**Supplementary Tables**

**Supplementary File 1a.** Results of ANOVAs testing the effect of sex and species on wing morphology parameters.

|  |  |  |  |
| --- | --- | --- | --- |
| Variable | Factor | F-value | P-value |
|  |   |   |   |
| Body mass *m* |   |   |   |
|   | sex | 4.061 | **0.047** |
|   | species | 53.897 | **<0.001** |
| Second-moment-of-area *S*2 |   |   |   |
|   | sex | 11.592 | **0.001** |
|   | species | 38.489 | **<0.001** |
| Wingspan *R* |   |   |  |
|   | sex | 0.334 | 0.564 |
|   | species | 67.411 | **<0.001** |
| Wing chord *c̄* |   |   |   |
|   | sex | 6.202 | **0.014** |
|   | species | 71.933 | **<0.001** |
| Normalized second- moment of-area *S*2\* |   |   |  |
|   | sex | 2.719 | 0.103 |
|   | species | 21.231 | **<0.001** |
|   |   |   |   |
| Bold indicates statistical significance |   |   |   |

**Supplementary File 1b.** Phylogenetic signal computed on morphological and flight traits. Species number in the morphology and flight dataset is 28 and 8, respectively.

|  |  |  |
| --- | --- | --- |
| **Morphological traits** |   | **Flight traits** |
|   | Blomberg’s K | P |   |   | Blomberg’s K | P |
| Body mass *m* | 0.81 | **0.004** |   | Wingbeat frequency *f* | 0.66 | 0.696 |
| Wingspan *R* | 0.66 | **0.005** |   | Stroke amplitude 𝐴𝜙 | 0.91 | 0.187 |
| Wing chord *c̄* | 0.72 | **0.004** |   | $$\overbar{ω}$$

|  |
| --- |
| Wing angular speed |

 | 0.89 | 0.235 |
| Second moment of area *S2* | 0.59 | 0.071 |   | $$\overbar{α}$$

|  |
| --- |
| Angle-of-attack |

 | 1.01 | 0.145 |
| Normalized secondmoment of area *S2\** | 0.88 | **0.004** |   |   |   |   |
|   |   |   |   |   |   |   |
| Bold indicates statistical significance. |   |   |   |   |   |

**Supplementary File 1c.** Results from multiple regressions testing correlations between the wingbeat kinematics parameters and body kinematics, expressed by flight speed and climb angle.

|  |  |  |
| --- | --- | --- |
|   | Flight speed | Climb angle |
|   | t value | P | t value | P |
| Wingbeat frequency *f* | 1.976 | 0.057 | -0.401 | 0.691 |
| Stroke amplitude 𝐴𝜙 | -0.037 | 0.971 | 0.602 | 0.552 |
| $$\overbar{ω}$$

|  |
| --- |
| Wing angular speed |

 | 2.331 | **0.026** | 0.499 | 0.621 |
| $$\overbar{α}$$

|  |
| --- |
| Angle-of-attack |

 | 0.721 | 0.477 | -0.451 | 0.655 |
| Bold indicates statistical significance. |   |   |   |

**Supplementary File 1d.** Results of phylogenetic generalized least square (PGLS) regressions of additional wingbeat kinematic parameters against body mass.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|   |   | n | P | R2 | Intercept | Scaling factor estimate [95% C.I.] |
|  |   |   |   |   |   |   |
|   | Rotation amplitude *A*θ | 8 | 0.301 | 0.25 | 4.692 |  0.016 [-0.011 – 0.044]  |
|   | Deviation amplitude *A*η | 8 | 0.942 | 0.07 | 0.492 |  0.022 [-0.551 – 0.595] |
|   | Peak stroke rate ϕ ̇peak | 8 | 0.201 | 0.11 | 11.178 |  -0.103 [-0.244 – 0.037] |
|   | Peak rotation rate θ ̇peak | 8 | 0.901 | 0.03 | 11.488 | 0.014 [-0.203 – 0.232] |
|   | Peak deviation rate η ̇peak | 8 | 0.247 | 0.14 | 10.308 |  -0.216 [-0.546 – 0.114] |
|  |   |   |   |   |   |   |