# *Supplementary material:* No evidence for cumulative effects of small wind turbines on bat activity

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## Appendix S1: Preliminary habitat data analysis

A total of 10 habitat variables were quantified in each transect section in all sites Table S 1 , using 1:1250 UK Ordnance Survey MasterMap Topography digital map (OS) data and QGIS v. 1.8. These variables were chosen on the basis of their known potential effect on bat activity. The five proportion land cover variables (proportion buildings, road or tracks, rough grassland, roadside, and woodland) were calculated from the OS polygon area data and were calculated as the sum of each of these five land cover types in each transect section, divided by the size of the transect section. These were defined as the total area size of all polygons listed as (1) "Buildings" in the *Theme* field; (2) "Road Tracks and Paths" in the *Theme* field; (3) "Rough grassland" (including all lower classifications) in the *descrTerm* field; (4) "Roadside" in the *descrGroup* field and (5) "Coniferous or Nonconiferous trees"" in the *descrGroup* field. The four distance variables (distance to buildings, linear features, trees and water) were calculated by overlaying the OS data with a 1x1m 'raster' of grid cells, calculating the distance (m) between each raster cell and the nearest raster cell containing each of the four land cover types (respectively, buildings as defined above, any linear feature as contained in the OS "line" data, any woodland as defined above and any water polygon), and averaging these distances for all cells within the transect sections.

Finally, edge density (m m-2) was expressed as the total length of all line features contained in the OS Linear data per transect section, divided by the transect section area. Line features include e.g. building-, woodland and water edges, hedgerows, roads and tracks, roadsides, and field boundaries.

To identify a subset of habitat variables that were most descriptive of bat activity (see main text), we ran an initial model selection procedure on a Generalised Linear Mixed Effects (GLMM) model for the probability of a bat pass per hectare as a function of all 10 habitat variables, transect within site as a random effect, a binomial error distribution with a log-log link function and transect section size (ha) as an offset. This model structure was identical to the model presented in the main text. To avoid problems with colinearity, we limited the full model set to include only one of the five 'proportion' habitat variables (because these represent proportion cover, lower cover of one automatically implies greater cover of another, leading to high colinearity). We further excluded all models including (1) **both** proportion of woodland and distance to trees, (2) **both** proportion buildings and distance to buildings, (3) **both** edge density and distance to linear features **or** proportion of roads or tracks. Again, these latter exclusions were to avoid high colinearity. For example, a greater proportion of woodland in a given transect section naturally implies shorter distances to trees; edge density includes linear features such roads and tracks; etc. Thus, these variables effectively measured very similar things but in slightly different ways. All model fitting procedures and analyses followed the methodology described in the main text.

The resulting full model set comprised of a total of 112 models (Table S 2). The candidate set (AICc<4) contained 4 models. The 'top' model retained three of the ten habitat variables: distance to water, edge density and the proportion of woodland. Distance to water was only included in two out of the four models in the top set, however. By contrast, edge density and the proportion of woodland were retained in all four models in the candidate set. Thus, we chose to use edge density and the proportion of woodland as the key two habitat variables explaining bat activity.

**Table S1**. Descriptive statistics of all ten original habitat variables as predictors for bat activity on their original (unstandardised) scale.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | Mean | Median | SD | Min. | Max. |
| Distance to buildings (m) | 200.47 | 184.14 | 128.82 | 9.20 | 623.77 |
| Distance to linear features (m) | 22.74 | 18.33 | 19.24 | 5.37 | 190.97 |
| Distance to trees (m) | 180.72 | 154.98 | 137.68 | 0.19 | 646.47 |
| Distance to water (m) | 201.16 | 168.36 | 154.68 | 13.20 | 689.27 |
| Edge density (m m-2) | 0.04 | 0.03 | 0.02 | 0.00 | 0.13 |
| Proportion buildings | 0.01 | 0.00 | 0.03 | 0.00 | 0.29 |
| Proportion roads or tracks | 0.02 | 0.01 | 0.03 | 0.00 | 0.26 |
| Proportion rough grassland | 0.04 | 0.00 | 0.13 | 0.00 | 1.00 |
| Proportion roadsides | 0.02 | 0.00 | 0.03 | 0.00 | 0.26 |
| Proportion woodland | 0.05 | 0.00 | 0.13 | 0.00 | 0.92 |

**Table S2**. Candidate set of Generalised Linear Mixed Models for bat activity (probability of bat activity ha-1, binomial errors, complementary log-log link) within 4 AICc points of the “top” model, as a function of ten candidate habitat predictors only. Coefficients are parameter estimates based on models fit using standardised (centred and scaled to 2 SD) inputs. K is the number of parameters in the models. All models included site and transect within site as a nested random effect structure.

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Model | Intercept | Distance to buildings | Distance to water | Edge density | Proportion woodland | K | Log-likelihood | AICc | Δ AICc | Model weight |
| 1 | -1.146 |  | -0.305 | 0.523 | 0.41 | 6 | -824.8 | 1661.7 | 0.000 | 0.541 |
| 2 | -1.146 | 0.028 | -0.301 | 0.532 | 0.408 | 7 | -824.8 | 1663.7 | 1.962 | 0.203 |
| 3 | -1.139 |  |  | 0.549 | 0.445 | 5 | -826.9 | 1663.9 | 2.184 | 0.181 |
| 4 | -1.138 | 0.059 |  | 0.568 | 0.438 | 6 | -826.8 | 1665.7 | 3.957 | 0.075 |