**Supplementary File 1**

**Supplementary File 1a**.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | thick solid rod | thin solid rod | hollow rod | solid platelet | hollow platelet | solid rod black feather |
| thick solid rod | 1 | 0.0015 | 0.0015 | 0.0015 | 0.0015 | 0.0455 |
| thin solid rod | 0.0015 | 1 | 0.0015 | 0.2319 | 0.0048 | 0.0015 |
| hollow rod | 0.0015 | 0.0015 | 1 | 0.3862 | 0.5318 | 0.0015 |
| solid platelet | 0.0015 | 0.2319 | 0.3862 | 1 | 0.1608 | 0.0015 |
| hollow platelet | 0.0015 | 0.0048 | 0.5318 | 0.1608 | 1 | 0.0015 |
| solid rod black feather | 0.0455 | 0.0015 | 0.0015 | 0.0015 | 0.0015 | 1 |

**Supplementary File 1b**.

|  |  |  |
| --- | --- | --- |
| Trait | Pagel's lamda | p |
| Melanin layer | 0.96 | <0.001 |
| Air (diameter) | 0.56 | 0.001 |
| Number of layers | 0.81 | <0.001 |

**Supplementary File 1c**.

|  |  |  |  |
| --- | --- | --- | --- |
| Melanosome type | Mean saturation (vs cone) | Mean brightness | Mean peak reflectance (%) |
| Thick solid rod | 0.090 | 0.054 | 11.58 |
| Thin solid rod | 0.149 | 0.075 | 19.93 |
| Hollow rod | 0.143 | 0.097 | 26.71 |
| Solid platelet | 0.187 | 0.095 | 25.23 |
| Hollow platelet | 0.167 | 0.224 | 51.89 |

**Supplementary File 1d**.

|  |  |  |  |
| --- | --- | --- | --- |
| Melanosome type | Mean saturation (vs cone) | Mean brightness | Mean peak reflectance (%) |
| Thick solid rod | 0.093 | 0.072 | 9.68 |
| Thin solid rod | 0.142 | 0.119 | 20.63 |
| Hollow rod | 0.159 | 0.235 | 38.72 |
| Solid platelet | 0.144 | 0.237 | 43.23 |
| Hollow platelet | 0.194 | 0.215 | 35.20 |

**Supplementary File 1e**.

|  |  |  |  |
| --- | --- | --- | --- |
| Melanosome type | Mean color span | Occupied voxels | Mean saturation |
| Thick solid rod | 0.109 | 33 | 0.081 |
| Thin solid rod | 0.211 | 97 | 0.148 |
| Hollow rod | 0.207 | 100 | 0.145 |
| Solid platelet | 0.262 | 116 | 0.192 |
| Hollow platelet | 0.247 | 108 | 0.179 |

**Supplementary File 1f**.

|  |  |  |  |
| --- | --- | --- | --- |
| Melanosome type | Mean color span | Occupied voxels | Mean saturation |
| Thick solid rod | 0.154 | 13 | 0.132 |
| Thin solid rod | 0.225 | 22 | 0.163 |
| Hollow rod | 0.216 | 22 | 0.170 |
| Solid platelet | 0.204 | 25 | 0.151 |
| Hollow platelet | 0.237 | 24 | 0.201 |

**Supplementary File 1g**.

|  |  |  |  |
| --- | --- | --- | --- |
| Coefficient | Estimate | Std. Error | t value |
| thin | 0.059622 | 0.003392 | 17.575 |
| hollow | -0.006571 | 0.003392 | -1.937 |
| platelet | 0.037834 | 0.003392 | 11.152 |
| hollow\*platelet | -0.014041 | 0.004798 | -2.927 |
| Intercept | 0.089683 | 0.002399 | 37.386 |

**Supplementary File 1h**.

|  |  |  |  |
| --- | --- | --- | --- |
| Coefficient | Estimate | Std. Error | t value |
| thin | 0.22949 | 0.02368 | 9.693 |
| hollow | 0.28932 | 0.02368 | 12.22 |
| platelet | 0.20454 | 0.02368 | 8.639 |
| hollow\*platelet | 0.6386 | 0.03348 | 19.073 |
| Intercept | -2.97208 | 0.01674 | -177.528 |

**Supplementary File 1i**.

|  |  |  |  |
| --- | --- | --- | --- |
| Coefficient | Estimate | Std. Error | t value |
| thin | 0.46605 | 0.02182 | 21.36 |
| hollow | 0.34085 | 0.02182 | 15.62 |
| platelet | 0.22359 | 0.02182 | 10.25 |
| hollow\*platelet | 0.5059 | 0.03086 | 16.39 |
| Intercept | 2.38295 | 0.01543 | 154.44 |

**Supplementary File 1j**.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | post.mean | lower 95% CI | upper 95% CI | pMCMC |
| (Intercept) | 0.0802273 | 0.0132239 | 0.148827 | **0.023** |
| PC | 0.0853062 | 0.0456787 | 0.1259197 | **0.00012** |
| hollow | 0.0309548 | -0.0158424 | 0.078923 | 0.19776 |
| platelet | -0.0003642 | -0.0571464 | 0.0548228 | 0.98715 |
| thin | -0.0022319 | -0.0602206 | 0.0539252 | 0.93445 |
| hollow:platelet | 0.020505 | -0.0472965 | 0.0875612 | 0.5444 |

|  |  |  |  |
| --- | --- | --- | --- |
| Random effects | post. mean | lower 95% CI | upper 95% CI |
| phylogeny | 0.003508 | 0.001273 | 0.006187 |
| patch | 0.002388 | 0.001442 | 0.003419 |

|  |  |  |  |
| --- | --- | --- | --- |
|  | post. mean | lower 95% CI | upper 95% CI |
| Residual variance | 0.001387 | 0.00104 | 0.001775 |

**DIC: -722.8817**

**Supplementary File 1k**.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | post.mean | lower 95% CI | upper 95% CI | pMCMC |
| (Intercept) | -2.76472 | -3.36719 | -2.15182 | **< 0.00001** |
| PC | 0.54649 | 0.17361 | 0.90788 | **0.00613** |
| hollow | 0.99645 | 0.54505 | 1.44248 | **< 0.00001** |
| platelet | 0.69742 | 0.18471 | 1.19531 | **0.00759** |
| thin | -0.30147 | -0.83223 | 0.24127 | 0.26653 |
| hollow:platelet | -0.52306 | -1.14786 | 0.08163 | 0.09451 |

|  |  |  |  |
| --- | --- | --- | --- |
| Random effects | post. mean | lower 95% CI | upper 95% CI |
| phylogeny | 0.2626 | 0.03862 | 0.5218 |
| patch | 0.2403 | 0.1441 | 0.3436 |

|  |  |  |  |
| --- | --- | --- | --- |
|  | post. mean | lower 95% CI | upper 95% CI |
| Residual variance | 0.07479 | 0.05483 | 0.09613 |

**DIC: 148.4126**

**Supplementary File 1l**.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | post.mean | lower 95% CI | upper 95% CI | pMCMC |
| (Intercept) | 1.9479 | 1.3087 | 2.5866 | **<0.00001** |
| PC | 0.759 | 0.4074 | 1.1127 | **0.00018** |
| hollow | 1.1177 | 0.6987 | 1.5452 | **<0.00001** |
| platelet | 0.7802 | 0.2841 | 1.2764 | **0.00226** |
| thin | -0.1655 | -0.649 | 0.3212 | 0.50032 |
| hollow:platelet | -0.7032 | -1.3124 | -0.12 | 0.02178 |

|  |  |  |  |
| --- | --- | --- | --- |
| Random effects | post. mean | lower 95% CI | upper 95% CI |
| phylogeny | 0.3539 | 0.114 | 0.6246 |
| patch | 0.1433 | 0.07449 | 0.2185 |

|  |  |  |  |
| --- | --- | --- | --- |
|  | post. mean | lower 95% CI | upper 95% CI |
| Residual variance | 0.08233 | 0.06068 | 0.1064 |

**DIC: 163.4472**

**Supplementary File 1m.**

|  |  |  |  |
| --- | --- | --- | --- |
| Creator | Source link | License | License link |
| Yuri B | https://pixabay.com/de/vectors/feder-blau-fallen-federbusch-1689331/ | Pixabay licence | https://pixabay.com/service/license/ |

**Supplementary File 1n**.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Species | Creator | Source link | License | License link |
| Brown-headed cowbird (*Molothrus ater*) | ksblack99 | https://www.flickr.com/photos/ksblack99/27839803094/in/photolist-Jq7gx5-2gvEQaq-9gM5NB-6k3bok-sXMf1i-s1KsCE-wLLtpq-UJzqLj-tHYN2a-cZRhrQ-ottCRD-xtAvqR-otjy7M-tmX1Th-ot7h1D-wLM1UE-VjRCWR-sYrSTz-YhTFJt-fcw7GC-triMQq-otf89N-2j1LWqd-cyFiEU-xFSLGt-otmBtm-d9ZYVP-xbYXyf-wYFHYW-nkP1sk-niLgFH-ow8pH3-9RmJek-bWuhNF-xp5Hfu-e2q5JG-xyhRin-xmAt8R-otQYWd-oxhJSH-6ocTZH-xxsvY3-xpc7Ux-8Zb38Y-xDyNVf-xDL47Q-fcgRcB-fcw9B7-8p4HDu-8D2rJu | Public Domain Dedication 1.0 License | https://creativecommons.org/publicdomain/zero/1.0/ |
| Nicobar pigeon (*Caloenas nicobarica*) | Vassil | https://commons.wikimedia.org/wiki/File:Caloenas\_nicobarica\_Parc\_des\_Oiseaux\_21\_10\_2015\_1.jpg | Public Domain Dedication 1.0 License | https://creativecommons.org/publicdomain/zero/1.0/) |
| Elegant trogon (*Trogon elegans*) | Alan Schimierer | https://www.flickr.com/photos/sloalan/23784019851/in/photolist-CeHjtM-xDSVzM-ThPQxJ-f16DMA-sDvHz8-255o9zm-26JkLDQ-SAomTQ-Mprzxb-2jifF3j-FWBmSw-29sZoJ1-29fBGJC-FT3y6x-q2JuPh-BNurCF-27AjoxU-TyC1qT-SYEwZd-q4EdUT-eZRhrk-TyC1fH-f16EcY-pMsNA6-eip1qD-eip1Cx-bdUeZa-f16FBC-BUSvyY-eZRfHg-mfK6MK-wLKEf1-97vAfz-trttis-obWYBH-mcorU9-mcnpEa-mcnq3z-eZRm6X-s4xMei-s4qVr5-sMbdjf-97vBri-9LWYu2-eip15i-otoWXP-tJ4Z76-owbiig-abCcwb-8D2YtL | Public Domain Dedication 1.0 License | https://creativecommons.org/publicdomain/zero/1.0/) |
| Variable sunbird (*Cinnyris venustus*) | Leonard A. Floyd | https://www.flickr.com/photos/51217537@N00/32313930413/in/photolist-aNi8vT-aNi8pZ-o1ooZ3-cWAKFA-RetkHg-wcEb4j-wirGqF | Public Domain Dedication 1.0 License | https://creativecommons.org/publicdomain/zero/1.0/) |
| Ruby-throated hummingbird(*Archilochus colubris*) | ksblack99 | https://www.flickr.com/photos/ksblack99/36807506921/in/photolist-Y5y6si-2agP137-R14ZdB-UNFU2C-XfnW2e-28RSmaQ-Vfjy4w-LYnf3q-VkGQnN-BTPYcZ-288kcNj-29oxRTB-Cskfbt-XZHMcb-RCVcRJ-Y5y7T4-kgLEvv-27KtGMj-Y2LDM3-Pdb7Nq-V7aAHa-27Q62ue-255mZGU-K1yonZ-Y5y7kk-KG6hLu-RTyb2A-UmySgH-2cqKc1X-uRqpjR-Vcjojj-WQ7ceX-tUjqCr-ejwh1h-2agNTPA-255iPfY-X1AF8m-9gMU1B-X9uzmq-YedUJE-SRvpLL-V7aBii-BrvipA-A2Ah4T-29uMJrT-U1v3C7-Jb4i3T-XFTKvw-2e5tAph-fswF1r | Public Domain Dedication 1.0 License | https://creativecommons.org/publicdomain/zero/1.0/) |

**Supplementary File 1o.**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Species | Creator | Source link | License | License link |
| *Phasanius colchius* by | Mattia Menchetti | http://phylopic.org/image/8b720ff5-8e5a-4640-babc-cc30d6495a84/ | Public Domain Dedication 1.0 License | https://creativecommons.org/publicdomain/zero/1.0/ |
| *Anas fulvigula* | Sharon Wegner-Larsen | http://phylopic.org/image/cf522e02-35cc-44f5-841c-0e642987c2e4/ | Public Domain Dedication 1.0 License | https://creativecommons.org/publicdomain/zero/1.0/) |
| Trogon | Ferran Sayol | http://phylopic.org/image/5eca6929-759a-482c-b29c-b78340c35143/ | Public Domain Dedication 1.0 License | https://creativecommons.org/publicdomain/zero/1.0/) |
| Hummingbird | Ferran Sayol | http://phylopic.org/image/2bf1e800-5384-45cd-a533-ac940b8eadd6/ | Public Domain Dedication 1.0 License | https://creativecommons.org/publicdomain/zero/1.0/) |
| Starling | Ferran Sayol | http://phylopic.org/image/54ba1b9e-7bd1-4248-9aac-7218f1b1d6f4/ | Public Domain Dedication 1.0 License | https://creativecommons.org/publicdomain/zero/1.0/) |