

Supporting Information

Appendix S3. Supplementary tables and figures.

Table S1. Territories and administrative divisions used in the American continent to estimate the distribution of each species.

Territories	Administrative division
Anguilla (UK)	No records
Antigua	Whole territory
Argentina	Provinces
Aruba, Bonaire & Curaçao (The Netherlands)	Whole territory
Bahamas	Whole territory
Barbados	Whole territory
Barbuda	No records
Belize	Districts
Bermuda (UK)	Whole territory
Bolivia	Departments
Brazil	States
Canada	Provinces
Cayman Islands (UK)	Whole territory
Chile	Regions
Colombia	Departments
Costa Rica	Whole country
Cuba	Whole territory
Dominica	Whole territory
Dominican Republic	Provinces
Ecuador	Whole country
El Salvador	Whole country
Falkland Islands	No records
French Guiana	Whole country
Galapagos Islands (Ecuador)	Whole territory
Grenada	Whole territory
Guadeloupe (France)	Whole territory
Guatemala	Whole country
Guyana	Whole country
Haiti	Whole territory
Honduras	Whole country
Jamaica	Whole territory
Martinique (France)	Whole territory
Mexico	States
Montserrat (UK)	Whole territory
Nicaragua	Whole country
Panama	Whole country
Paraguay	Whole country
Peru	Departments

Puerto Rico	Whole territory
Saint Barthélemy (France)	Whole territory
Saint Kitts and Nevis	No records
Saint Lucia	Whole territory
Saint Martin (France & The Netherlands)	Whole territory
Saint Vincent	Whole territory
Suriname	Whole country
Trinidad and Tobago	Whole territory
Turks and Caicos Islands (UK)	No records
United States	States
Virgin Islands (UK and US)	Whole territory
Uruguay	Whole country
Venezuela	Whole country

Table S2. Model selection for the retained morphological, ecological and eco-geographical variables in the male dataset. Models of trait evolution used (Corr.): white noise (-), Brownian motion (BM), and Ornstein–Uhlenbeck (OU). The most supported models are highlighted in bold. When collinearity was detected between pairs of variables, separate sets of models were run (I and II).

Models for males	Corr.	df	log-likelihood	AICc	ΔAICc	AICc weight
Range size						
~ hindwing PC1 + migratory status	-	4	-75.562	159.7	0.00	0.554
~ hindwing PC1 + migratory status	OU	5	-75.031	160.9	1.21	0.302
~ hindwing PC1	-	3	-79.009	164.3	4.68	0.053
~ migratory status	-	3	-79.408	165.1	5.48	0.036
~ hindwing PC1	OU	4	-78.350	165.2	5.58	0.034
~ migratory status	OU	4	-78.884	166.3	6.64	0.020
~ hindwing PC1 + migratory status	BM	4	-98.390	205.3	45.65	0.000
~ hindwing PC1	BM	3	-100.578	207.5	47.82	0.000
~ migratory status	BM	3	-102.260	210.8	51.18	0.000
Latitudinal range I						
~ forewing PC1 + mid-range latitude	OU	5	-45.474	101.7	0.00	0.586
~ mid-range latitude	OU	4	-47.170	102.9	1.12	0.335
~ forewing PC1 + mid-range latitude	-	4	-49.285	107.1	5.35	0.040
~ mid-range latitude	-	3	-50.831	108.0	6.22	0.026
~ forewing PC1 + mid-range latitude + mid-range longitude	OU	6	-48.671	110.5	8.73	0.007
~ mid-range latitude + mid-range longitude	OU	5	-50.355	111.5	9.76	0.004
~ forewing PC1 + mid-range latitude + mid-range longitude	-	5	-52.065	114.9	13.18	0.001
~ mid-range latitude + mid-range longitude	-	4	-53.597	115.7	13.97	0.001
~ forewing PC1	OU	4	-56.430	121.4	19.64	0.000
~ forewing PC1 + mid-range longitude	OU	5	-59.475	129.8	28.00	0.000
~ forewing PC1	BM	3	-64.801	135.9	34.16	0.000
~ mid-range longitude	OU	4	-63.807	136.1	34.39	0.000
~ forewing PC1 + mid-range latitude	BM	4	-64.119	136.8	35.02	0.000
~ forewing PC1	-	3	-65.925	138.2	36.41	0.000
~ mid-range latitude	BM	3	-66.869	140.0	38.30	0.000
~ forewing PC1 + mid-range longitude	-	4	-68.292	145.1	43.36	0.000
~ forewing PC1 + mid-range latitude + mid-range longitude	BM	5	-67.843	146.5	44.74	0.000
~ forewing PC1 + mid-range longitude	BM	4	-69.062	146.6	44.90	0.000
~ mid-range longitude	BM	3	-71.633	149.6	47.83	0.000
~ mid-range latitude + mid-range longitude	BM	4	-70.602	149.7	47.98	0.000
~ mid-range longitude	-	3	-72.595	151.5	49.75	0.000
Latitudinal range II						
~ hindwing PC2 + mid-range latitude	OU	5	-44.932	100.7	0.00	0.634
~ mid-range latitude	OU	4	-47.170	102.9	2.20	0.211
~ hindwing PC2 + mid-range latitude	-	4	-47.688	103.9	3.24	0.126
~ mid-range latitude	-	3	-50.831	108.0	7.31	0.016
~ hindwing PC2 + mid-range latitude + mid-range longitude	OU	6	-48.135	109.4	8.74	0.008
~ mid-range latitude + mid-range longitude	OU	5	-50.355	111.5	10.84	0.003
~ hindwing PC2 + mid-range latitude + mid-range longitude	-	5	-50.508	111.8	11.15	0.002
~ mid-range latitude + mid-range longitude	-	4	-53.597	115.7	15.05	0.000
~ hindwing PC2	OU	4	-56.426	121.4	20.71	0.000
~ hindwing PC2 + mid-range longitude	OU	5	-59.766	130.3	29.67	0.000
~ mid-range longitude	OU	4	-63.807	136.1	35.47	0.000
~ hindwing PC2	BM	3	-65.670	137.7	36.99	0.000
~ hindwing PC2 + mid-range latitude	BM	4	-64.766	138.1	37.39	0.000
~ mid-range latitude	BM	3	-66.869	140.0	39.38	0.000
~ hindwing PC2	-	3	-67.986	142.3	41.62	0.000
~ hindwing PC2 + mid-range latitude + mid-range longitude	BM	5	-68.450	147.7	47.04	0.000
~ hindwing PC2 + mid-range longitude	-	4	-69.886	148.3	47.63	0.000
~ hindwing PC2 + mid-range longitude	BM	4	-69.953	148.4	47.77	0.000

~ mid-range longitude	BM	3	-71.633	149.6	48.91	0.000
~ mid-range latitude + mid-range longitude	BM	4	-70.602	149.7	49.07	0.000
~ mid-range longitude	-	3	-72.595	151.5	50.84	0.000
Longitudinal range I						
~ hindwing PC1 + hindwing PC3 + migratory status	-	5	-49.247	109.3	0.00	0.361
~ hindwing PC1 + hindwing PC3 + migratory status	OU	6	-48.153	109.4	0.15	0.335
~ hindwing PC3 + migratory status	OU	5	-50.755	112.3	3.02	0.080
~ hindwing PC1 + hindwing PC3	OU	5	-50.844	112.5	3.19	0.073
~ hindwing PC3 + migratory status	-	4	-52.131	112.8	3.49	0.063
~ hindwing PC1 + hindwing PC3	-	4	-52.542	113.6	4.32	0.042
~ hindwing PC1 + migratory status	OU	5	-52.338	115.5	6.18	0.016
~ hindwing PC3	OU	4	-53.907	116.3	7.05	0.011
~ hindwing PC1	OU	4	-53.983	116.5	7.20	0.010
~ migratory status	OU	4	-54.692	117.9	8.62	0.005
~ hindwing PC3	-	3	-56.981	120.3	10.98	0.001
~ hindwing PC1 + migratory status	-	4	-55.877	120.3	10.99	0.001
~ hindwing PC1	-	3	-57.136	120.6	11.29	0.001
~ migratory status	-	3	-59.013	124.3	15.04	0.000
~ hindwing PC1 + hindwing PC3 + migratory status	BM	5	-65.800	142.4	33.11	0.000
~ hindwing PC1 + hindwing PC3	BM	4	-67.991	144.5	35.21	0.000
~ hindwing PC3 + migratory status	BM	4	-68.416	145.4	36.06	0.000
~ hindwing PC1 + migratory status	BM	4	-69.094	146.7	37.42	0.000
~ hindwing PC3	BM	3	-70.591	147.5	38.20	0.000
~ hindwing PC1	BM	3	-71.074	148.5	39.16	0.000
~ migratory status	BM	3	-71.633	149.6	40.28	0.000
Longitudinal range II						
~ hind pterostigma ratio + migratory status	OU	5	-49.725	110.3	0.00	0.470
~ hind pterostigma ratio + migratory status	-	4	-51.277	111.1	0.83	0.310
~ hind pterostigma ratio	OU	4	-52.111	112.7	2.50	0.135
~ hind pterostigma ratio	-	3	-53.810	113.9	3.68	0.075
~ migratory status	OU	4	-54.692	117.9	7.66	0.010
~ migratory status	-	3	-59.013	124.3	14.09	0.000
~ hind pterostigma ratio + migratory status	BM	4	-68.800	146.1	35.88	0.000
~ hind pterostigma ratio	BM	3	-70.872	148.1	37.81	0.000
~ migratory status	BM	3	-71.633	149.6	39.33	0.000

Table S3. Model selection for the retained morphological, ecological and eco-geographical variables in the female dataset. Models of trait evolution used (Corr.): white noise (-), Brownian motion (BM), and Ornstein–Uhlenbeck (OU). The most supported models are highlighted in bold.

Models for females	Corr.	df	log-likelihood	AICc	ΔAICc	AICc weight
Range size						
~ hindwing ratio + migratory status	-	4	-53.240	115.2	0.00	0.360
~ migratory status	-	3	-54.858	116.1	0.95	0.224
~ hindwing ratio + migratory status	OU	5	-52.863	116.8	1.61	0.161
~ migratory status	OU	4	-54.338	117.4	2.20	0.120
~ hindwing ratio	-	3	-55.835	118.1	2.91	0.084
~ hindwing ratio	OU	4	-55.260	119.2	4.04	0.048
~ migratory status	BM	3	-60.183	126.8	11.60	0.001
~ hindwing ratio + migratory status	BM	4	-59.289	127.3	12.10	0.001
~ hindwing ratio	BM	3	-60.975	128.4	13.19	0.000
Latitudinal range						
~ forewing PC1 + mid-range latitude	OU	5	-31.488	74.0	0.00	0.338
~ forewing PC1 * mid-range latitude	OU	6	-30.678	74.9	0.83	0.223
~ forewing PC1 * mid-range latitude	-	5	-32.090	75.2	1.21	0.185
~ mid-range latitude	OU	4	-33.459	75.6	1.58	0.153
~ forewing PC1 + mid-range latitude	-	4	-34.284	77.3	3.23	0.067
~ mid-range latitude	-	3	-36.267	78.9	4.91	0.029
~ forewing PC1	BM	3	-39.157	84.7	10.69	0.002
~ forewing PC1 + mid-range latitude	BM	4	-39.042	86.8	12.75	0.001
~ forewing PC1 * mid-range latitude	BM	5	-37.938	86.9	12.90	0.001
~ forewing PC1	OU	4	-39.140	87.0	12.94	0.001
~ mid-range latitude	BM	3	-41.055	88.5	14.49	0.000
~ forewing PC1	-	3	-47.885	102.2	28.15	0.000
Longitudinal range						
~ forewing ratio + hind pterostigma ratio	-	4	-37.580	83.9	0.00	0.231
~ forewing ratio + hind pterostigma ratio	OU	5	-36.797	84.6	0.80	0.155
~ forewing ratio + hind pterostigma ratio + migratory status	-	5	-36.994	85.0	1.19	0.127
~ forewing ratio + hind pterostigma ratio + migratory status	OU	6	-35.837	85.2	1.32	0.119
~ hind pterostigma ratio + migratory status	OU	5	-37.145	85.3	1.49	0.109
~ hind pterostigma ratio	OU	4	-39.129	86.9	3.10	0.049
~ hind pterostigma ratio + migratory status	-	4	-39.291	87.3	3.42	0.042
~ forewing ratio	-	3	-40.460	87.3	3.48	0.041
~ forewing ratio	OU	4	-39.645	88.0	4.13	0.029
~ forewing ratio + migratory status	OU	5	-38.595	88.2	4.39	0.026
~ forewing ratio + migratory status	-	4	-39.817	88.3	4.47	0.025
~ migratory status	OU	4	-39.972	88.6	4.78	0.021
~ hind pterostigma ratio	-	3	-41.222	88.9	5.00	0.019
~ migratory status	-	3	-42.315	91.0	7.19	0.006
~ hind pterostigma ratio + migratory status	BM	4	-44.204	97.1	13.25	0.000
~ forewing ratio + hind pterostigma ratio + migratory status	BM	5	-43.570	98.2	14.34	0.000
~ forewing ratio + hind pterostigma ratio	BM	4	-45.328	99.3	15.50	0.000
~ hind pterostigma ratio	BM	3	-46.734	99.9	16.02	0.000
~ migratory status	BM	3	-47.003	100.4	16.56	0.000
~ forewing ratio + migratory status	BM	4	-46.348	101.4	17.53	0.000
~ forewing ratio	BM	3	-48.200	102.8	18.96	0.000

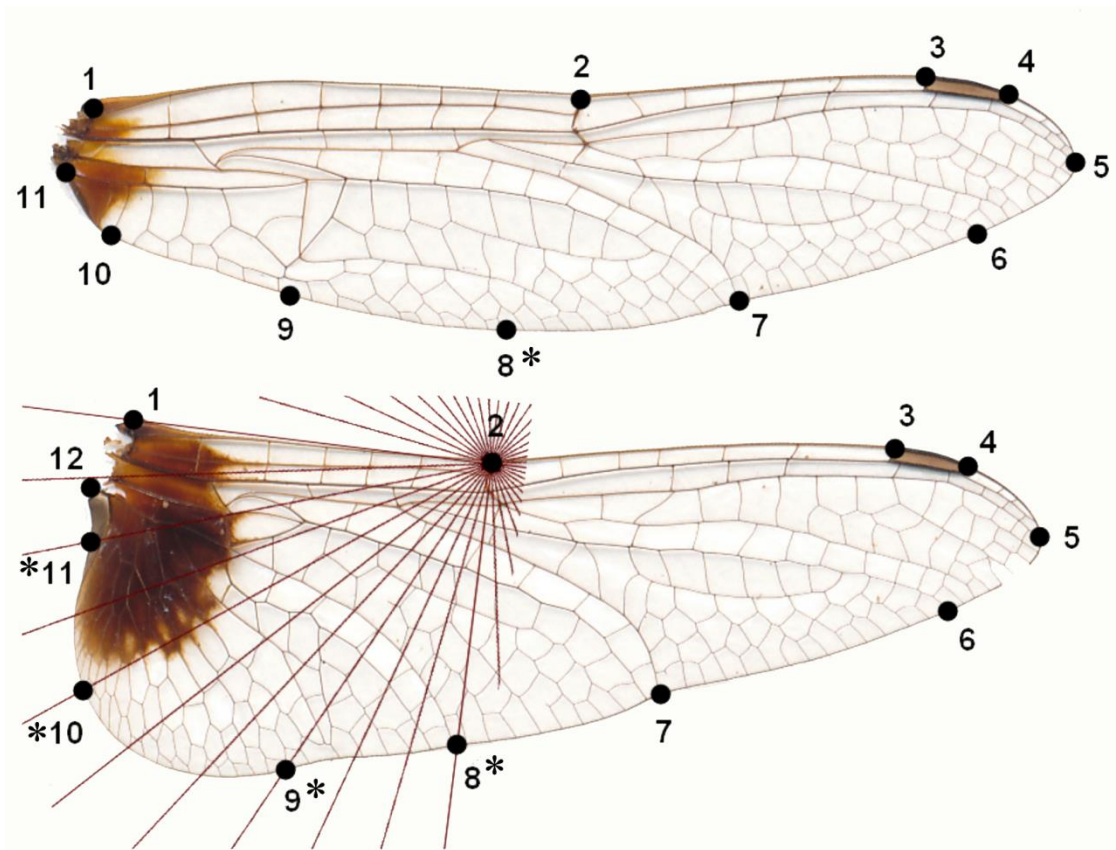


Figure S1. Landmarks and semi-landmarks (*) used to characterize wing shape in fore- (above) and hindwings (below). Pterostigma length was estimated as the distance between landmarks 3 and 4.

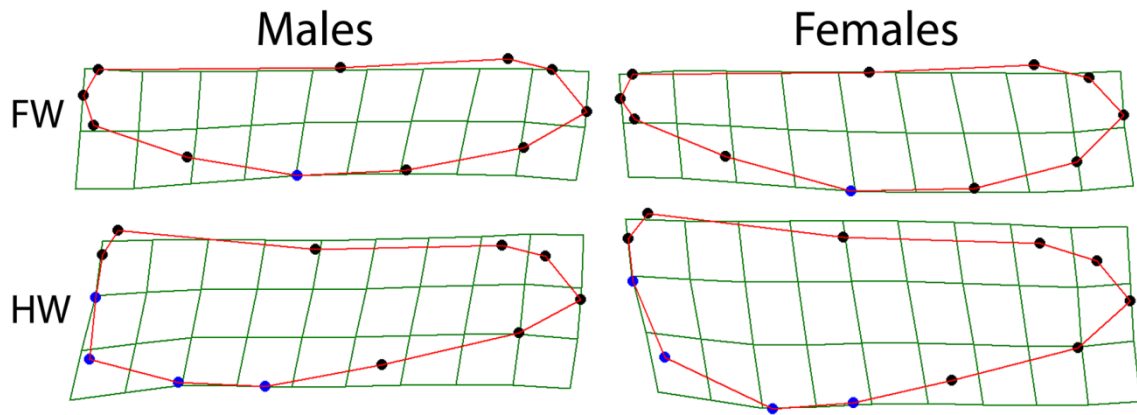


Figure S2. Deformation grids depicting sexual dimorphism in wing shape. We first calculated the mean wing shape across species, separately for fore- and hindwings, and males and females. We then computed the thin-plate spline transformations of each mean wing shape with respect to the opposite sex, using tpsSpln (Rohlf, 2004). The deformations are exaggerated three times for ease of clarity. (FW: forewings; HW: hindwings)

References

Rohlf FJ, 2004. *tpsSpln. Thin-plate spline version 1.20*. Available at: <http://life.bio.sunysb.edu/morph/>