**Supplementary Information**

**Figure S1** Correlation matrix for continuous habitat variables, showing Spearman's correlation coefficient and positive (blue) and negative (orange) correlations. Darker colours and bigger circle size mean stronger correlations.

**![Immagine che contiene testo, schermata, numero, diagramma

Descrizione generata automaticamente]()**

**Table S1** Variables weights and numbers of models containing the variable for occurrence probability, abundance and species richness models. Weights were calculated based on Akaike weights for each model, which is expressed as the likelihood contribution of each model as a proportion of the summed likelihood contributions of all models. The weight for each variable is the sum of model weights for all models in which a given variable was present (Burnham & Anderson 2002).

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Snow^2** | **Mud** | **Snow** | **Grass height** | **Elevation** | **Rock** | **Distance from forest** |
| **Occurrence probability model** | | | | | | | |
| **Importance (weights)** | 1.00 | 0.95 | 0.33 | 0.31 | 0.30 | 0.27 | 0.26 |
| **N containing models** | 64 | 64 | 64 | 64 | 64 | 64 | 64 |
| **Abundance model** | | | | | | | |
| **Importance (weights)** | 1.00 | 0.63 | 0.96 | 0.36 | 0.67 | 0.40 | 0.45 |
| **N containing models** | 64 | 64 | 64 | 64 | 64 | 64 | 64 |
| **Species richness model** | | | | | | | |
| **Importance (weights)** | 1.00 | 0.32 | 0.79 | 0.33 | 0.51 | 0.29 | 0.27 |
| **N containing models** | 64 | 64 | 64 | 64 | 64 | 64 | 64 |

**Table S2** Outputs of the final model-averaged parameters for occurrence probability, abundance and species richness. Estimate, standard error (SE), test value (z) and p-value are given for each parameter. See variable importance in Table S1

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Dependent variable** | **Parameter** | **Estimate ± SE** | ***z*** | ***p-value*** |
| **Occurrence probability** | Snow2 | -2.19 ± 0.38 | 5.66 | <0.001 |
|  | Mud | 0.68 ± 0.26 | 2.59 | 0.010 |
|  | Snow | -0.36 ± 0.22 | 0.85 | 0.396 |
|  | Grass Height | 0.21 ± 0.25 | 0.83 | 0.405 |
|  | Elevation | -0.18 ± 0.29 | 0.63 | 0.531 |
|  | Rock | 0.12 ± 0.22 | 0.52 | 0.601 |
|  | Forest Distance | -0.15 ± 0.31 | 0.49 | 0.620 |
| **Abundance** | Snow2 | -1.45 ± 0.28 | 5.06 | <0.001 |
|  | Snow | -0.67 ± 0.27 | 2.46 | 0.014 |
|  | Elevation | -0.29 ± 0.15 | 1.98 | 0.048 |
|  | Forest Distance | 0.24 ± 0.16 | 1.53 | 0.126 |
|  | Mud | 0.26 ± 0.14 | 1.85 | 0.064 |
|  | Rock | -0.15 ± 0.15 | 0.99 | 0.328 |
|  | Grass Height | -0.13 ± 0.15 | 0.88 | 0.379 |
| **Species richness** | Snow2 | -1.39 ± 0.26 | 5.25 | <0.001 |
|  | Snow | -0.52 ± 0.26 | 1.97 | 0.049 |
|  | Elevation | -0.17 ± 0.11 | 1.53 | 0.125 |
|  | Grass Height | -0.13 ± 0.15 | 0.931 | 0.352 |
|  | Mud | 0.10 ± 0.12 | 0.794 | 0.427 |
|  | Rock | -0.094 ± 0.13 | 0.697 | 0.486 |

**Table S3** Outputs of the GLMM for occurrence probability of the water pipit Anthus spinoletta. Estimate, standard error (SE), test value (z) and p-value are given for each parameter.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Dependent variable** | **Parameter** | **Estimate ± SE** | ***z*** | ***p-value*** |
| **Occurrence probability** | Snow | -1.65 ± 0.87 | -1.90 | 0.058 |
|  | Mud | 4.98 ± 1.84 | 2.71 | 0.007 |
|  | Grass Height | -3.58 ± 1.57 | -2.28 | 0.023 |
|  | Elevation | 1.40 ± 0.91 | 1.54 | 0.124 |
|  | Rock | 0.30 ± 0.56 | 0.54 | 0.590 |
|  | Forest Distance | -3.41 ± 1.75 | -1.94 | 0.052 |