**Appendices**

Table S1. Transect of each study site with temperature information from WorldClim during the breeding season (April to October) in 1970-2000

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Location | Site | Transect | Average elevation(m) | Averaged wet season (Apr-Oct) monthly maximum/minimum/mean temperatures (°C) in 1970-2000 from WorldClim |
| HongKong | Tai Mo Shan Country Park | 1 | 673 | 26.4/20.6/23.5 |
| HongKong | Tai Mo Shan Country Park | 2 | 673 | 26.4/20.6/23.5 |
| HongKong | Shing Mun Country Park | 1 | 360 | 27.4/21.4/24.4 |
| HongKong | Shing Mun Country Park | 2 | 460 | 27.4/21.4/24.4 |
| HongKong | Shing Mun Country Park | 3 | 465 | 27.4/21.4/24.4 |
| HongKong | Shing Mun Country Park | 4 | 460 | 27.4/21.4/24.4 |
| HongKong | Tai Po Kau Nature Reserve | 1 | 180 | 28.6/22.6/25.6 |
| HongKong | Tai Po Kau Nature Reserve | 2 | 190 | 28.6/22.6/25.6 |
| HongKong | Tai Po Kau Nature Reserve | 3 | 175 | 28.6/22.6/25.6 |
| HongKong | Tai Po Kau Nature Reserve | 4 | 170 | 28.6/22.6/25.6 |
| HongKong | Victoria Peak | 1 | 392 | 28.3/22.6/25.4 |
| HongKong | Victoria Peak | 2 | 388 | 28.3/22.6/25.4 |
| HongKong | Victoria Peak | 3 | 365 | 28.3/22.6/25.4 |
| HongKong | Pok Fu Lam Reservoir Country Park | 1 | 235 | 28.1/22.4/25.2 |
| HongKong | Pok Fu Lam Reservoir Country Park | 2 | 241 | 28.1/22.4/25.2 |
| HongKong | Pok Fu Lam Reservoir Country Park | 3 | 177 | 28.1/22.4/25.2 |
| HongKong | Pok Fu Lam Reservoir Country Park | 4 | 177 | 28.1/22.4/25.2 |
| Xishuangbanna | Xishuangbanna Tropical Botanical Garden,CAS | 1 | 612 | 29.8/20.6/25.2 |
| Xishuangbanna | Xishuangbanna Tropical Botanical Garden,CAS | 2 | 563 | 29.8/20.6/25.2 |
| Xishuangbanna | Xishuangbanna Tropical Botanical Garden,CAS | 3 | 555 | 29.8/20.6/25.2 |
| Xishuangbanna | Xishuangbanna Tropical Botanical Garden,CAS | 4 | 552 | 29.8/20.6/25.2 |
| Xishuangbanna | Bubeng station, Xishuangbanna Nature Reserve | 1 | 790 | 28.4/19.4/23.9 |
| Xishuangbanna | Bubeng station, Xishuangbanna Nature Reserve | 2 | 790 | 28.4/19.4/23.9 |
| Xishuangbanna | Bubeng station, Xishuangbanna Nature Reserve | 3 | 800 | 28.4/19.4/23.9 |
| Xishuangbanna | Bubeng station, Xishuangbanna Nature Reserve | 4 | 800 | 28.4/19.4/23.9 |
| Xishuangbanna | Bubeng station, Xishuangbanna Nature Reserve | 5 | 800 | 28.4/19.4/23.9 |
| Xishuangbanna | Nangongshan,Xishuangbanna Nature Reserve | 1 | 1165 | 27.1/18.3/22.7 |
| Xishuangbanna | Nangongshan, Xishuangbanna Nature Reserve | 2 | 1200 | 27.1/18.3/22.7 |
| Xishuangbanna | Nangongshan, Xishuangbanna Nature Reserve | 3 | 1250 | 27.1/18.3/22.7 |
| Xishuangbanna | Nangongshan, Xishuangbanna Nature Reserve | 4 | 1300 | 27.1/18.3/22.7 |
| Xishuangbanna | Nangongshan, Xishuangbanna Nature Reserve | 5 | 1360 | 27.1/18.3/22.7 |
| Xishuangbanna | Nangongshan, Xishuangbanna Nature Reserve | 6 | 1460 | 25.4/16.8/21.1 |
| Xishuangbanna | Nangongshan, Xishuangbanna Nature Reserve | 7 | 1530 | 25.4/16.8/21.1 |
| Guangxi | Mao’er Mountain Nature Reserve | 1 | 550 | 25.6/18.0/21.8 |
| Guangxi | Mao’er Mountain Nature Reserve | 2 | 600 | 24.9/17.5/21.2 |
| Guangxi | Mao’er Mountain Nature Reserve | 3 | 700 | 24.9/17.5/21.2 |
| Guangxi | Mao’er Mountain Nature Reserve | 4 | 800 | 24.8/17.3/21.0 |
| Guangxi | Mao’er Mountain Nature Reserve | 5 | 900 | 24.4/17.0/20.7 |
| Guangxi | Mao’er Mountain Nature Reserve | 6 | 1000 | 24.4/17.0/20.7 |
| Guangxi | Mao’er Mountain Nature Reserve | 7 | 1400 | 21.9/14.6/18.3 |
| Guangxi | Mao’er Mountain Nature Reserve | 8 | 1650 | 20.6/13.4/17.0 |
| Guangxi | Mao’er Mountain Nature Reserve | 9 | 2000 | 18.4/11.4/14.9 |

Table S2. Name list of sampled species with morphological information (n=184)

|  |  |  |  |
| --- | --- | --- | --- |
| Species | Dorsal color luminance | Ventral color luminance | Wingspan (mm) |
| *Abisara echerius* | 74.66666667 | 104 | 33.68 |
| *Abisara fylla* | 143 | 159.3333333 | 39.71 |
| *Abisara fylloides* | 119 | NA | 35.71 |
| *Abisara neophron* | 140.6666667 | 173.8333333 | 38.97333333 |
| *Abisara saturata* | 86.66666667 | 115 | 35.47 |
| *Acytolepis puspa* | 135.6666667 | 190.2222222 | 24.12333333 |
| *Aemona amathusia* | 121.6666667 | 150 | 58.935 |
| *Ampittia virgata* | 90.66666667 | 127.6666667 | 27.23 |
| *Appias lyncida* | 195.5 | 195.8333333 | 56.89 |
| *Argynnis hyperbius* | 125.6666667 | 147.8333333 | 70.5975 |
| *Argynnis paphia* | 146.3333333 | 167.3333333 | 66.34 |
| *Arhopala bazalus* | 85.91666667 | 126.0833333 | 36.6875 |
| *Athyma cama* | 93.16666667 | 169.6666667 | 55.01 |
| *Athyma nefte* | 80.66666667 | 141.2638889 | 51.22714286 |
| *Athyma perius* | 83.5 | 142.5 | 59.565 |
| *Athyma pravara* | 107.8333333 | 158.8333333 | 45.00333333 |
| *Athyma selenophora* | 109.8333333 | 157.6666667 | 57.1 |
| *Athyma zeroca* | 110 | 169.6666667 | 48.48 |
| *Atrophaneura varuna* | 79.66666667 | 76.33333333 | 91.99 |
| *Bhagadatta austenia* | 122 | 189.6666667 | 63.68 |
| *Caleta elna* | 120.3333333 | 147.3333333 | 23.08666667 |
| *Caleta roxus* | 133.3333333 | 155.3333333 | 21.08 |
| *Caltoris cahira* | 82.66666667 | 84.83333333 | 35.09333333 |
| *Catopsilia pomona* | 190.7685185 | 201.75 | 56.08222222 |
| *Catopsilia pyranthe* | NA | NA | NA |
| *Celaenorrhinus aurivittatus* | 87.33333333 | 102.3333333 | 33.816 |
| *Celaenorrhinus leucocera* | 111.3333333 | 127 | 37.72666667 |
| *Celaenorrhinus pero* | 133.3333333 | 140.6666667 | 43.235 |
| *Celastrina lavendularis* | 173.6666667 | 214 | 28.22 |
| *Cethosia biblis* | 133.3333333 | 163.6666667 | 68.26 |
| *Cethosia cyane* | 133.3333333 | 153.6666667 | 75.355 |
| *Charaxes bernardus* | 153.3333333 | 174 | 69.24 |
| *Chersonesia risa* | 140 | 161 | 28.928 |
| *Childrena childreni* | 132.6666667 | 162.3333333 | 78.8 |
| *Choaspes benjaminii* | 140.6666667 | 135.3333333 | 49.12 |
| *Coladenia agnioides* | 107.6666667 | 119.3333333 | 28.93 |
| *Cupha erymanthis* | 130.6 | 173.4 | 47.722 |
| *Cyrestis thyodamas* | 176.3333333 | 199.4166667 | 43.61833333 |
| *Damora sagana* | 136.3333333 | 169.6666667 | 68.9 |
| *Delias pasithoe* | 129.5555556 | 128.2222222 | 61.18333333 |
| *Dercas verhuelli* | 191.5 | 200.1666667 | 56.97333333 |
| *Deudorix epijarbas* | 101 | 148.3333333 | 25.76 |
| *Dichorragia nesimachus* | 75.66666667 | 86.66666667 | 60.46 |
| *Discophora sondaica* | NA | NA | 62.985 |
| *Elymnias hypermnestra* | 79.33333333 | 97.33333333 | 52.12666667 |
| *Enispe duranius* | 121.3333333 | 152.3333333 | 72.7 |
| *Erites falcipennis* | NA | NA | 38.23 |
| *Euploea midamus* | 63.55555556 | 102.6111111 | 82.4 |
| *Euploea mulciber* | 81 | 107.6666667 | 70.87666667 |
| *Eurema blanda* | 189.3333333 | 202 | 37.89 |
| *Eurema hecabe* | 190.5 | 199.3333333 | 36.8 |
| *Eurema laeta* | 205.1666667 | 208 | 40.22 |
| *Euthalia aconthea* | 51.66666667 | 129.3333333 | 52.02666667 |
| *Euthalia anosia* | 130.3333333 | 183.6666667 | 63.81666667 |
| *Euthalia lepidea* | 75.66666667 | 178 | NA |
| *Euthalia lubentina* | NA | NA | NA |
| *Euthalia phemius* | NA | NA | NA |
| *Euthalia pratti* | NA | NA | NA |
| *Euthalia thibetana* | NA | NA | NA |
| *Faunis canens* | 116.6666667 | 100.3333333 | 58.945 |
| *Faunis eumeus* | 106.4444444 | 116.2222222 | 54.77 |
| *Gandaca harina* | 214.8333333 | 209.5 | 37.53 |
| *Gerosis sinica* | 110.3333333 | 130.3333333 | 31.57 |
| *Graphium agamemnon* | 114 | 148.8888889 | 74.605 |
| *Graphium chironides* | 72 | 95 | 71.37 |
| *Graphium sarpedon* | 98.33333333 | 117 | 64.38666667 |
| *Halpe kusala* | 96.33333333 | 123.3333333 | 25.68 |
| *Hasora anura* | 100.3333333 | 128.6666667 | 46.325 |
| *Hebomoia glaucippe* | 214.3333333 | 205 | 84.12 |
| *Helcyra superba* | 216.6666667 | 219.6666667 | 75.73 |
| *Heliophorus ila* | 76 | 160.6666667 | 28.09 |
| *Herona marathus* | 120.6666667 | 162.6666667 | 68.07 |
| *Hyarotis adrastus* | 70.83333333 | 80.33333333 | 35.115 |
| *Hypolycaena erylus* | 99 | 183.3333333 | NA |
| *Iambrix salsala* | 80 | 95.83333333 | 24.64125 |
| *Ideopsis similis* | 122.3333333 | 137.0666667 | 69.13 |
| *Isoteinon iamprospilus* | 89 | 115 | 35.43 |
| *Ixias pyrene* | 178.6666667 | 195.6666667 | 56.795 |
| *Jamides alecto* | 212.8333333 | 192.3333333 | 28.23333333 |
| *Jamides bochus* | 160.5 | 181.3333333 | 28.335 |
| *Jamides celeno* | 200.3333333 | 190 | 26.404 |
| *Junonia iphita* | 130.6666667 | 132.3333333 | NA |
| *Junonia lemonias* | NA | NA | 49.3275 |
| *Junonia orithya* | 123.3333333 | 180.6666667 | 37.54 |
| *Kaniska canace* | 64.5 | 68.16666667 | 56.56 |
| *Koruthaialos rubecula* | 82 | 101 | 23.74 |
| *Koruthaialos sindu* | 82.66666667 | 91 | 30.575 |
| *Lampides boeticus* | 134.6666667 | 192.3333333 | 29.66 |
| *Lamproptera curius* | 99.33333333 | 146.6666667 | 32.56 |
| *Lethe chandica* | 84.83333333 | 125.1666667 | 52.79 |
| *Lethe confusa* | 67.66666667 | 95.77777778 | 42.95625 |
| *Lethe dura* | 95.33333333 | 136.3333333 | 56.575 |
| *Lethe helena* | 105.6666667 | 136 | 56.365 |
| *Lethe lanaris* | 141 | 147 | 55.25 |
| *Lethe procne* | 128 | 150.3333333 | 45.91 |
| *Lethe rohria* | NA | NA | NA |
| *Lethe satyrina* | 87.66666667 | 99 | 50.37333333 |
| *Lethe siderea* | 121.8333333 | 145.1666667 | 48.18 |
| *Lethe syrcis* | 151.6666667 | 192.3333333 | 52.7 |
| *Lethe violaceopicta* | 93 | 106 | 44.47 |
| *Lexias dirtea* | 111.3333333 | 177 | 82.4 |
| *Libythea celtis* | 111.3333333 | 154.6666667 | 48.88 |
| *Loxura atymnus* | NA | NA | 32.3 |
| *Mandarinia regalis* | NA | NA | NA |
| *Megisba malaya* | 105.6666667 | 183.1666667 | 16.71 |
| *Melanitis leda* | 101.3333333 | 114.3333333 | 57.85625 |
| *Melanitis phedima* | 106.1666667 | 126.5 | 59.09 |
| *Melanitis zitenius* | 116 | 149.6666667 | 58.72333333 |
| *Miletus archilochus* | 100.6666667 | 148.3333333 | 52.03 |
| *Mooreana trichoneura* | 131.3333333 | 151.3333333 | 30.14 |
| *Mycalesis anaxias* | 109.6666667 | 104.6666667 | 40.855 |
| *Mycalesis francisca* | 118.3888889 | 148.1666667 | 43.82615385 |
| *Mycalesis gotama* | 116.3333333 | 153.3333333 | 35.58 |
| *Mycalesis mamerta* | 97.66666667 | 116.3333333 | 41.91 |
| *Mycalesis mineus* | 127.3333333 | 123.3333333 | 39.175 |
| *Mycalesis zonata* | 111.5 | 137.0555556 | 37.845 |
| *Nacaduba kurava* | 146.6666667 | 168.8333333 | 27.07 |
| *Neope muirheadii* | 109.5 | 135.5 | 60.816 |
| *Neptis clinia* | 113.0952381 | 156.5714286 | 40.6475 |
| *Neptis miah* | 87.66666667 | 139.3333333 | 43.52666667 |
| *Neptis soma* | 93.22222222 | 143.2222222 | 48.43333333 |
| *Notocrypta curvifascia* | 97.58333333 | 114.5833333 | 38.126 |
| *Notocrypta paralysos* | 95.66666667 | 123.6666667 | 32.94 |
| *Ochus subvittatus* | 83.83333333 | 136 | 19.19666667 |
| *Odina decoratus* | 129.6666667 | 140.6666667 | 25.58 |
| *Pantoporia hordonia* | 87.5 | 144 | 37.955 |
| *Papilio arcturus* | 71.66666667 | 86.33333333 | 95.58 |
| *Papilio bianor* | 65.66666667 | 93 | 85.085 |
| *Papilio helenus* | 50.75 | 67.72222222 | 104.4444444 |
| *Papilio memnon* | 93.16666667 | 91.94444444 | 109.13125 |
| *Papilio nephelus* | 70 | 98.33333333 | 104.42 |
| *Papilio paris* | 43.66666667 | 56.77777778 | 89.655 |
| *Papilio polytes* | 62 | 72 | 72.29714286 |
| *Papilio protenor* | 67.41666667 | 77.58333333 | 89.368 |
| *Paralaxita dora* | 82.66666667 | 124 | 34.21 |
| *Parantica aglea* | 164.4666667 | 169.4 | 68.08666667 |
| *Parantica melaneus* | 145.6666667 | 147.5 | 71.4175 |
| *Parantica sita* | 146.3333333 | 149.6666667 | 88.595 |
| *Parasarpa dudu* | 75.33333333 | 138.6666667 | 64.1 |
| *Pareronia anais* | NA | NA | NA |
| *Parthenos sylvia* | 114.6666667 | 192.3333333 | 74.345 |
| *Penthema darlisa* | 93.66666667 | 122 | 106.6733333 |
| *Phaedyma columella* | 120.6666667 | 167.3333333 | 63.81 |
| *Polytremis theca* | 132 | 163 | 35.295 |
| *Polyura athamas* | 96.66666667 | 153 | 51.94 |
| *Potanthus lydia* | 107 | 136 | 25.38 |
| *Potanthus trachala* | 88.33333333 | 113.3333333 | 20.03 |
| *Prosotas dubiosa* | 111.6666667 | 147.3333333 | 17.26 |
| *Prosotas nora* | 108.1666667 | 162.1666667 | 21.18 |
| *Pseudozizeeria maha* | 167 | 205.6666667 | 23.35 |
| *Rhaphicera dumicola* | 106 | 138.3333333 | 48.86 |
| *Sinthusa chandrana* | 107.8333333 | 182.1666667 | 23.295 |
| *Spindasis lohita* | NA | NA | NA |
| *Stibochiona nicea* | 79 | 105.3333333 | 54.105 |
| *Stichophthalma louisa* | 111.6666667 | 165.3333333 | 114.87 |
| *Sumalia daraxa* | 119.3333333 | 156.6666667 | 30.52 |
| *Symbrenthia hypselis* | 120.5 | 169.6666667 | 37.375 |
| *Symbrenthia lilaea* | 86.55555556 | 151.2222222 | 42.92833333 |
| *Tagiades litigiosa* | 125.5 | 163.8333333 | 33.77 |
| *Tagiades menaka* | 110.4444444 | 152.2222222 | 34.83 |
| *Talbotia naganum* | 212 | 211.3333333 | 54.525 |
| *Taraka hamada* | 145.3333333 | 193.6666667 | 20.97 |
| *Thaumantis diores* | 80.33333333 | 97 | 79.47 |
| *Thauria lathyi* | 73.66666667 | 125.6666667 | 95.45 |
| *Tongeia filicaudis* | 124.3333333 | 199.3333333 | 22.84 |
| *Tongeia potanini* | 93.66666667 | 191.3333333 | 20.53 |
| *Troides helena* | 68.33333333 | 88.5 | 116.79625 |
| *Udara albocaerulea* | 182.4444444 | 214.2222222 | 27.7075 |
| *Udara dilecta* | 162.9166667 | 199.3888889 | 25.62 |
| *Vagrans egista* | 90.33333333 | 148.6666667 | 20.63 |
| *Vanessa cardui* | 138.6666667 | 169.6666667 | 53.89 |
| *Vanessa indica* | NA | NA | 56.72 |
| *Vindula erota* | 144 | 160.3333333 | 76.25 |
| *Yasoda tripunctata* | 139.5 | 179 | 25.066 |
| *Ypthima baldus* | 111.5333333 | 144.0666667 | 31.70333333 |
| *Ypthima chinensis* | NA | NA | 33.63 |
| *Ypthima conjuncta* | 116.1666667 | 152 | 34.03 |
| *Ypthima esakii* | 105 | 156.3333333 | 36.35666667 |
| *Ypthima motschulskyi* | 113.6666667 | 148.3333333 | 31.955 |
| *Ypthima praenubila* | 85.83333333 | 143.8333333 | 45.22 |
| *Zeltus amasa* | NA | NA | NA |
| *Zemeros flegyas* | 110.1666667 | 148 | 29.44 |
| *Zinaspa todara* | 144 | 161.3333333 | 27.18 |
| *Zipaetis unipupillata* | 114.3333333 | 119.3333333 | 45.22 |

##### Table S3. Five best multiple linear regression models for environmental factors and dorsal color luminance of butterfly individuals.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Environmental factors | Number of factors | AIC | ∆AIC | Weights | LogLik |
| Solar radiation, Temperature, Elevation, Location | 4 | 21917 | 0 | 0.68 | -10951.30 |
| Solar radiation, Temperature, Elevation, Location, Sun | 5 | 21918 | 1.79 | 0.28 | -10951.19 |
| Solar radiation, Temperature, Location, Sun | 4 | 21924 | 7.12 | 0.02 | -10954.86 |
| Solar radiation, Temperature, Location | 3 | 21924 | 7.27 | 0.02 | -10955.93 |
| Elevation, Location | 2 | 21934 | 17.25 | 0.00 | -10961.92 |

AIC, Akaike information criterion; ∆AIC, Akaike differences; Weights, Akaike weights; LogLik, the log-likelihood estimate.

##### Table S4. Five best multiple linear regression models for environmental factors and wingspan of butterfly individuals.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Environmental factors | Number of factors | AIC | ∆AIC | Weights | LogLik |
| Solar radiation, Temperature, Elevation, Location, Sun | 5 | 19918 | 0.00 | 0.90 | -9951.04 |
| Solar radiation, Temperature, Elevation, Location | 4 | 19923 | 4.77 | 0.08 | -9954.43 |
| Elevation, Location, Sun | 3 | 19928 | 9.59 | 0.01 | -9957.84 |
| Elevation, Location, | 2 | 19929 | 10.00 | 0.004 | -9959.25 |
| Solar radiation, Temperature, Location, Sun | 4 | 20013 | 94.44 | 0.000 | -9999.26 |

AIC, Akaike information criterion; ∆AIC, Akaike differences; Weights, Akaike weights; LogLik, the log-likelihood estimate.

##### Table S5. Averaged statistical results of best multiple linear regression models for relationships of phylogenetic and specific components with environmental factors based on 300 phylogenetic trees.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Phylogenetic components | df | Parameter | Estimate | Std. Error | Pr(>|t|) |
| Dorsal color luminance | 2114 | Solar radiation | 0.074 | 0.024 | 0.003\*\* |
| Air temperature | 0.688 | 0.325 | 0.034\* |
| Elevation | -0.009 | 0.003 | <0.001\*\* |
| Hong Kong | -46.612 | 2.394 | <0.001\*\* |
| Yunnan | -18.782 | 1.727 | <0.001\*\* |
| Ventral color luminance | 2108 | Solar radiation | 0.070 | 0.025 | 0.005 \*\* |
| Air temperature | 0.628 | 0.328 | 0.06 |
| Elevation | -0.020 | 0.003 | <0.001\*\* |
| Hong Kong | -63.062 | 2.418 | <0.001\*\* |
| Yunnan | -25.559 | 1.744 | <0.001\*\* |
| Wingspan | 2102 | Solar radiation | -0.039 | 0.016 | 0.013\*\* |
| Air temperature | -0.109 | 0.216 | 0.614 |
| Elevation | 0.019 | 0.002 | <0.001\*\* |
| Sun | 2.282 | 1.090 | 0.036 \* |
| Hong Kong | 19.884 | 1.587 | <0.001\*\* |
| Yunnan | -7.492 | 1.126 | <0.001\*\* |
|  |  |  |  |  |  |
| Specific components | df | Parameter | Estimate | Std. Error | Pr(>|t|) |
| Dorsal color luminance | 2114 | Solar radiation | 0.002 | 0.001 | 0.024\* |
| Air temperature | -0.026 | 0.010 | 0.012\* |
| Elevation | -0.0004 | 0.0001 | <0.001\*\* |
| Hong Kong | -1.451 | 0.075 | <0.001\*\* |
| Yunnan | -0.965 | 0.054 | <0.001\*\* |
| Ventral color luminance | 2108 | Solar radiation | 0.0005 | 0.0003 | 0.12 |
| Air temperature | -0.011 | 0.004 | 0.007\*\* |
| Elevation | -0.0003 | 0.000 | <0.001\*\* |
| Hong Kong | -0.782 | 0.031 | <0.001\*\* |
| Yunnan | -0.618 | 0.022 | <0.001\*\* |
| Wingspan | 2102 | Solar radiation | -0.0007 | 0.0003 | 0.077 |
| Air temperature | 0.001 | 0.004 | 0.558 |
| Elevation | 0.0004 | 0.000 | <0.001\*\* |
| Sun | 0.047 | 0.023 | 0.057 |
| Hong Kong | -0.0038 | 0.034 | 0.099 |
| Yunnan | -0.195 | 0.020 | <0.001\*\* |

\* P<0.05; \*\* P<0.01

###### Figure S1. Three study locations: Hong Kong (22° 15' 0" N , 114° 10' 0" E), Yunnan (XSBN: Xishuangbanna National Nature Reserve, 21°36'42''–58''N, 101°34'26''–47''E), Guangxi (MES: Mao’er Mountain Nature Reserve, 25°51'59.42"N, 110°24'46.05"E).

###### Figure S2. Hourly mean air temperature (A) and solar radiation (B) recorded along elevations at the three locations. Boxplots show medians with overall variances of temperature and solar radiation.



Figure S3. Bayesian 50% majority-rule consensus tree generated from ten genes regions (COI, COII, 16s, NADH1, NADH5, CAD, EF1α, GAPDH, IDH and wingless). Posterior probabilities are indicated at each note (PP). Among the species found in the sampling locations, we obtained the sequences for 139 species (out of 184 species recorded in this study) from the National Center for Biotechnology Information (NCBI) (http://www.ncbi.nlm.nih.gov/). Another 21 species of Lepidoptera were additionally selected for phylogenetic reconstruction, which were: *Chersonesia rahria*, *Lamproptera meges*, *Mathoris loceusalis*, *Morova subfasciata*, *Potanthus flavus*, *Rhodoneura terminalis*, *Daimio tethys*, *Striglina cinnamomea*, *Hasora chromus*, *Hesperia comma*, *Danaus plexippus*, *Ocybadistes walkeri*, *Thymelicus lineola*, *Tagiades flesus*, *Pyrgus malvae*, *Coeliades forestan*, *Ctenoptilum vasava*, *Badamia exclamationis*, *Thyris fenestrella*, *Iphiclides podalirius*, *Polyura nepenthes*. Thus in total we used 155 species of butterfly as in-group species and 5 species of moths as out-group species. We used mitochondrial gene regions (COI, COII, 16s, NADH1 and NADH5) and combined nuclear genes (CAD, EF1α, GAPDH, IDH and *wingless*). The sequences were aligned by MAFFT Multiple Sequence Alignment Software Version 7.215 (Katoh & Standley, 2013). Sequences were concatenated and manually edited in Geneious v.4.8.5 ([Kearse et al., 2012](#_ENREF_36)). The aligned concatenated matrix contained 10689 base pairs. Bayesian inference phylogenetic reconstruction was performed using MrBayes v.3.1.2. (Ronquist & Huelsenbeck, 2003). We used two independent MCMC chains each with 20,000,000 generations and sampled every 5,000th generation. We set cold Markov chain with the temperature parameter of 0.16, while keeping other priors as default. We adjusted the mean branch length prior to be 0.01 (brlenspr = unconstrained : exponential (100.0)) for reducing the likelihood of stochastic entrapment in local tree length optima (Brown et al., 2010, Marshall 2010). The resultant standard deviation of split frequencies was smaller than 0.03. The parameters sampled during the MCMC were checked by Tracer v.1.6 (Rambaut et al., 2014) and showed adequate effective sample sizes (ESS > 200). We excluded 1000 initial samples (around 25%) for each MCMC run (burn-in=1000) from the summary analysis and calculated a 50% majority-rule consensus tree from the post burn-in trees. The posterior probabilities (PP) of each node were summarized (Larget & Simon, 1999) to infer support for individual clades: nodes with PP values ≥ 0.95 were considered well or strongly supported (Yang & Rannala, 1997). Since the incomplete gene information for some species caused a relative high uncertainty in phylogenetic reconstruction, we constrained the phylogenetic relationship with MrBayes according to previous high taxa level of Lepidoptera phylogeny (Heikkilä et al., 2011; Regier et al., 2013).

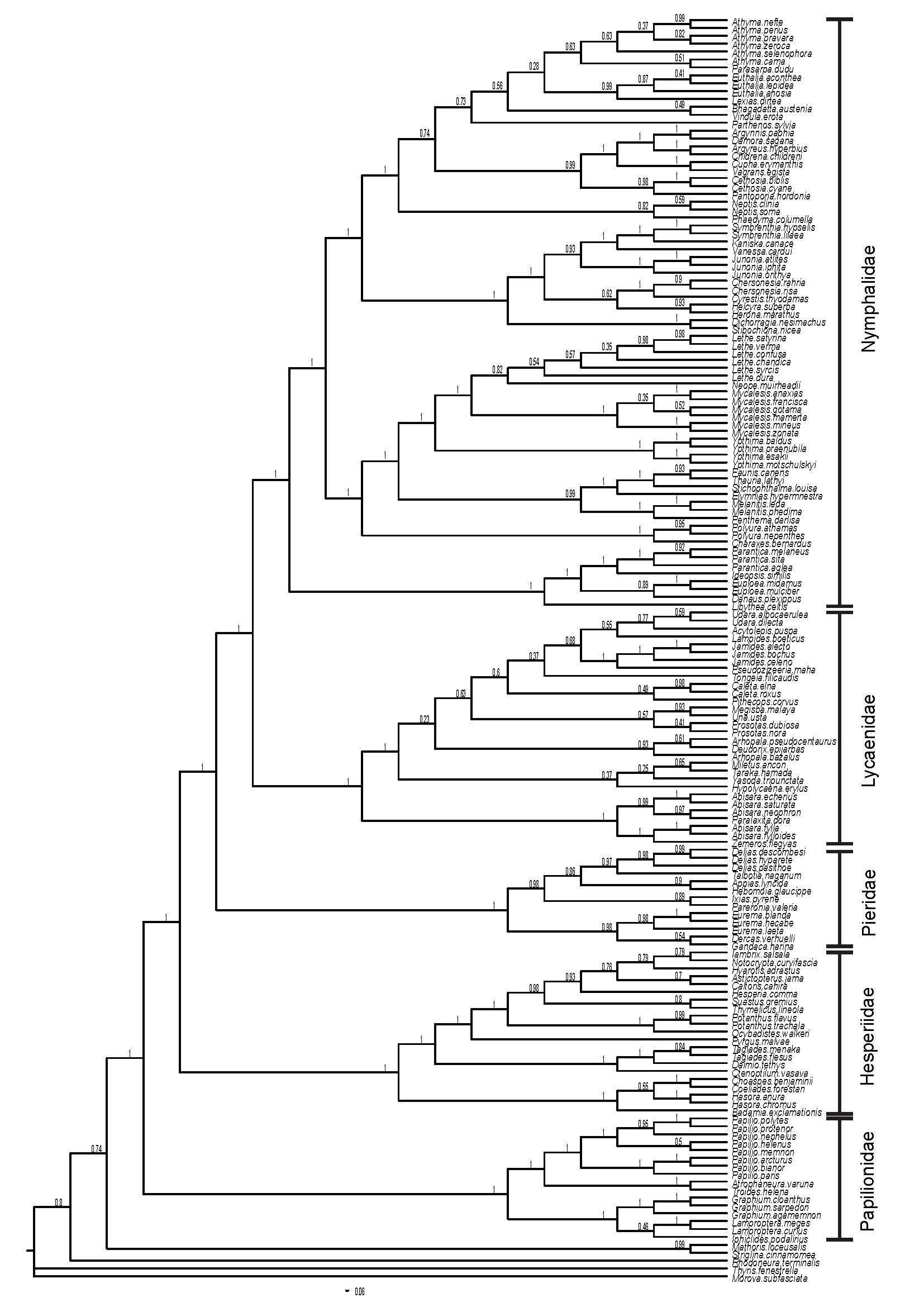


Figure S4. Correlation between dorsal/ventral color luminance and wingspan of 164 butterfly species.



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