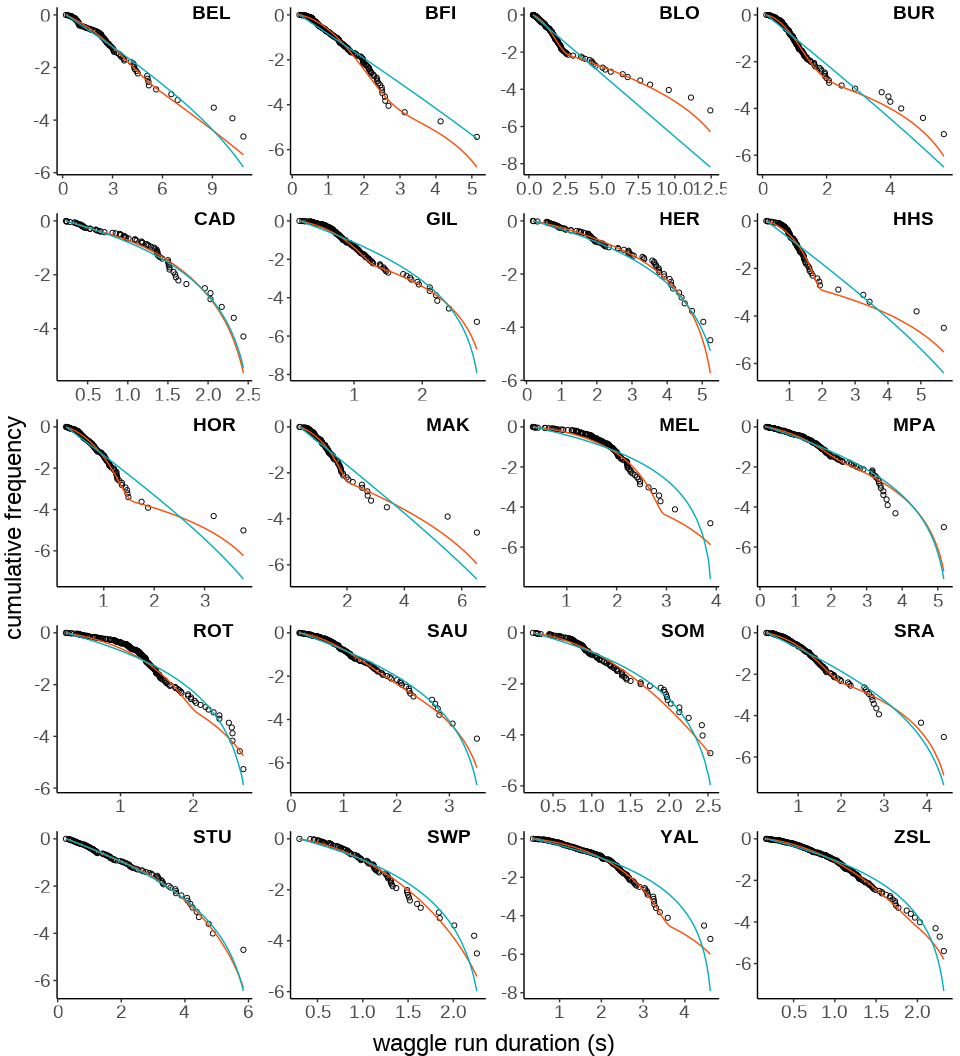
Waggle dance distributions quantify collective foraging in honey bee colonies: Supplementary material

Joseph Palmer, Ash Samuelson, Elli Leadbeater and Vincent Jansen

# Waggle dance model

# Waggle dance model fit



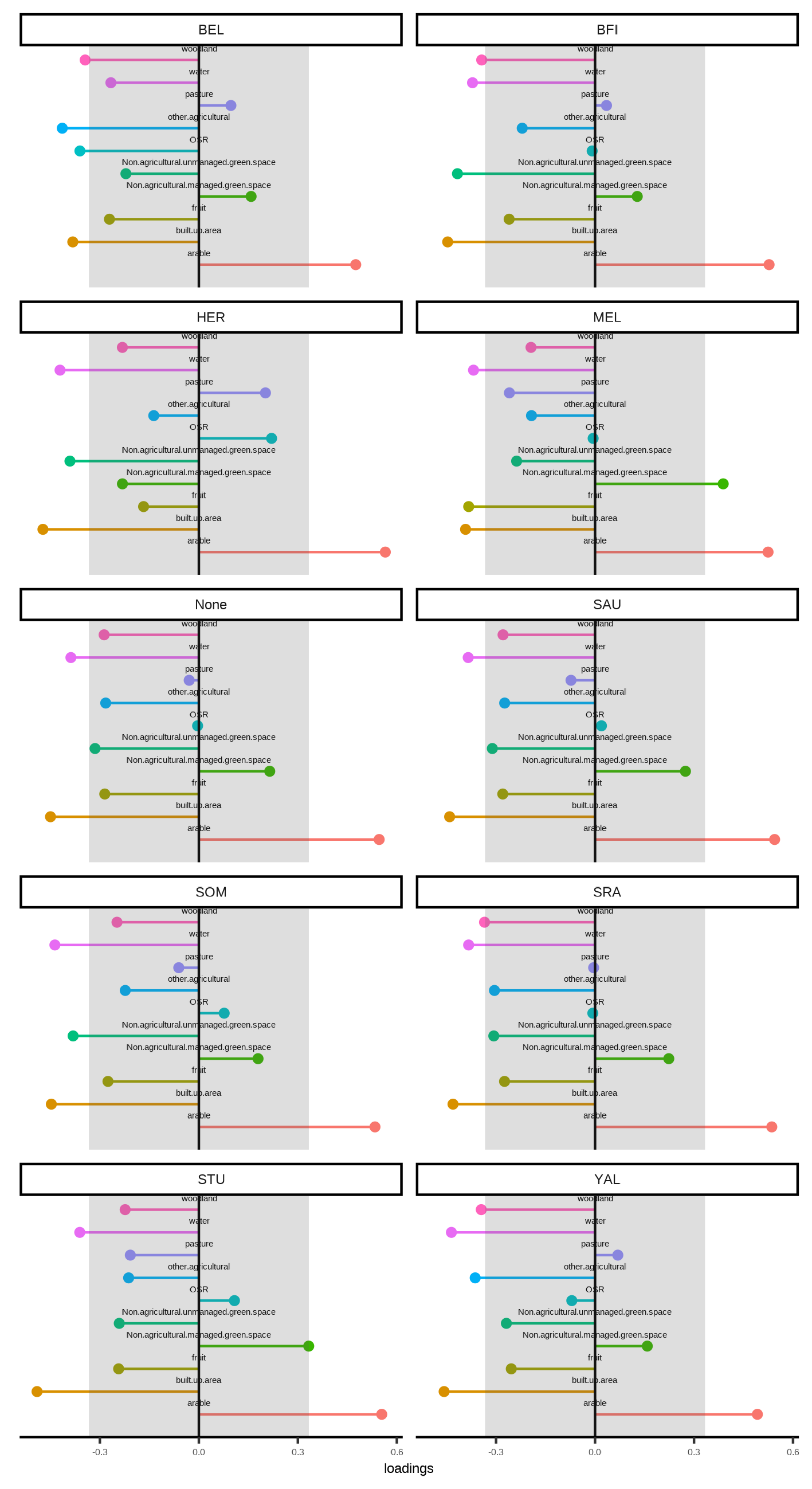
Supplementary Fig 1. **Cumulative frequency distribution** of waggle dance durations and fits of the collective (red line) and individual (blue line) models for all 20 sites.

Table 1. shows the results of the model fitting, including likelihood scores, parsimony measures -AIC, delta\_AIC, rAIC (relative delta\_AIC) and wAIC (Akaike weights)- and goodness of fit -Ks statistics (ks\_statistic, ks\_pvalue)- for all 20 sites.

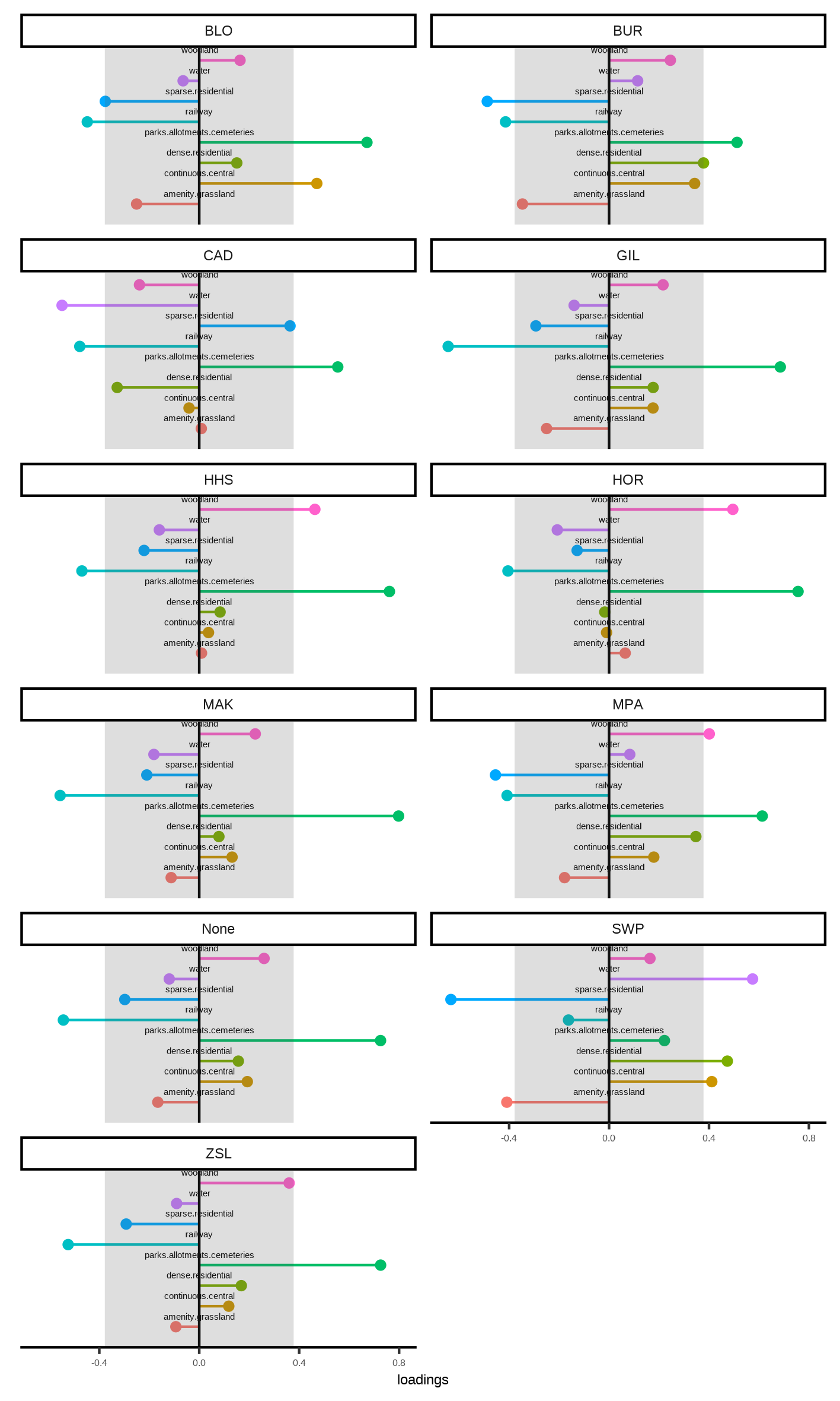
**Table** : Fit results for the fitting of the waggle dance model to each site.

| **site** | **model** | **MLE** | **AIC** | **ΔAIC** | **rAIC** | **wAIC** | **p** | **bs** | **br** | **as** | **ar** | **D** | **p\_value** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| BEL | collective | -181.415 | 372.830 | 1.827 | 0.401 | 0.286 | 0.648 | 7.042 | 0.814 | 0.051 | 0.170 | 0.098 | 0.710 |
| BEL | individual | -183.501 | 371.002 | 0.000 | 1.000 | 0.714 | 1.000 | 4.495 |  | 0.073 |  | 0.088 | 0.785 |
| BFI | collective | -190.499 | 390.998 | 0.000 | 1.000 | 1.000 | 0.045 | 0.000 | 2.818 | 0.165 | 0.247 | 0.087 | 0.326 |
| BFI | individual | -211.297 | 426.593 | 35.595 | 0.000 | 0.000 | 1.000 | 9.470 |  | 0.100 |  | 0.183 | 0.001 |
| BLO | collective | -221.026 | 452.052 | 0.000 | 1.000 | 1.000 | 0.209 | 1.786 | 0.571 | 0.068 | 0.359 | 0.071 | 0.762 |
| BLO | individual | -237.389 | 478.778 | 26.726 | 0.000 | 0.000 | 1.000 | 5 505.000 |  | 0.000 |  | 0.112 | 0.239 |
| BUR | collective | -118.305 | 246.610 | 0.000 | 1.000 | 1.000 | 0.112 | 0.000 | 500.000 | 0.152 | 0.027 | 0.067 | 0.824 |
| BUR | individual | -143.718 | 291.435 | 44.826 | 0.000 | 0.000 | 1.000 | 10.000 |  | 0.100 |  | 0.177 | 0.006 |
| CAD | collective | -48.278 | 106.557 | 2.650 | 0.266 | 0.210 | 0.165 | 0.000 | 0.430 | 1.459 | 0.386 | 0.082 | 0.949 |
| CAD | individual | -49.953 | 103.906 | 0.000 | 1.000 | 0.790 | 1.000 | 0.000 |  | 0.385 |  | 0.110 | 0.738 |
| GIL | collective | -74.542 | 159.084 | 0.000 | 1.000 | 1.000 | 0.261 | 0.000 | 0.000 | 0.334 | 0.754 | 0.135 | 0.064 |
| GIL | individual | -102.309 | 208.618 | 49.534 | 0.000 | 0.000 | 1.000 | 2.037 |  | 0.345 |  | 0.198 | 0.001 |
| HER | collective | -136.968 | 283.936 | 2.076 | 0.354 | 0.262 | 0.277 | 0.000 | 0.159 | 0.378 | 0.182 | 0.079 | 0.946 |
| HER | individual | -138.930 | 281.860 | 0.000 | 1.000 | 0.738 | 1.000 | 0.000 |  | 0.175 |  | 0.112 | 0.593 |
| HHS | collective | -61.348 | 132.696 | 0.000 | 1.000 | 1.000 | 0.096 | 0.000 | 0.000 | 0.141 | 0.503 | 0.133 | 0.364 |
| HHS | individual | -83.749 | 171.498 | 38.802 | 0.000 | 0.000 | 1.000 | 7.095 |  | 0.125 |  | 0.244 | 0.005 |
| HOR | collective | -40.502 | 91.004 | 0.000 | 1.000 | 1.000 | 0.056 | 0.000 | 0.538 | 0.218 | 0.628 | 0.053 | 0.966 |
| HOR | individual | -56.652 | 117.304 | 26.300 | 0.000 | 0.000 | 1.000 | 7.775 |  | 0.202 |  | 0.167 | 0.021 |
| MAK | collective | -84.519 | 179.038 | 0.000 | 1.000 | 1.000 | 0.209 | 2.319 | 0.020 | 0.122 | 0.478 | 0.091 | 0.793 |
| MAK | individual | -98.025 | 200.049 | 21.012 | 0.000 | 0.000 | 1.000 | 9.168 |  | 0.096 |  | 0.192 | 0.033 |
| MEL | collective | -115.316 | 240.633 | 0.000 | 1.000 | 1.000 | 0.080 | 0.000 | 0.000 | 0.213 | 0.338 | 0.163 | 0.070 |
| MEL | individual | -135.731 | 275.462 | 34.829 | 0.000 | 0.000 | 1.000 | 0.000 |  | 0.252 |  | 0.244 | 0.000 |
| MPA | collective | -181.873 | 373.746 | 0.000 | 1.000 | 0.959 | 0.567 | 0.578 | 0.000 | 0.185 | 0.420 | 0.067 | 0.871 |
| MPA | individual | -188.038 | 380.076 | 6.330 | 0.042 | 0.041 | 1.000 | 1.474 |  | 0.187 |  | 0.100 | 0.427 |
| ROT | collective | -138.129 | 286.259 | 0.000 | 1.000 | 1.000 | 0.306 | 0.000 | 0.000 | 0.314 | 0.483 | 0.149 | 0.021 |
| ROT | individual | -153.355 | 310.710 | 24.451 | 0.000 | 0.000 | 1.000 | 0.000 |  | 0.354 |  | 0.201 | 0.001 |
| SAU | collective | -108.185 | 226.370 | 0.000 | 1.000 | 0.987 | 0.310 | 0.000 | 9.983 | 0.262 | 0.164 | 0.061 | 0.956 |
| SAU | individual | -115.503 | 235.005 | 8.635 | 0.013 | 0.013 | 1.000 | 1.489 |  | 0.271 |  | 0.129 | 0.210 |
| SOM | collective | -70.536 | 151.072 | 0.000 | 1.000 | 0.958 | 0.002 | 10.000 | 10.000 | 1.500 | 0.149 | 0.107 | 0.504 |
| SOM | individual | -76.671 | 157.343 | 6.271 | 0.043 | 0.042 | 1.000 | 0.000 |  | 0.377 |  | 0.161 | 0.095 |
| SRA | collective | -123.371 | 256.741 | 0.000 | 1.000 | 1.000 | 0.243 | 0.000 | 0.214 | 0.214 | 0.492 | 0.052 | 0.984 |
| SRA | individual | -138.114 | 280.228 | 23.487 | 0.000 | 0.000 | 1.000 | 3.002 |  | 0.213 |  | 0.143 | 0.074 |
| STU | collective | -155.700 | 321.401 | 4.320 | 0.115 | 0.103 | 0.352 | 0.000 | 1.018 | 0.521 | 0.156 | 0.045 | 1.000 |
| STU | individual | -156.540 | 317.081 | 0.000 | 1.000 | 0.897 | 1.000 | 1.347 |  | 0.161 |  | 0.055 | 0.997 |
| SWP | collective | -40.424 | 90.848 | 0.000 | 1.000 | 0.953 | 0.000 | 0.247 | 1.275 | 0.002 | 0.384 | 0.100 | 0.708 |
| SWP | individual | -46.441 | 96.882 | 6.034 | 0.049 | 0.047 | 1.000 | 0.000 |  | 0.424 |  | 0.144 | 0.308 |
| YAL | collective | -205.760 | 421.520 | 0.000 | 1.000 | 1.000 | 0.080 | 0.000 | 0.298 | 0.181 | 0.273 | 0.044 | 0.992 |
| YAL | individual | -222.433 | 448.866 | 27.345 | 0.000 | 0.000 | 1.000 | 0.217 |  | 0.213 |  | 0.099 | 0.335 |
| ZSL | collective | -110.008 | 230.015 | 0.000 | 1.000 | 0.999 | 0.240 | 0.000 | 0.794 | 0.386 | 0.500 | 0.036 | 0.997 |
| ZSL | individual | -119.948 | 243.896 | 13.881 | 0.001 | 0.001 | 1.000 | 0.392 |  | 0.419 |  | 0.095 | 0.251 |

# Jackknifed partial least squares analysis



Supplementary Fig 2. **Loadings of PLS calculated for each site removed for the agri-rural sites**. Each plot shows the loadings of the first principle component with that site removed from the analysis, showing the individual points making up the overall box plot loadings in Fig 4b.



Supplementary Fig 3. **Loadings of PLS calculated for each site removed for the urban sites**. Each plot shows the loadings of the first principle component with that site removed from the analysis, showing the individual points making up the overall box plot loadings in Fig 4d.