Supplement Materials

Presence of multiple parasitoids decreases host survival under warming, but parasitoid performance also decreases

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Supplement Material S1: Identification of parasitoid eggs and larvae inside D. simulans 2, 3 or 4 days after infection.

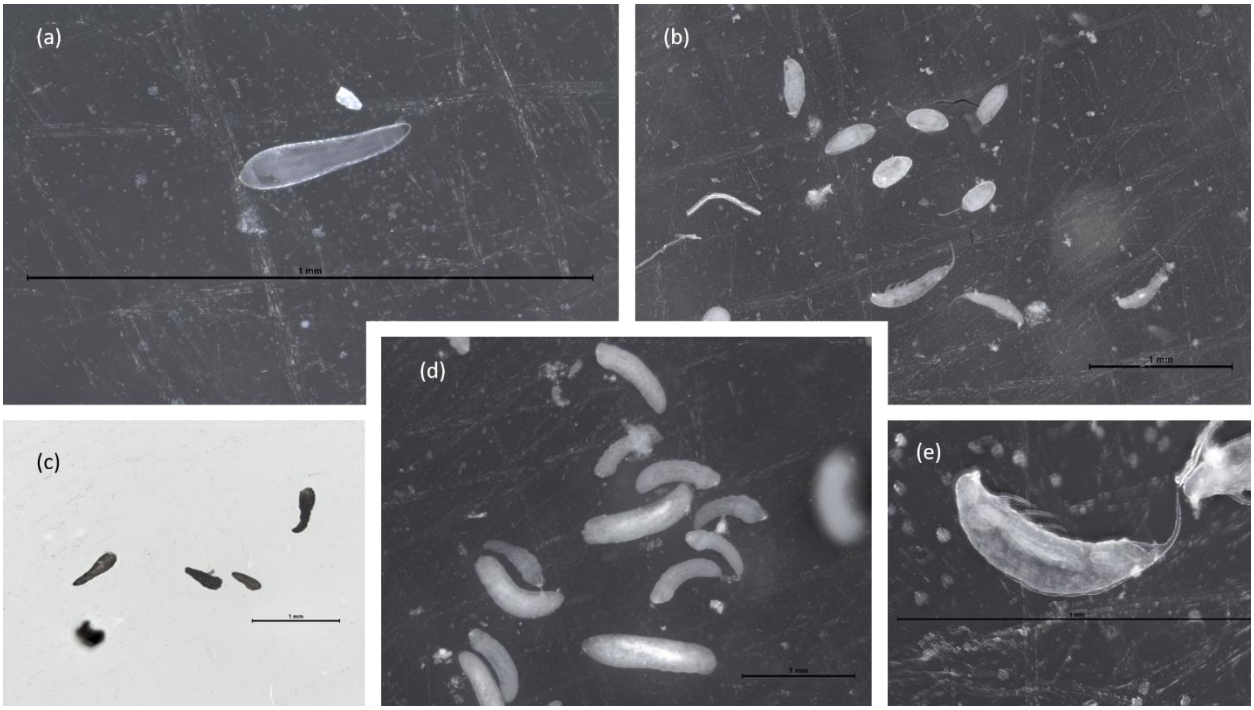

Figure S1. (a) *Asobara sp*. egg, (b) *Ganaspis sp*. eggs and larvae, (c) encapsulated parasitoid eggs, (d) *Asobara sp*. larvae, (e) *Ganaspis sp*. larva. For all pictures, the bar scale represents 1 mm

Supplement Material S2: Parasitoid functional responses

We fit three functional response models to the single-parasitoid experiments (Experiment 1) at all temperatures and for all parasitoid species. All three functional response models can be expressed by

$$F(H) = \frac{aH^{1+q}}{1 + ahH^{1+q}}$$

where (1) q = 0 defines a type II response, (2) q = 1 defines a type III response, and (3) a free parameter q defines a generalized type III response, that allows a continuous shift between type II and type III (Rosenbaum & Rall, 2018). We used the leave-one-out information criterion (LOOIC) for model comparison, which was computed from the log-likelihood values of posterior samples (*loo* package). Although type III and generalized type III responses had lower LOOIC scores than the type II response (differences ΔLOOIC = 0.7, SE = 30.6, and ΔLOOIC = 19.2, SE = 26.2, respectively), the differences were in the range of estimated uncertainty. Therefore, we chose the type II response as the most parsimonious model.

Table S1. Estimated parameters *a* search rate (day host^{-1}) and *h* handling time (day host^{-1}) of the type II functional response for each parasitoid species at each temperature ± standard error.

Species	**Temperature**	**a ± s.d.**	**h ± s.d.**
Asobara sp.	23°C	1.85 ± 0.16	0.029 ± 0.002
Asobara sp.	27°C	0.56 ± 0.05	0.008 ± 0.003
Ganaspis sp.	23°C	3.13 ± 0.21	0.002 ± 0.001
Ganaspis sp.	27°C	1.26 ± 0.05	0.001 ± 0.0004
Leptopilina sp.	23°C	1.67 ± 0.58	0.541 ± 0.064
Leptopilina sp.	27°C	0.08 ± 0.01	0.042 ± 0.026

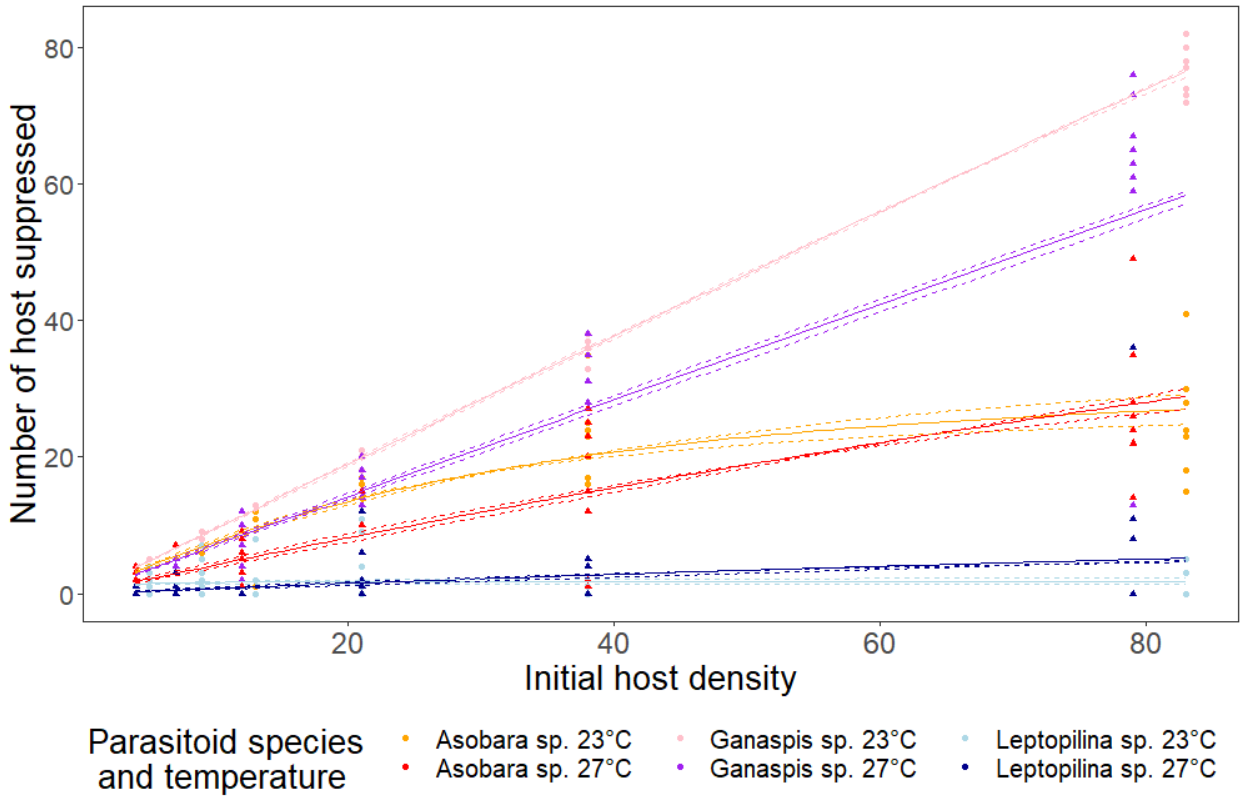

Figure S2. Type II functional responses of the three parasitoids at ambient (23°C) and warmed (27°C) temperature estimated from Experiment 1. Points represent observed values, solid lines correspond to the fitted functional responses, and dashed lines the 95% confidence intervals

Supplement Material S3: Effects of warming and parasitoid assemblage on parasitoid developmental rate

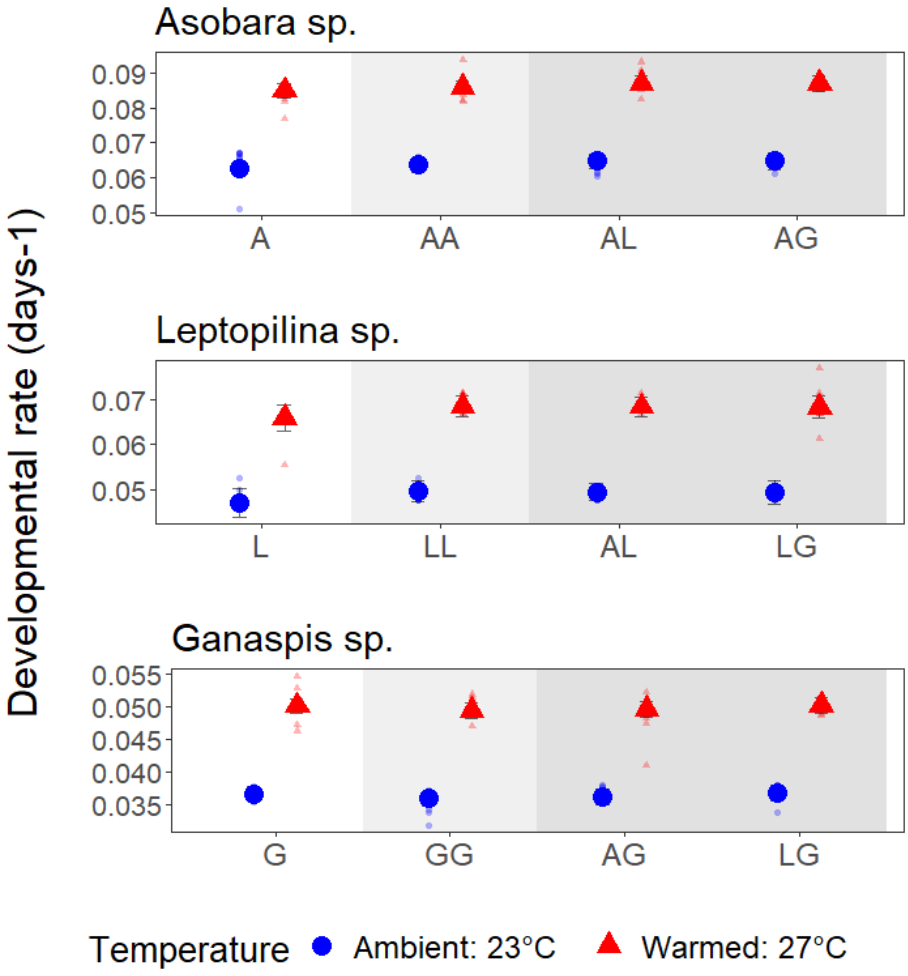

Figure S3. Development rate per day of each parasitoid species significantly increased with warming, but was not affected by parasitoid assemblage. White panel: single parasitoid, light grey panel: two parasitoids conspecific, darker grey panel; two parasitoids heterospecific. Parasitoid abbreviations: A: *Asobara sp*., L: *Leptopilina sp*., and G: *Ganaspis sp*. Big dots represent the estimated means (±95% CIs) and small dots represent raw data. Note that y-axis scale varies between parasitoid species.

Supplement Material S4: Effect of warming and parasitoid assemblages on degree of infestation

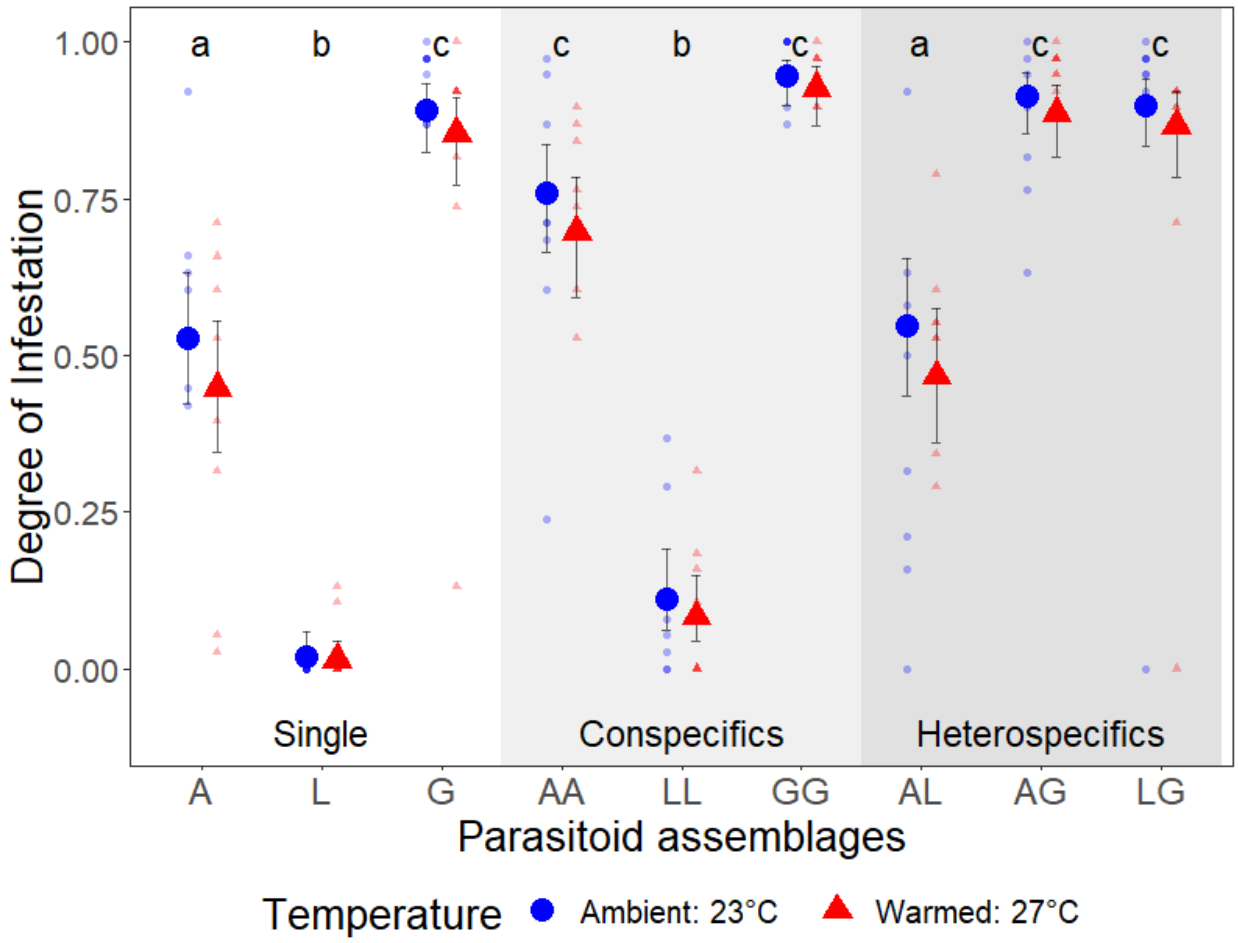

Figure S4. Degree of infestation for each parasitoid assemblage and temperature. Different small letters denote significant differences between parasitoid assemblages. White panel: single parasitoid, light grey panel: two parasitoids conspecific, darker grey panel; two parasitoids heterospecific. Parasitoid abbreviations: A: *Asobara sp*., L: *Leptopilina sp*., and G: *Ganaspis sp*. Big dots represent the estimated means (±95% CIs) and small dots represent raw data.

Supplement Material S5: Effects of warming and parasitoid assemblage on successful parasitism rate

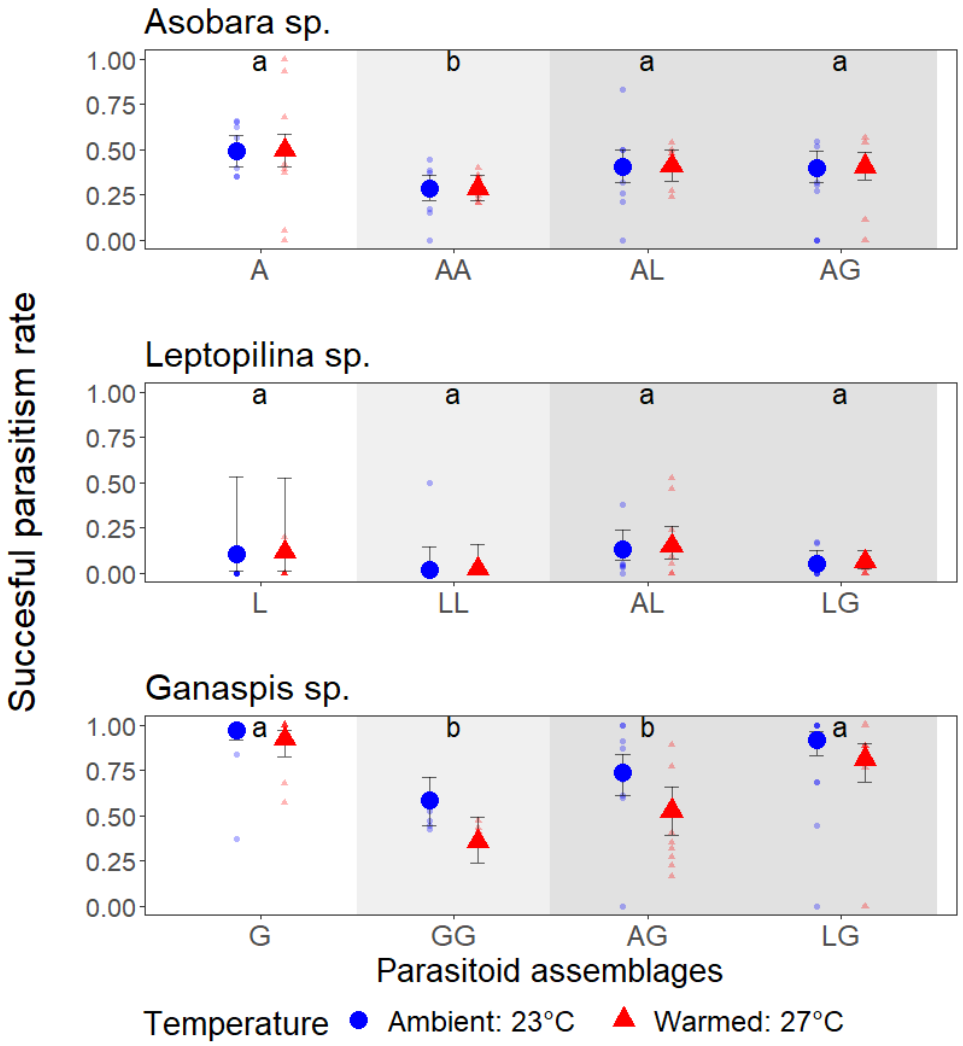

Figure S5. Probability of successful parasitism rate varied across parasitoid assemblage and temperature depending on the species identity. Within each parasitoid species, different small letters denote significant differences between parasitoid assemblages. White panel: single parasitoid, light grey panel: two parasitoids conspecific, darker grey panel; two parasitoids heterospecific. Parasitoid abbreviations: A: *Asobara sp*., L: *Leptopilina sp*., and G: *Ganaspis sp*.. Big dots represent the estimated means (±95% CIs) and small dots represent raw data. Contrasts between parasitoid assemblages are presented in Table S2.

Table S2. Effects of parasitoid assemblages on successful parasitism rate for each parasitoid species. Abbreviations: A: *Asobara sp*., L: *Leptopilina sp*., and G: *Ganaspis sp*. Results are averaged over both temperatures because there was no significant interaction between temperature treatments and parasitoid assemblages. Significant differences are highlighted in bold.

Parasitoid species	Contrast	Odds Ratio	p-value
Asobara sp.	**AA/A**	**0.41**	**0.001**
	AL/A	0.71	0.434
	AL/AA	**1.73**	**0.080**
	AG/A	0.70	0.082
	AG/AA	1.70	0.082
	AG/AL	0.99	1.000
Ganaspis sp.	**GG/G**	**0.05**	**< 0.0001**
	AG/G	**0.10**	**0.0002**
	AG/GG	2.02	0.183
	LG/G	0.37	0.301
	LG/GG	**7.93**	**< 0.0001**
	LG/AG	**3.94**	**0.010**
Leptopilina sp.	LL/L	0.18	0.656
	AL/L	1.35	0.993
	AL/LL	7.51	0.231
	LG/L	0.51	0.931
	LG/LL	2.81	0.768
	LG/AL	0.38	0.124

Supplement Material S6: Effects of warming and parasitoid assemblage on encapsulation frequency

52.4% of the parasitized larvae (n = 868) had evidence of melanization (traces, melanized egg, and/or melanized larvae), signaling a host immune response. The frequency of encapsulated parasitoids was significantly affected by parasitoid assemblages ($\chi2_{(4)}$ = 23.89, P < 0.0001), and the interaction between temperature and parasitoid assemblages ($\chi2_{(4)}$ = 11.42, P = 0.0223), but only because of the difference between *Asobara sp*. and *Ganaspis sp*., not because of parasitoid treatments (single, conspecifics, and heterospecifics; Figure S6). *Asobara sp*. escaped encapsulation due to its fast development time (Figure S3). Indeed, when larvae were parasitized by *Asobara sp*., most traces of melanization were observed on the empty eggshell, with the parasitoid larva still alive. Moreover, observations through dissections did not inform us on the outcome of the interactions. Indeed, when larvae were parasitized by *Ganaspis sp*., some eggs were only partially encapsulated, and parasitoid larvae were still able to hatch from these.

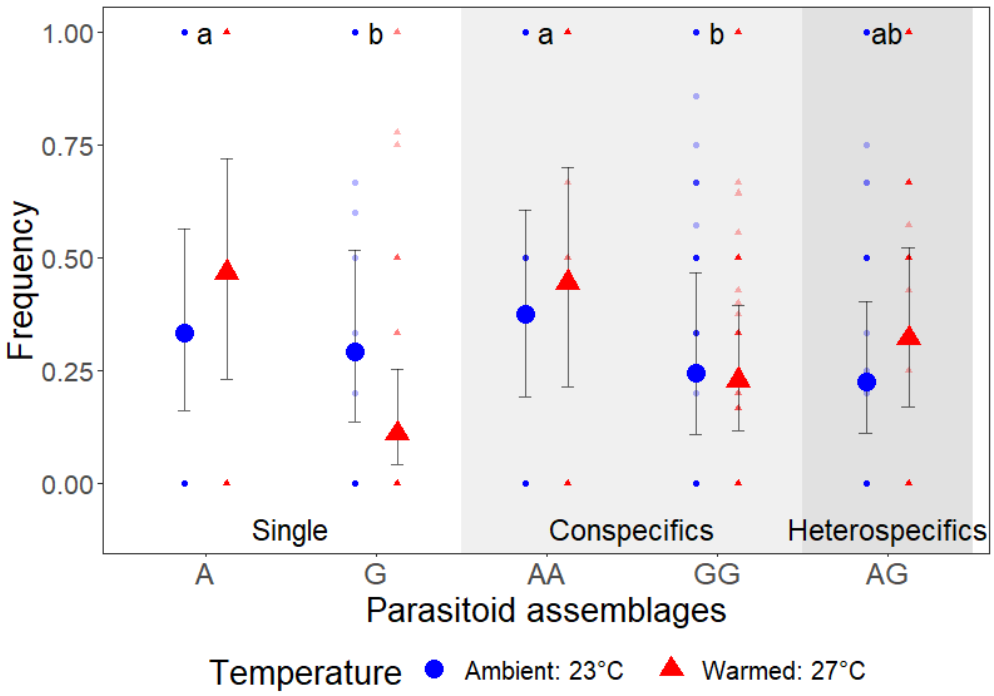

Figure S6. Frequency of encapsulated parasitoids out of the total of parasitoids per host only changed between parasitoid species. Within each plot, different small letters denote significant differences between parasitoid assemblages. White panel: single parasitoid, light grey panel: two parasitoids conspecific, darker grey panel; two parasitoids heterospecific. Parasitoid abbreviations: A: *Asobara sp*., and G: *Ganaspis sp.* Big dots represent the estimated means (±95% CIs) and small dots represent raw data.