Supporting Material S2 – Additional results of quantitative analyses for

Comparative life-history responses of lacewings to changes in temperature

For all correspondence, please contact Maria Paniw: maria.paniw@ebd.csic.es or

m.paniw@gmail.com

All R scripts to run the analyses can be found at:

https://github.com/MariaPaniw/lacewings_life_histories

Analyses of life-history processes including 6 life-history processes (n = 51)

See `mcmc_pca_Neuroptera_main_text.R`

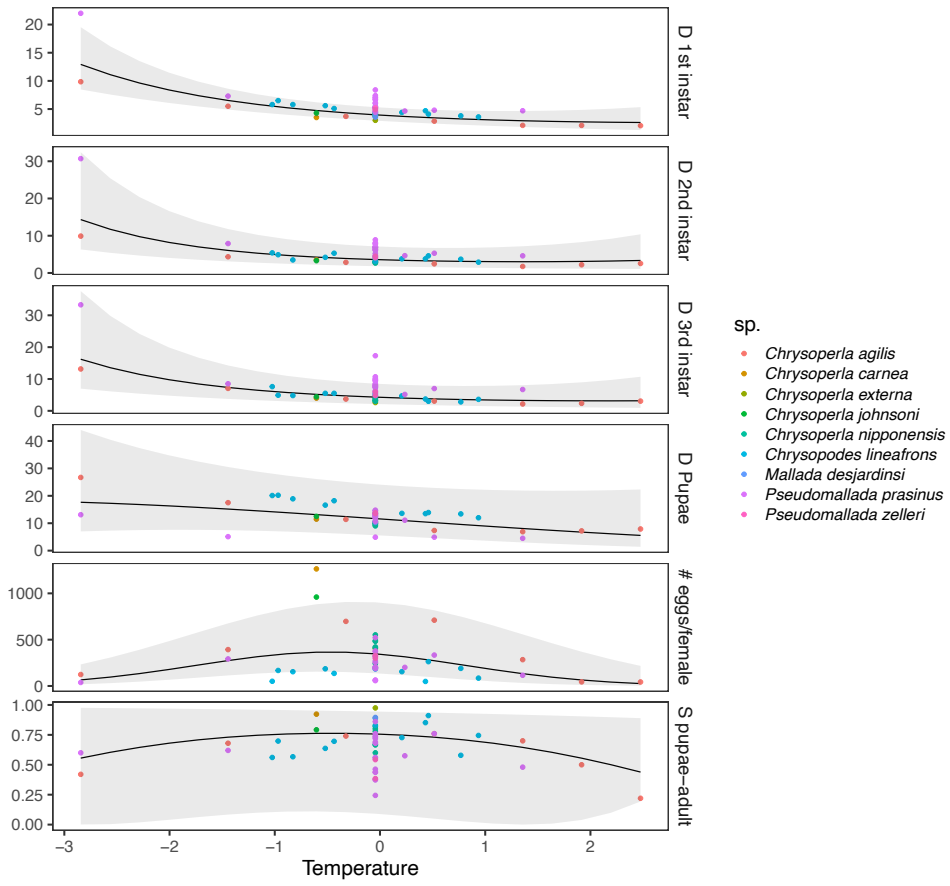

Figure S2.1. Covariation in life-history responses to temperature across 9 Neuroptera species (point colors). Points are observed values from the literature review. Lines are mean predictions of developmental (D) times (in days) for three instar and pupae stages, number of eggs per female, and proportion of pupae surviving (S) to adult stages from the multivariate MCMCglmm. Grey area are 95 % credible intervals of model predictions.

Table S2.1 Loadings of life-history processes (rows; see Fig. S1.1 for description) on the principal component axes. The first two axes, which together explain 76% of the variation in the data and have associated eigenvalues > 1 (in bold), are varimax-corrected. Redder colors identify more positive loadings while bluer colors identify more negative loadings. % var. – percent variation explained by each principal component axis; Cumulative var. – cumulative variance explained.

Life-history trait	PCA 1	PCA 2	PCA 3	PCA 4	PCA 5	PCA6
D 1st instar	0.93	0.11	0.03	-0.17	0.76	0.34
D 2nd instar	0.94	0.00	-0.15	-0.35	-0.09	-0.74
D 3rd instar	0.95	0.00	-0.05	-0.12	-0.62	0.54
D Pupae	0.00	0.94	0.07	-0.51	-0.07	0.04
S pupae-adult	-0.57	-0.33	-0.79	-0.43	0.07	0.17
#eggs/female	-0.51	-0.58	0.57	-0.61	-0.02	0.06
Eigenvalue	**1.83**	**1.66**	0.87	0.62	0.42	0.28
% Var.	54.1	22.3	12.8	6.3	3.0	1.3
Cumulative var.	54.1	76.5	89.3	95.6	98.6	100.0

Analyses of life-history processes including 4 life-history processes (n = 120)

See `mcmc_pca_Neuroptera_dev_times_only.R & mcmc_ Neuroptera_in_vivo.R`

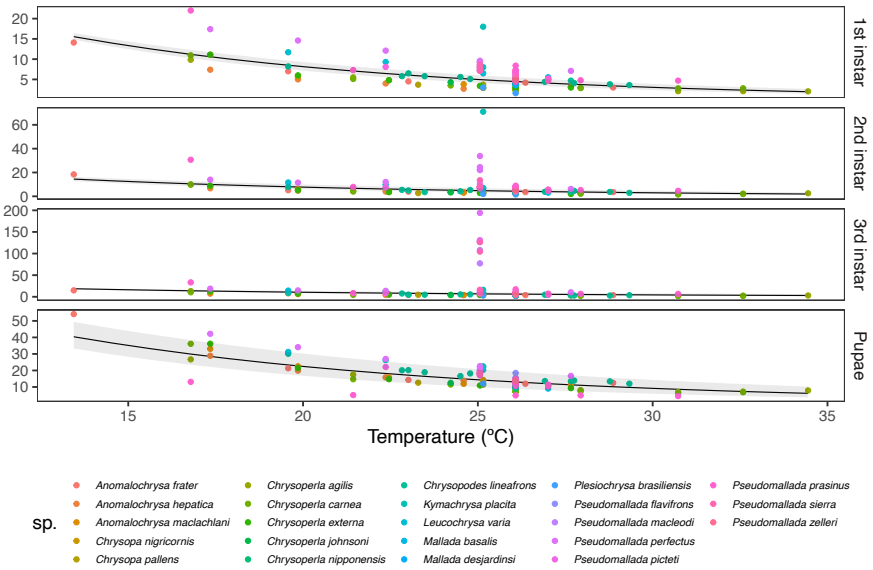

Figure S2.2. Covariation in life-history responses to temperature across 23 Neuroptera species (point colors). Points are observed values from the literature review. Lines are mean predictions of developmental times (in days) for three instar and pupae stages from the multivariate MCMCglmm. Grey area are 95 % credible intervals of model predictions.

Table S2.2. Parameter estimates of fixed effects from multivariate GLMMs, modelling covariation of life-history processes as a function of temperature.

Life-history process	Mean effect (at temp = 0)	Temperature slope
Intercept (D 1st instar)	1.59[1.40,1.78]	-0.35[-0.39,-0.31]
D 2nd instar	-0.04[-0.21,0.12]	-0.34[-0.41,-0.27]
D 3rd instar	0.31[0.04,0.57]	-0.31[-0.43,-0.19]
D pupae	1.06[0.87,1.24]	-0.32[-0.37,-0.27]

Parameters show mean values and 95 % credible intervals in brackets. The model was parameterized using contrasts, so that the intercept represents the developmental times of the 1st instar and the subsequent terms represent differences from the intercept. Note that we did not include the temperature^2 effect, as it did not contribute to improve model fit.

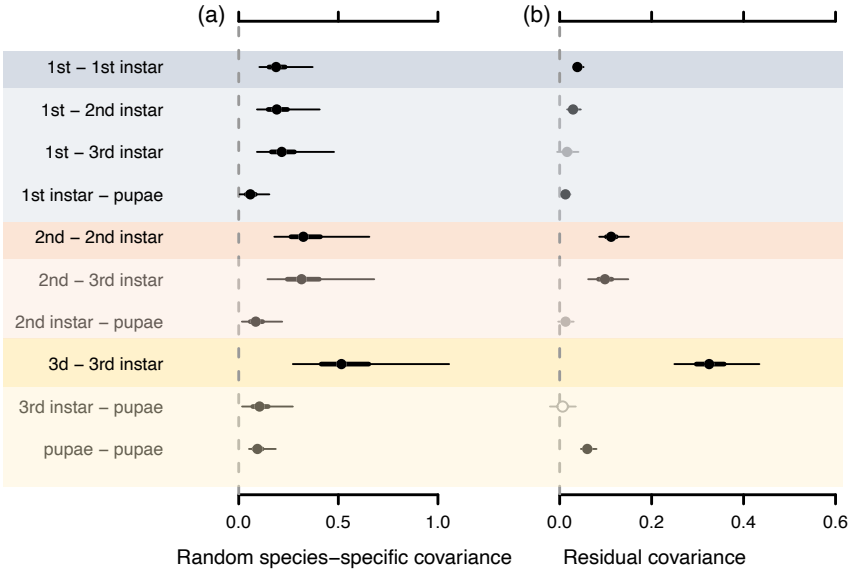

Figure S2.3. Caterpillar plots of the distribution of posterior parameters from the Bayesian multivariate mixed effect model describing the covariance of life-history processes in Neuroptera due to random among-species effect and residual (within-species) error. Life-history processes include: developmental times of 1st, 2nd, and 3rd instar and pupae stages. Parameters where 50% credible intervals (C.I.) overlap 0 are indicated by open circles. Parameters where 50% C.I. do not but 95% C.I. do overlap 0 are indicated by closed gray circles. Parameters where 95% C.I. do overlap 0 are indicated by closed black circles. Thick lines represent 50% C.I.; thin lines represent 95% credible intervals.

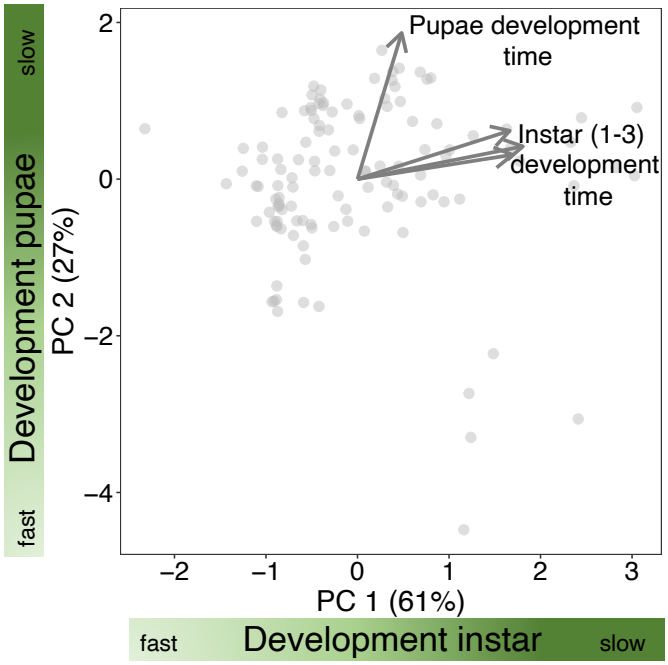

Figure S2.4. Life histories of study species' populations (points) are characterized by life-history processes representing developmental times in different life cycle stages. To characterize life histories, a PCA was performed on the residual variation of GLMMs modelling four life-history processes: development (in days) in 3 instar stages and development in pupae stage. Arrow lengths are proportional to the loadings of each process onto the two axes.

Table S2.3 Loadings of life-history processes (rows; see Fig. S1.1 for description) on the principal component axes. The first two axes, which together explain 89% of the variation in the data and have associated eigenvalues > 1 (in bold), are varimax-corrected. Redder colors identify more positive loadings while bluer colors identify more negative loadings. % var. – percent variation explained by each principal component axis; Cumulative var. – cumulative variance explained.

Life-history trait	PCA 1	PCA 2	PCA 3	PCA 4
D 1st instar	0.86	0.32	0.59	0.58
D 2nd instar	0.93	0.22	0.20	-0.77
D 3rd instar	0.87	0.16	-0.77	0.26
D Pupae	0.25	0.97	-0.11	-0.07
Eigenvalue	**2.44**	**1.07**	0.57	0.33
% Var.	61.2	27.7	8.3	2.7
Cumulative var.	61.2	**88.9**	97.2	100.0

Analyses of life-history processes including 2 life-history processes (n = 56)

See `mcmc_Neuroptera_surv_repro_only.R`

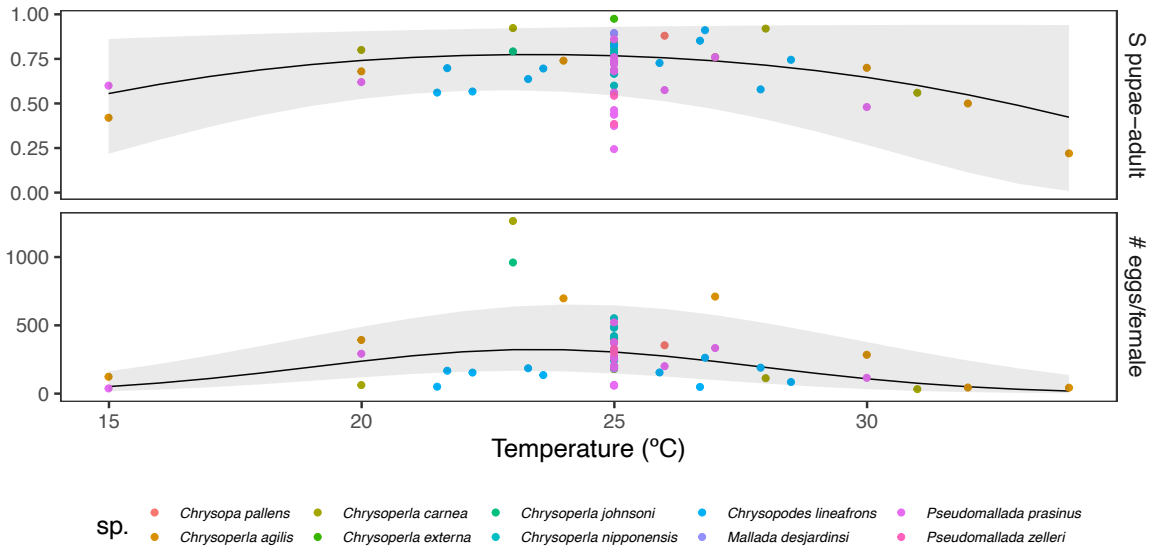

Figure S2.5. Covariation in life-history responses to temperature across 10 Neuroptera species (point colors). Points are observed values from the literature review. Lines are mean predictions of survival (S) and number of eggs per female from the multivariate MCMCglmm. Grey area are 95 % credible intervals of model predictions.

Table S2.4. Parameter estimates of fixed effects from multivariate GLMMs, modelling covariation of life-history processes as a function of temperature.

Life-history process	Mean effect (at temp = 0)	Temperature slope	Temperature^2 slope
Intercept (Survival)	1.06[0.89,1.30]	-0.04[-0.08,0.02]	-0.05[-0.39,-0.00]
#eggs/female	4.64[4.15,5.17]	-0.30[-0.49,-0.10]	-0.37[-0.41,-0.23]

Parameters show mean values and 95 % credible intervals in brackets. The model was parameterized using contrasts, so that the intercept represents survival of pupae to adult and the subsequent term represent differences in #eggs per female from the intercept.

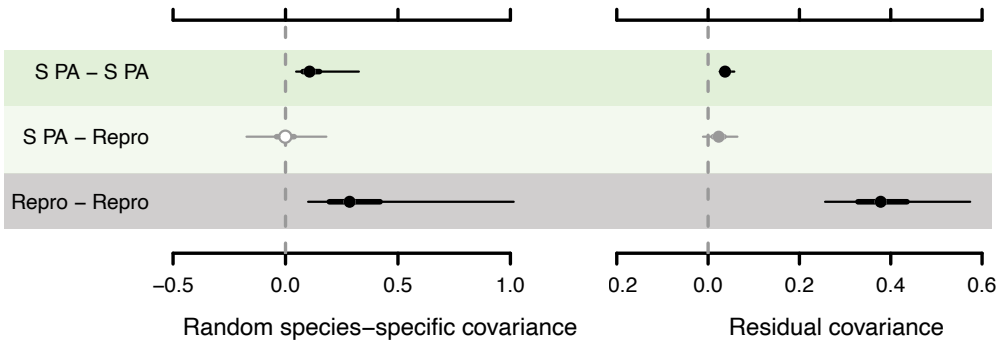

Figure S2.3. Caterpillar plots of the distribution of posterior parameters from the Bayesian multivariate mixed effect model describing the covariance of life-history processes in Neuroptera due to random among-species effect and residual (within-species) error. Life-history processes include survival (S) of pupae to adult (PA) and #eggs/female (Repro). Parameters where 50% credible intervals (C.I.) overlap 0 are indicated by open circles. Parameters where 50% C.I. do not but 95% C.I. do overlap 0 are indicated by closed gray circles. Parameters where 95% C.I. do overlap 0 are indicated by closed black circles. Thick lines represent 50% C.I.; thin lines represent 95% credible intervals.