0.79	-28.85	30.30	0.34	-23.77	49.79	0.63	-21.14	51.29	0.68	-22.24	62.22	0.72	30.69	73.00	0.67	53.44	71.64	0.46	48.06	69.06	0.49	52.69	66.21	0.43	73.65	64.65	0.25	91.77	51.23	0.07
	sl	C. dorsalis	41.83	26.75	0.12	22.03	21.29	0.30	32.06	27.94	0.25	-17.42	33.66	0.60	-11.22	44.37	0.80	-18.27	62.03	0.77	-31.59	82.89	0.70	-29.73	94.74	0.75	-11.97	106.55	0.91	49.14	135.07	0.72	95.01	76.65	0.22
sra	is cal	P.	5.15	67.38	0.94	51.20	116.94	0.66	163.70	127.11	0.20	278.99	125.29	0.03	311.25	141.47	0.03	354.58	149.36	0.02	335.72	128.54	0.01	368.40	136.20	0.01	339.94	128.16	0.01	345.92	130.00	0.01	346.58	123.66	0.01
opte	nuor	P. nana	199.80	84.84	0.02	138.12	135.79	0.31	254.23	116.21	0.03	371.44	194.97	0.06	174.41	295.36	0.55	94.23	274.59	0.73	131.43	323.18	0.68	205.51	2498.71	0.93	179.65	NaN	NaN	411.94	227.43	0.07	250.30	347.98	0.47
Orth	conti	U.	-27.41	3.21	0.00	-68.83	7.78	0.00	-62.25	6.53	0.00	-93.92	7.38	0.00	-187.19	10.80	0.00	-265.60	11.77	0.00	-384.47	15.53	0.00	-441.07	20.14	0.00	-554.36	30.69	0.00	-614.64	44.04	0.00	NA	NA	NA
Ŭ	non	P. tessellata	-4.71	52.67	0.93	9.64	71.34	0.89	15.65	67.09	0.82	-8.36	72.05	0.91	-16.63	97.65	0.86	-23.97	129.87	0.85	-27.57	143.00	0.85	-20.57	152.46	0.89	-55.27	191.97	0.77	-69.07	239.22	0.77	-94.89	217.71	0.66
	F	Р.	-24.03	76.99	0.75	-283.00	47.28	0.00	-202.25	878.74	0.82	-81.33	NaN	NaN	11.69	643.00	0.99	68.08	1001.76	0.95	180.85	5909.55	0.98	223.94	NaN	NaN	323.95	NaN	NaN	1017.17	324.85	0.00	558.78	567.55	0.32
-	а	lbopunctata CSI	6.83	21.05	0.75	1 04	30.28	0.97	-6 35	41 39	0.88	-2 54	48.74	0.96	-3 35	56 52	0.95	3.05	65.89	0.96	10.66	71 92	0.88	13.07	76.21	0.86	22.97	81 30	0.78	31.86	90.76	0.73	34.05	101 70	0.74
-	t	Mobility	0.00	6.80	0.88	2 30	9.42	0.57	4 46	13.28	0.00	5 16	15 79	0.50	9 34	17.85	0.55	12.83	21 24	0.50	14.94	23.93	0.53	15.07	24 41	0.53	16.78	25.19	0.51	19.08	26.67	0.75	22 37	9 52	0.02
	ity trai	Sedentary	-7 20	25 27	0.00	-41.86	40.14	0.30	-19.08	18.20	0.21	-60.38	53.40	0.74	-69.44	63.01	0.00	-65.94	73 13	0.33	_/0 77	72.24	0.35	-60.22	75.04	0.33	-71 30	78 70	0.31	-77 70	85.03	0.47	-10 01	86.88	0.57
	Mobili	ntermediate	18 51	2 J. J /	0.77	34.60	11.88	0.30	50 21	20.80	0.01	-00.58	28 65	0.20	28.22	32 44	0.28	25 81	/3.13	0.37	-49.77	/2.24	0.43	-00.22	51.00	0.42	-71.35	51.00	0.50	-77.70	51 00	0.57	-45.54	54.61	0.57
	-	B.	10.31	20.21	0.64	54.05	E1 72	0.00	07.56	20.00	0.00	02.05	20.05	0.12	04.29	04.91	0.24	02.54	115 01	0.41	05.01	122 55	0.85	120.65	120.62	0.75	122.40	121 22	0.07	125.15	141 01	0.00	124.22	127 45	0.30
	l	parbastellus	-10.59	50.25	0.05	30.07	51.75	0.20	97.50	72.11	0.18	95.65	61.55	0.25	94.56	94.01	0.52	92.54	115.61	0.42	95.01	125.55	0.44	120.05	129.02	0.55	125.74	151.52	0.55	125.15	141.91	0.56	124.52	157.45	0.57
		E. serotinus	-53.03	18.04	0.00	-42.94	68.86	0.53	40.59	65.02	0.53	-48.08	59.03	0.42	-/3.36	61.41	0.23	-//.5/	54.08	0.15	-78.00	49.33	0.11	-84.52	47.42	0.07	-113.84	43.16	0.01	-119.23	51.67	0.02	-20.21	/1./1	0.78
a	Ľ	Myotis spp.	-39.60	18.52	0.03	45.82	1.51	0.00	126.78	43.67	0.00	170.75	53.89	0.00	261.13	/2.4/	0.00	306.27	79.86	0.00	332.40	87.57	0.00	304.06	/8.24	0.00	326.50	30.19	0.00	403.42	101.14	0.00	429.73	NaN	NaN
pter	-	N. leisleri	-26.23	43.47	0.55	14.20	32.49	0.66	6.98	48.54	0.89	-39.68	68.87	0.56	-42.63	101.25	0.67	-109.54	124.98	0.38	-114.24	113.79	0.32	-95.00	104.39	0.36	-102.28	109.27	0.35	-80.11	128.67	0.53	-48.71	125.40	0.70
hiro	-	N. noctula	11.72	10.99	0.29	-1.93	9.03	0.83	15.78	20.99	0.45	39.31	18.31	0.03	47.29	19.65	0.02	55.90	22.83	0.01	56.30	29.73	0.06	51.19	33.40	0.13	39.01	33.46	0.24	33.75	35.27	0.34	34.68	36.83	0.35
Ü	_	P. kuhlii	20.03	24.64	0.42	45.98	29.58	0.12	73.62	43.59	0.09	82.64	58.71	0.16	79.31	67.69	0.24	69.09	80.60	0.39	112.76	89.22	0.21	141.81	94.35	0.13	157.16	104.27	0.13	185.76	111.94	0.10	44.10	116.31	0.70
	_	P. nathusii	16.41	16.88	0.33	36.84	23.42	0.12	56.56	31.34	0.07	65.86	36.56	0.07	73.34	40.82	0.07	84.35	47.72	0.08	106.26	50.57	0.04	119.74	52.44	0.02	137.01	55.26	0.01	153.94	59.84	0.01	167.27	56.34	0.00
	P	pipistrellus	-21.20	16.90	0.21	-16.86	20.64	0.41	-9.93	25.69	0.70	1.52	29.97	0.96	10.78	34.44	0.75	12.95	40.61	0.75	13.42	47.43	0.78	11.41	51.72	0.83	14.91	57.47	0.80	13.97	64.24	0.83	17.55	57.63	0.76
	F	lecotus spp.	114.90	82.63	0.16	33.29	10.02	0.00	94.70	15.23	0.00	99.51	16.13	0.00	69.81	18.37	0.00	45.96	21.56	0.03	31.06	21.12	0.14	27.17	22.04	0.22	40.66	22.36	0.07	68.48	23.57	0.00	64.38	24.73	0.01

]	CSI	1.48	8.80	0.87	3.05	12.14	0.80	3.05	16.50	0.85	5.92	19.67	0.76	4.17	22.73	0.85	6.44	26.76	0.81	10.86	30.14	0.72	12.02	31.45	0.70	14.56	33.20	0.66	15.43	36.01	0.67	13.84	38.99	0.72
uigi		Aerial	4.49	22.52	0.84	43.04	31.82	0.18	65.14	40.04	0.10	76.99	47.52	0.11	101.42	51.09	0.05	113.76	60.48	0.06	143.81	67.69	0.03	157.05	73.15	0.03	170.06	81.01	0.04	190.76	86.49	0.03	215.30	72.32	0.00
FOI2	•	Gleaner	-35.78	39.79	0.37	162.07	61.85	0.01	238.21	87.94	0.01	270.35	97.83	0.01	160.65	97.26	0.10	134.25	115.76	0.25	174.39	132.45	0.19	244.90	148.52	0.10	298.81	157.62	0.06	328.65	176.86	0.06	336.35	194.37	0.08

		S		50 m			100 n	1		200 n	1		300 m	I		400 m	l		500 m	L		600 m	ı		700 m	l		800 m	L		900 m	1		1000 n	1
		Species /traits	Est.	SE	Pvalue	Est.	SE	Pvalue	Est.	SE	Pvalue	Est.	SE	Pvalue	Est.	SE	Pvalue	Est.	SE	Pvalue	Est.	SE	Pvalue	Est.	SE	Pvalue	Est.	SE	Pvalue	Est.	SE	Pvalue	Est.	SE	Pvalue
	alls	T. viridissima	-0.77	0.86	0.37	0.61	0.77	0.43	0.70	0.92	0.45	-0.48	0.95	0.61	-0.41	1.28	0.75	-0.55	1.94	0.78	0.37	2.27	0.87	0.74	2.66	0.78	0.61	3.13	0.84	0.97	3.47	0.78	2.70	3.74	0.47
	ous ca	R. nitidula	-0.11	1.01	0.92	0.40	0.99	0.69	0.58	1.08	0.59	0.13	1.15	0.91	-0.31	1.59	0.85	-0.10	2.53	0.97	-4.05	3.19	0.20	-3.77	3.76	0.32	-4.62	4.68	0.32	-2.89	5.15	0.58	-3.95	5.79	0.49
	tinuc	M. roeselii	-0.79	0.85	0.36	1.75	0.96	0.07	3.16	1.22	0.01	1.72	1.32	0.19	2.06	1.61	0.20	3.48	2.40	0.15	1.61	2.56	0.53	1.85	3.06	0.55	1.34	3.93	0.73	2.54	4.68	0.59	5.92	4.58	0.20
	con	P. falcata	-0.28	2.49	0.91	0.52	1.95	0.79	-0.42	2.04	0.84	0.07	1.96	0.97	2.02	2.53	0.43	5.05	3.24	0.12	5.23	3.88	0.18	5.77	4.72	0.22	5.63	6.57	0.39	3.17	8.04	0.69	0.14	6.59	0.98
		L. punctatissima	1.30	0.52	0.01	-0.77	0.70	0.27	0.70	0.77	0.36	-0.21	0.80	0.79	-1.31	1.22	0.28	-0.57	1.85	0.76	-4.50	1.62	0.01	-5.51	1.46	0.00	-5.82	1.88	0.00	-8.36	2.32	0.00	-7.59	2.05	0.00
	alls	C. dorsalis	-0.44	0.84	0.60	1.13	0.89	0.20	0.84	0.88	0.34	0.80	1.64	0.63	0.22	2.61	0.93	-1.18	4.42	0.79	1.78	4.42	0.69	-1.69	5.64	0.76	-4.54	6.19	0.46	-5.25	5.82	0.37	-3.32	7.42	0.65
tera	ous ca	P. griseoaptera	-2.44	1.74	0.16	-2.43	2.32	0.29	3.97	3.74	0.29	1.48	5.59	0.79	1.37	5.67	0.81	1.04	6.62	0.88	-4.72	5.84	0.42	-8.38	5.65	0.14	-9.71	5.55	0.08	-14.23	7.16	0.05	-16.70	4.40	0.00
dou	ıtinuc	P. nana	-4.93	6.53	0.45	6.51	3.31	0.05	3.32	2.31	0.15	5.17	2.28	0.02	-21.27	9.79	0.03	13.71	7.56	0.07	-27.09	7.35	0.00	-24.22	6.79	0.00	-31.48	13.32	0.02	-43.48	14.91	0.00	-54.84	11.08	0.00
Cr	n-con	U. rugosicollis	-2.71	0.38	0.00	-0.27	0.06	0.00	-0.22	0.09	0.01	-0.58	0.29	0.05	-3.24	1.50	0.03	-3.12	1.18	0.01	5.16	1.66	0.00	3.70	0.91	0.00	6.08	1.24	0.00	14.04	6.55	0.03	12.30	1.37	0.00
	noi	P. tessellata	-0.63	NA	NA	0.42	1.01	0.68	0.26	1.21	0.83	0.23	1.79	0.90	0.64	2.11	0.76	3.08	3.79	0.42	4.19	4.46	0.35	8.84	7.79	0.26	15.25	10.81	0.16	10.91	12.17	0.37	22.67	4.64	0.00
		P. albopunctata	-0.77	1.96	0.69	-5.74	0.34	0.00	-9.35	3.42	0.01	-12.23	4.04	0.00	-19.08	3.75	0.00	-18.13	3.50	0.00	NA	NA	NA	NA	NA	NA									
		CSI	-0.09	0.76	0.91	-0.18	0.68	0.79	-0.11	0.73	0.88	0.25	0.82	0.76	0.38	1.07	0.72	0.43	1.62	0.79	0.32	1.93	0.87	0.17	2.22	0.94	-0.20	2.63	0.94	-0.44	3.16	0.89	-0.73	3.64	0.84
	trait	Mobility	-0.02	0.22	0.94	0.15	0.24	0.55	0.12	0.26	0.64	0.09	0.30	0.75	0.25	0.39	0.53	0.40	0.56	0.47	0.19	0.64	0.76	0.10	0.76	0.90	-0.09	0.92	0.92	-0.18	1.02	0.86	-0.36	0.38	0.34
	bility	Sedentary	0.38	1.08	0.73	0.09	0.69	0.89	0.10	0.91	0.91	-0.24	1.09	0.83	0.03	1.31	0.98	1.23	1.93	0.52	0.51	2.23	0.82	1.19	2.65	0.65	1.91	2.93	0.51	1.44	3.39	0.67	1.57	2.59	0.54
	Mc	Intermediate	0.66	0.32	0.04	1.29	0.38	0.00	1.05	0.68	0.13	-0.89	0.65	0.17	-0.96	0.80	0.23	-0.81	1.18	0.49	-0.73	1.27	0.57	0.63	1.63	0.70	1.64	1.73	0.34	2.46	1.96	0.21	2.01	2.08	0.33
		B. barbastellus	0.74	1.32	0.58	1.15	1.28	0.37	2.94	1.99	0.14	2.50	2.26	0.27	1.45	2.07	0.48	1.55	2.90	0.59	1.35	3.67	0.71	0.73	4.27	0.87	2.34	5.03	0.64	1.98	5.51	0.72	3.81	5.70	0.50
		E. serotinus	-0.28	0.46	0.54	0.78	0.41	0.06	1.32	0.53	0.01	3.97	1.01	0.00	3.04	1.26	0.02	3.57	1.51	0.02	3.41	1.22	0.00	3.72	1.07	0.00	4.33	0.82	0.00	6.19	0.77	0.00	6.00	1.25	0.00
		Myotis spp.	1.49	0.51	0.00	1.16	0.86	0.18	3.84	1.91	0.04	5.80	1.62	0.00	5.29	1.40	0.00	7.59	1.96	0.00	8.66	2.20	0.00	10.89	2.99	0.00	31.51	8.46	0.00	15.36	8.10	0.06	46.68	7.53	0.00
		N. leisleri	0.25	1.71	0.88	1.56	1.01	0.12	1.63	1.52	0.28	0.94	2.33	0.68	0.98	2.45	0.69	4.19	4.23	0.32	4.50	3.82	0.24	5.29	3.11	0.09	6.76	2.73	0.01	6.73	3.63	0.06	10.65	3.11	0.00
сa		N. noctula	0.44	0.57	0.44	-0.20	0.51	0.70	2.03	0.51	0.00	-0.81	1.35	0.55	4.29	2.32	0.06	3.48	2.26	0.12	0.18	2.32	0.94	0.22	2.23	0.92	-0.80	1.96	0.68	-1.63	1.80	0.36	-2.39	1.64	0.14
ptei		P. kuhlii	1.04	0.84	0.22	0.57	0.92	0.53	1.60	0.74	0.03	1.43	1.03	0.17	3.46	1.70	0.04	3.60	2.45	0.14	3.35	3.05	0.27	2.04	3.17	0.52	1.82	3.56	0.61	0.24	4.01	0.95	2.79	3.80	0.46
hirc		P. nathusii	1.21	0.52	0.02	-0.44	0.63	0.49	1.73	0.67	0.01	1.36	0.95	0.15	1.33	1.35	0.32	1.98	1.92	0.30	-1.67	1.93	0.39	-4.56	2.10	0.03	-5.07	2.46	0.04	-6.57	2.94	0.03	-4.57	2.93	0.12
5		P. pipistrellus	-0.56	0.50	0.27	-0.66	0.43	0.13	-0.39	0.49	0.43	0.47	0.63	0.46	1.68	0.95	0.08	2.07	1.31	0.11	3.45	1.79	0.05	1.73	1.97	0.38	0.81	2.14	0.70	-1.05	2.43	0.67	-2.11	2.33	0.37
		Plecotus spp.	-3.40	0.39	0.00	0.07	0.17	0.67	0.31	0.22	0.17	0.19	0.23	0.40	-0.97	0.27	0.00	-2.97	0.49	0.00	-4.89	0.68	0.00	-5.11	0.76	0.00	-3.42	0.75	0.00	-3.74	0.81	0.00	-3.33	0.85	0.00
		CSI	-0.05	0.30	0.86	0.05	0.29	0.87	0.09	0.33	0.77	0.28	0.40	0.48	0.31	0.53	0.56	0.36	0.80	0.66	0.04	0.95	0.97	-0.32	1.12	0.77	-0.90	1.35	0.50	-0.91	1.56	0.56	-0.93	1.77	0.60
	raging rait	Aerial	0.45	0.71	0.53	0.48	0.78	0.53	1.35	0.69	0.05	1.76	0.88	0.05	3.84	1.37	0.01	4.61	1.87	0.01	4.63	2.49	0.06	1.89	2.64	0.47	0.69	2.88	0.81	-1.42	3.27	0.67	-0.65	3.40	0.85
	For t	Gleaner	-2.13	1.19	0.07	0.41	0.95	0.67	0.30	1.06	0.78	-0.13	1.06	0.90	-1.24	1.41	0.38	-3.32	2.39	0.17	-5.96	3.25	0.07	-7.12	3.79	0.06	-9.58	4.30	0.03	-7.94	4.63	0.09	-6.83	4.95	0.17

		Snecies /traits		50 m			<u>100 m</u>	1		<u>200 m</u>			<u>300 m</u>			400 m			<u>500 m</u>			600 m			700 m			800 m			900 m		1	.000 m	i
		Species /trans	Est.	SE	Pvalue	Est.	SE	Pvalue	Est.	SE	Pvalue	Est.	SE	Pvalue	Est.	SE	Pvalue	Est.	SE	Pvalue	Est.	SE	Pvalue	Est.	SE	Pvalue	Est.	SE	Pvalue	Est.	SE	Pvalue	Est.	SE	Pvalue
	~	T. viridissima	-2.94E-	1.07E-	9.78E-	1.21E-	1.41E-	9.32E-	9.07E-	2.12E-	6.69E-	1.38E-	2.68E-	6.07E-	6.64E-	3.05E-	8.28E-	5.64E-	3.56E-	8.74E-	6.98E-	3.94E-	8.59E-	1.19E-	4.12E-	7.72E-	1.63E-	4.23E-	6.99E-	2.70E-	4.48E-	5.47E-	3.35E-	4.11E-	4.15E-
	alls-		05	03	01	2.805	03	01	04	03	01	03	03	01	04	03	01	04	03	01	04	03	01	03	03	01	03	03	01	03	03	01	03	03	01
	us c	R. nitidula	1.67E- 03	1.37E- 03	2.24E- 01	-3.89E-	1.81E- 03	01	-3.25E- 04	2.56E- 03	8.99E-	-1.34E- 04	3.16E-	9.66E-	4.11E- 04	3.77E-	9.13E- 01	1.85E- 03	4.51E- 03	0.82E- 01	2.01E- 03	5.19E- 03	6.99E- 01	9.00E- 04	5.44E- 03	8.69E- 01	3.51E- 04	5.59E- 03	9.50E- 01	9.25E- 04	03	8.77E-	1.75E- 03	5.57E- 03	7.53E- 01
	Ioni	14 11	1.83E-	1.09E-	8.67E-	7.95E-	1.46E-	5.86E-	2.52E-	2.03E-	2.14E-	2.61E-	2.53E-	3.02E-	2.49E-	2.94E-	3.96E-	3.22E-	3.53E-	3.61E-	4.23E-	4.20E-	3.14E-	3.47E-	4.40E-	4.31E-	1.81E-	4.50E-	6.87E-	1.32E-	4.74E-	7.80E-	8.85E-	4.60E-	9.85E-
	ntir	M. roeselii	04	03	01	04	03	01	03	03	01	03	03	01	03	03	01	03	03	01	03	03	01	03	03	01	03	03	01	03	03	01	05	03	01
	CO]	P. falcata	1.27E-	2.74E-	6.42E-	1.26E-	3.76E-	9.73E-	-7.14E-	6.73E-	9.16E-	-2.78E-	8.14E-	7.33E-	-2.54E-	7.91E-	7.48E-	-2.63E-	8.94E-	7.69E-	-3.09E-	1.03E-	7.64E-	-3.37E-	1.08E-	7.55E-	8.80E-	1.14E-	9.94E-	2.37E-	1.16E-	8.39E-	2.70E-	1.02E-	7.91E-
F		I	03 -2.87F-	03 8 83F-	01 9 74F-	-1 09F-	03 1 22F-	01 3 73F-	04 -1 38F-	03 2 53F-	01 9.96F-	03 6 51F-	03 2 59F-	01 9 80F-	03 -6 72E-	03 3 10F-	01 8 28F-	03 2.08F-	03 3 55F-	01 5 59F-	03 3 10F-	02 3 54F-	01 3 81F-	03 2 71F-	02 3.46F-	01 4 34F-	05 2 51F-	02 3 35F-	01 4 54F-	03 3 3/F-	02 3 27F-	01 3.07F-	03 // 18F-	02 2.68F-	01 1 19F-
		L. punctatissima	05	0.031	01	03	03	01	05	03	01	0.511	03	01	0.721	03	0.201	03	03	01	03	03	01	03	03	01	03	03	01	03	03	01	03	03	01
	Ē	C dorealis	2.36E-	1.06E-	2.64E-	1.27E-	8.93E-	1.55E-	1.85E-	1.15E-	1.09E-	1.47E-	1.55E-	9.24E-	3.42E-	2.14E-	8.73E-	6.16E-	3.13E-	8.44E-	8.19E-	4.43E-	8.53E-	6.03E-	4.82E-	9.01E-	7.24E-	5.03E-	8.86E-	2.68E-	5.86E-	6.47E-	3.51E-	3.54E-	3.21E-
	lls	C. aorsans	03	03	02	03	04	01	03	03	01	04	03	01	04	03	01	04	03	01	04	03	01	04	03	01	04	03	01	03	03	01	03	03	01
ra	S I	. griseoaptera	1.75E-	3.35E-	9.58E-	3.43E-	5.02E-	4.95E-	1.11E-	6.19E-	7.26E-	1.95E-	6.13E-	1.46E-	2.41E-	7.97E-	2.49E-	2.55E-	8.53E-	2.79E-	2.27E-	7.35E-	1.99E-	2.37E-	7.87E-	2.63E-	2.12E-	7.31E-	3.69E-	2.01E-	7.19E-	5.27E-	1.98E-	6.98E-	4.60E-
pte	nor		04 9 29F-	1 55F-	01 5 /19F-	03 5.66F-	03 4 73F-	01 2 31F-	02 5.07F-	03 5 79F-	02 3 81F-	02 6.46E-	03 7 / 1 F-	03 3 83F-	02 1 15F-	03 9.42F-	03 9 03F-	-1 13F-	03 1 17F-	03 9.23F-	-6 12E-	03 1 37F-	03 9.64F-	02 6 775-	03 1 /1F-	03 9.62F-	02 5.40F-	03 1 53F-	03 7 25F-	02 2 55F-	03 1 /18F-	03 8 57F-	02 3.04F-	03 1 72F-	03 7 70F-
loq	tim	P. nana	03	02	01	03	03	01	03	03	01	0.401	03	01	03	03	01	03	02	01	0.121	02	01	0.771	02	01	03	02	01	02	02	0.571	02	02	02
)rt	con	T rugosicollis	-9.14E-	1.37E-	2.83E-	4.63E-	1.10E-	2.47E-	-1.23E-	4.65E-	8.46E-	-1.16E-	5.63E-	3.96E-	-1.54E-	7.61E-	4.24E-	-1.91E-	7.27E-	8.72E-	-3.38E-	1.03E-	9.82E-	-4.93E-	1.31E-	1.58E-	-9.45E-	2.23E-	2.18E-	-9.78E-	2.77E-	4.26E-	-4.47E-	1.29E-	5.54E-
\cup	-uo	. rugosicoms	04	04	11	03	03	05	03	04	03	03	04	02	03	04	02	03	04	03	03	03	04	03	03	04	03	03	05	03	03	04	03	03	04
	ü	P. tessellata	1.13E- 03	6.43E-	8.60E- 01	2.34E- 03	NA	NA	2.36E- 03	3.17E- 03	4.56E- 01	1.75E- 03	3.62E- 03	6.29E- 01	1.81E- 03	4.73E- 03	7.02E- 01	1.57E- 03	5.79E- 03	7.87E- 01	3.66E- 04	6.13E- 03	9.52E- 01	-6.38E- 04	6.50E- 03	9.22E- 01	-2.09E- 03	8.06E- 03	7.95E- 01	-3.08E- 03	1.00E- 02	7.59E- 01	-5.12E- 03	1.06E- 02	6.29E- 01
	E	albonunctata	-5.32E-	3.05E-	8.61E-	-9.66E-	3.53E-	6.14E-	-1.87E-	8.33E-	2.51E-	-2.10E-	6.85E-	2.18E-	-1.76E-	6.12E-	4.10E-	-2.75E-	1.03E-	7.73E-	-5.80E-	3.09E-	6.06E-	7.79E-	7.47E-	2.97E-	1.21E-	1.05E-	1.09E-	5.75E-	1.75E-	1.02E-	NA	NA	NA
Ļ	r	. шооринский	04	03	01	03	03	03	02	03	02	02	03	03	02	03	03	02	02	03	02	02	02	02	02	01	01	02	30	02	02	03	INA	N/A	NA
		CSI	5.18E-	9.35E-	5.80E-	2.39E-	1.29E-	8.54E-	-2.27E-	1.83E-	9.01E-	-1.21E-	2.23E-	9.96E-	-6.96E-	2.65E-	9.79E-	2.47E-	3.08E-	9.36E-	5.73E-	3.51E-	8.70E-	6.18E-	3.80E-	8.71E-	1.14E-	4.03E-	7.78E-	1.61E-	4.39E-	7.14E-	1.72E-	4.80E-	7.19E-
F	-		7 55E-	2 73F-	7 82F-	9 60F-	3 81F-	8 01F-	2 91F-	5 65F-	6 07F-	4 62F-	7 10F-	5 15F-	6 32F-	8 13F-	4 37F-	7 92F-	9 64F-	4 11F-	04 8 94F-	1 12F-	4 24F-	04 8 85F-	1 16F-	4 45F-	9.83F-	1 19F-	4 09F-	1 11F-	05 1 25F-	3 76F-	1 26F-	4 76F-	8 34F-
	ait	Mobility	05	04	01	05	04	01	04	04	01	04	04	01	0.521	04	01	04	04	01	0.542	03	01	0.031	03	01	04	03	01	03	03	01	03	04	0.542
	ity tr	Sedentary	-2.06E-	1.17E-	8.60E-	-1.85E-	1.98E-	3.51E-	-2.44E-	2.36E-	3.01E-	-3.32E-	2.72E-	2.22E-	-3.78E-	3.23E-	2.42E-	-3.60E-	3.67E-	3.27E-	-2.99E-	3.68E-	4.17E-	-4.12E-	3.86E-	2.87E-	-5.03E-	4.11E-	2.21E-	-5.67E-	4.42E-	2.00E-	-6.75E-	4.49E-	1.32E-
	lido	Bedentary	04	03	01	03	03	01	03	03	01	03	03	01	03	03	01	03	03	01	03	03	01	03	03	01	03	03	01	03	03	01	03	03	01
	Μ	Intermediate	9.20E-	3.68E-	1.23E-	1.63E-	5.48E-	2.92E-	2.24E-	1.01E-	2.69E-	1.67E-	1.35E-	2.15E-	1.82E-	1.57E-	2.47E-	2.06E-	2.06E-	3.15E-	-2.42E-	2.37E-	9.92E-	-8.79E-	2.40E-	7.14E-	-1.43E-	2.36E-	5.46E-	-1.78E-	2.38E-	4.54E-	-2.10E-	2.52E-	4.04E-
	-		-9 63F-	1 80F-	9 96F-	3 03F-	2 23F-	1 73F-	5 57F-	3 25F-	8 67F-	5 11F-	3 82F-	1 81F-	4 72F-	4 44F-	2 88F-	5 21F-	5 36F-	3 31F-	5 32F-	5 83F-	3 61F-	6 62F-	6 17F-	2 83F-	6 21F-	6 04F-	3 04F-	6 44F-	6 32F-	3 08F-	6 46F-	6 04F-	2 85F-
	I	3. barbastellus	06	03	01	03	03	01	03	03	02	03	03	01	03	03	01	03	03	01	03	03	01	03	03	01	03	03	01	03	03	01	03	03	01
		F serotinus	-2.01E-	6.44E-	1.81E-	-4.35E-	1.66E-	8.86E-	1.59E-	2.63E-	5.47E-	-1.33E-	2.74E-	6.26E-	-2.47E-	3.12E-	4.28E-	-3.01E-	2.78E-	2.79E-	-3.01E-	2.58E-	2.43E-	-2.98E-	2.52E-	2.35E-	-4.11E-	2.49E-	9.86E-	-4.22E-	2.84E-	1.37E-	1.16E-	3.41E-	7.34E-
		ы веленины	03	04	03	03	03	03	03	03	01	03	03	01	03	03	01	03	03	01	03	03	01	03	03	01	03	03	02	03	03	01	03	03	01
		Myotis spp.	-2.54E-	1.24E-	4.04E- 02	2.79E-	1.5/E-	7.49E-	6.46E-	1.43E- 03	6.51E-	7.91E-	2.43E-	1.13E-	9.92E-	2.68E-	2.16E-	1.2/E-	3.29E-	1.07E-	1.41E- 02	3.56E-	/.//E- 05	1.41E- 02	3.55E-	7.51E- 05	1.50E-	3./3E-	5.66E-	1.84E- 02	4.45E-	3.72E-	1.97E-	1.5/E-	4.19E-
_	-		-6.22E-	2.22E-	7.80E-	5.47E-	1.53E-	7.21E-	7.12E-	2.23E-	7.50E-	1.07E-	3.26E-	9.74E-	-5.22E-	5.12E-	9.19E-	-4.19E-	6.66E-	5.29E-	-5.04E-	6.40E-	4.31E-	-3.63E-	5.67E-	5.22E-	-3.93E-	6.10E-	5.19E-	-2.24E-	6.90E-	7.45E-	-1.23E-	6.50E-	8.50E-
era		N. leisleri	04	03	01	04	03	01	04	03	01	04	03	01	04	03	01	03	03	01	03	03	01	03	03	01	03	03	01	03	03	01	03	03	01
opt		N. noctula	6.86E-	4.58E-	1.34E-	-2.58E-	1.87E-	9.89E-	6.93E-	9.96E-	4.86E-	1.72E-	8.65E-	4.68E-	2.02E-	9.99E-	4.33E-	2.68E-	1.13E-	1.76E-	3.13E-	1.53E-	4.11E-	2.87E-	1.77E-	1.05E-	2.12E-	1.72E-	2.17E-	1.82E-	1.76E-	3.00E-	1.85E-	1.78E-	2.97E-
JIT.	_		04	04	01	05	03	01	04	04	01	03	04	02	03	04	02	03	03	02	03	03	02	03	03	01	03	03	01	03	03	01	03	03	01
U		P. kuhlii	2.04E- 03	8.79E- 04	2.02E- 02	2.58E- 03	1.1/E- 03	02	4.22E- 03	1.91E- 03	2.70E- 02	5.43E- 03	2.50E- 03	2.96E- 02	5.33E- 03	3.18E- 03	9.34E- 02	4.91E- 03	3.83E- 03	2.00E- 01	6.79E- 03	4.25E- 03	1.11E- 01	8.11E- 03	4.42E- 03	0.64E-	9.08E- 03	4.74E- 03	5.53E- 02	1.08E- 02	4.96E- 03	2.89E- 02	1.08E- 02	4.96E- 03	2.89E- 02
		n .1 .:	1.25E-	6.77E-	6.39E-	1.25E-	6.77E-	6.39E-	2.93E-	1.38E-	3.38E-	3.82E-	1.72E-	2.59E-	4.15E-	1.94E-	3.27E-	4.92E-	2.23E-	2.76E-	6.13E-	2.43E-	1.15E-	6.87E-	2.54E-	6.78E-	7.45E-	2.67E-	5.27E-	8.13E-	2.81E-	3.87E-	8.68E-	2.69E-	1.29E-
		P. nathusu	03	04	02	03	04	02	03	03	02	03	03	02	03	03	02	03	03	02	03	03	02	03	03	03	03	03	03	03	03	03	03	03	03
		P. pipistrellus	-7.49E-	6.77E-	9.12E-	-5.01E-	8.28E-	5.45E-	-3.03E-	1.10E-	7.84E-	4.73E-	1.40E-	7.35E-	9.21E-	1.68E-	5.84E-	1.14E-	1.96E-	5.61E-	1.47E-	2.30E-	5.23E-	1.62E-	2.51E-	5.20E-	1.91E-	2.77E-	4.90E-	2.24E-	2.98E-	4.53E-	2.59E-	2.67E-	3.32E-
	\vdash	. 1	05 7 225	04 2 00F	01 6 365	04 1 15F	04 5 545	01	04 6 87F	03 7 25F	01 2 50F	04 4.65E	03 8 14F	01 1 10F	04 6 5 9 F	03 0.21F	01 4 70F	U3	03 1 10F	01 2.12F	03 -1 04F	03 1 1 1 F	01 8 1 2 E	U3	03 1 16F	01 2.45E	03 -4 70F	03 1 14F	01 9.67F	03 2.41E	U3 1 12E	01 2 27F	03	U3	01 1.45E
		Plecotus spp.	03	03	02	02	03	02	03	03	01	03	04	08	04	04	+./9E- 01	03	03	01	03	03	02	03	03	01		03	01	03	03	02	03	03	02

Table J3: Effect of Production (estimate (Est.), SE and p value)

	CSI	1.57E- 04	3.83E- 04	6.82E- 01	1.57E- 04	5.26E- 04	7.65E- 01	9.90E- 05	7.29E- 04	8.92E- 01	2.02E- 04	9.05E- 04	8.23E- 01	2.09E- 04	1.06E- 03	8.44E- 01	3.52E- 04	1.24E- 03	7.77E- 01	5.73E- 04	1.45E- 03	6.92E- 01	5.75E- 04	1.53E- 03	7.07E- 01	6.85E- 04	1.60E- 03	6.69E- 01	7.34E- 04	1.72E- 03	6.69E- 01	7.30E- 04	1.86E- 03	6.95E- 01
ging uit	Aerial	1.59E- 03	9.23E- 04	8.57E- 02	2.15E- 03	1.22E- 03	7.86E- 02	3.33E- 03	1.70E- 03	5.00E- 02	4.90E- 03	2.09E- 03	1.91E- 02	5.97E- 03	2.33E- 03	1.04E- 02	6.68E- 03	2.71E- 03	1.39E- 02	8.31E- 03	3.07E- 03	6.81E- 03	9.04E- 03	3.32E- 03	6.52E- 03	9.81E- 03	3.61E- 03	6.55E- 03	1.08E- 02	3.72E- 03	3.71E- 03	1.17E- 02	3.22E- 03	2.81E- 04
Fora	Gleaner	-4.72E- 04	1.49E- 03	7.52E- 01	4.45E- 03	1.84E- 03	1.55E- 02	6.35E- 03	2.65E- 03	1.64E- 02	8.76E- 03	3.29E- 03	7.76E- 03	5.82E- 03	3.71E- 03	1.17E- 01	4.51E- 03	4.47E- 03	3.14E- 01	5.58E- 03	5.09E- 03	2.73E- 01	8.49E- 03	5.60E- 03	1.29E- 01	9.86E- 03	5.78E- 03	8.79E- 02	1.14E- 02	6.17E- 03	6.47E- 02	1.23E- 02	6.67E- 03	6.45E- 02

18 Appendix K: Density figures for bats and bush crickets

Figure K1: Effects of the density of linear landscape elements on bats at different spatial scales. On the Y-axis: estimates of the relationships between density and activity of 4 different species and community specialization and activity of aerial and gleaner species. We present 6 graphs: 4 species (a, b, c, d) with various ecologies and 2 traits (e, f). In graph 1.e., we present the effect of the density of linear landscape elements on the aerial bat species. We show that 1) using in the 1000 m buffer as an example, the activity of aerial species is positively correlated with the density of linear elements (the estimate reported from the modeling at 1000 meters - with its standard error - is positive, i.e., above zero, and this effect is significant as indicated by asterisks; and 2) the scale effect from 50 meters to 1000 meters was significant and is visualized by the dotted line. The activity of aerial bat species was significantly and positively correlated with the linear landscape element density in a 1000 m buffer. The scale effect was significant, and there is a positive scale effect for these communities (above zero). When we did not detect a linear scale effect, we assessed a potential breakpoint value (see Appendix I).


Buffer size (meters)

Figure K2: Effect of the density of linear landscape elements on bush crickets at different spatial scales. On the Y-axis: estimates of the relationships between density and activity for 4 different species, community specialization and activity of mobile and sedentary species (see also Appendix J)



Buffer size (meters)

7 20 Appendix L: Diversity figures for bats and bush crickets

8

- 9 Figure L1: Effect of the diversity of linear landscape elements on bats at different spatial scales. On the Y-axis:
- 10 estimates of the relationships between diversity and activity for 4 different species and community specialization
- 11 and activity of aerial and gleaner species (see also supplementary material G)

12



- 19
- 20 Figure L2: Effect of the diversity of linear landscape elements on bush crickets at different spatial scales. On the
- 21 Y-axis: estimates of the relationships between diversity and activity for 4 different species, community
- 22 specialization and activity of mobile and sedentary species (see also Appendix J)

23



Buffer size (meters)