# Figures and figure supplements

Temperature stress induces mites to help their carrion beetle hosts by eliminating rival blowflies

**Syuan-Jyun Sun and Rebecca M Kilner**

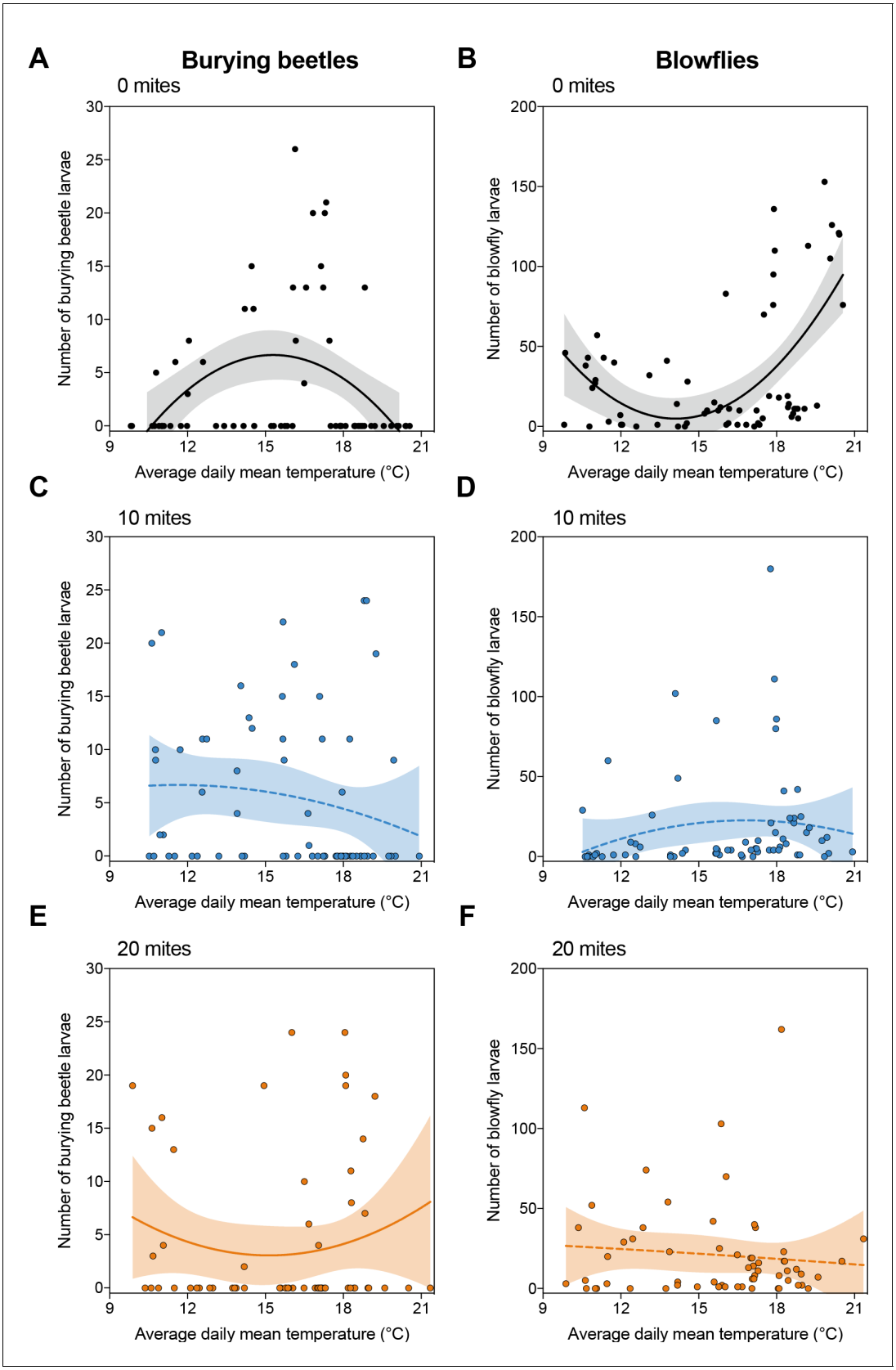
A
Burying beetles
0 mites
Number of burying beetle larvae
Average daily mean temperature (°C)
B
Blowflies
0 mites
Number of blowfly larvae
Average daily mean temperature (°C)
C
10 mites
Number of burying beetle larvae
Average daily mean temperature (°C)
D
10 mites
Number of blowfly larvae
Average daily mean temperature (°C)
E
20 mites
Number of burying beetle larvae
Average daily mean temperature (°C)
F
20 mites
Number of blowfly larvae
Average daily mean temperature (°C)

**Figure 1.** Reproductive success of burying beetles and blowflies under field conditions in relation to ambient air temperature, across the three different mite treatments. Shaded regions represent 95% confidence intervals, and solid and dashed lines represent statistically significant and non-significant regression lines from GLMM, respectively. Each datapoint represents one breeding event.

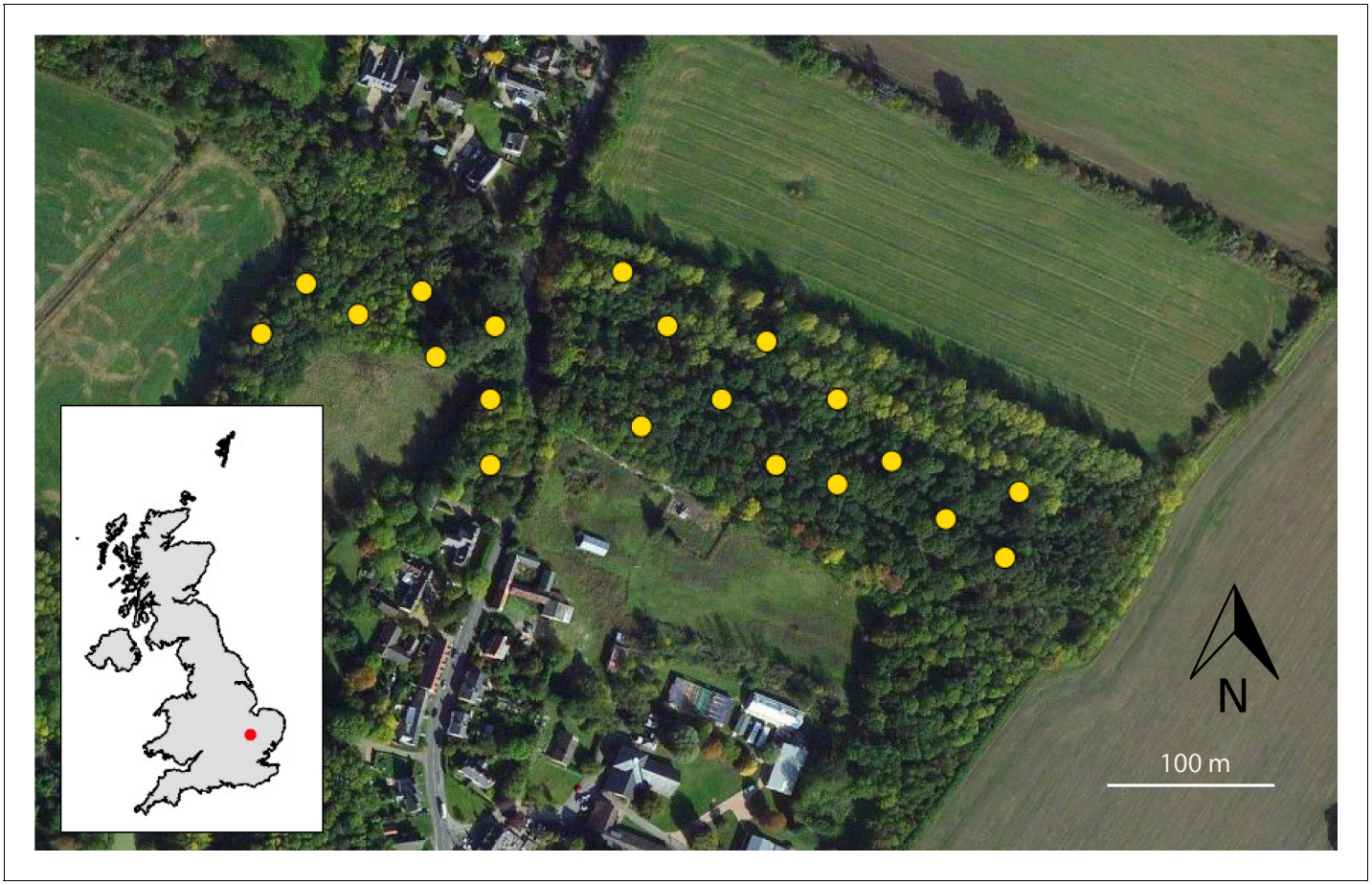


**Figure 1—figure supplement 1.** Spatial distribution of breeding sites (yellow dots) used in the field experiment at the study in Madingley Wood, Cambridge, UK (Latitude: 52.22730˚; Longitude: 0.04442˚). Image taken from GoogleMaps.

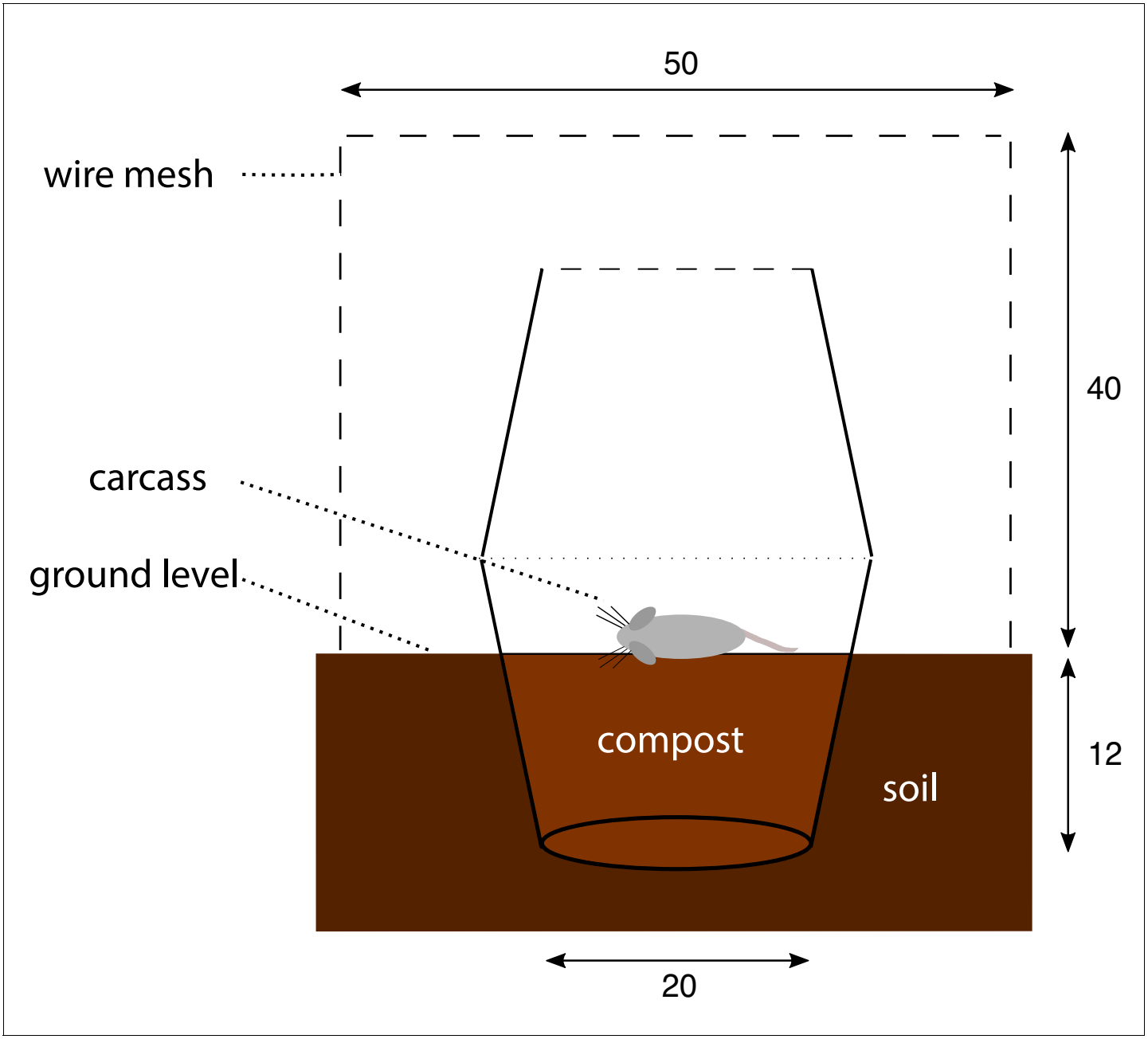


**Figure 1—figure supplement 2.** Schematic side-view representation of the experimental setup used for each breeding event in the field (dimensions are in cm). One flowerpot was partially buried in the ground, filled with compost (planting soil) and covered above with a second inverted flowerpot, perforated on the top to let in wild blowflies. The whole apparatus was surrounded by wire mesh, pegged in the ground, to prevent disruption by scavengers.

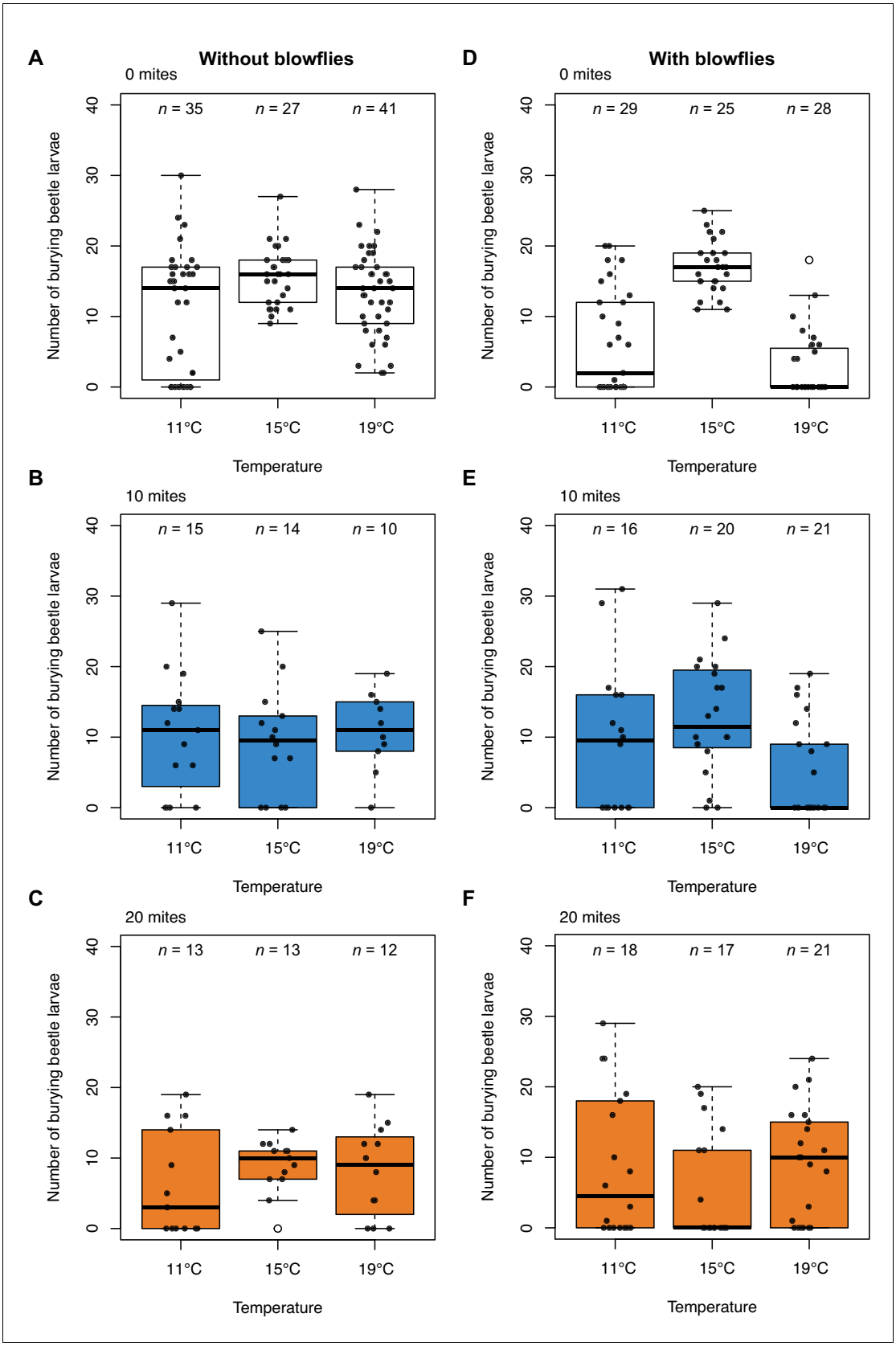


**Figure 2.** Burying beetle reproductive success under lab conditions in relation to ambient air temperature in the incubator, without and with blowflies, and across three different mite treatments. Sample sizes are shown above each boxplot. Boxplots show median (solid line), first quartile (bottom of

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*Figure 2 continued*

box), third quartile (top of box), values that fall within 1.5 times of the interquartile range (dotted lines), and outliers (open circles). Each datapoint represents one breeding event.

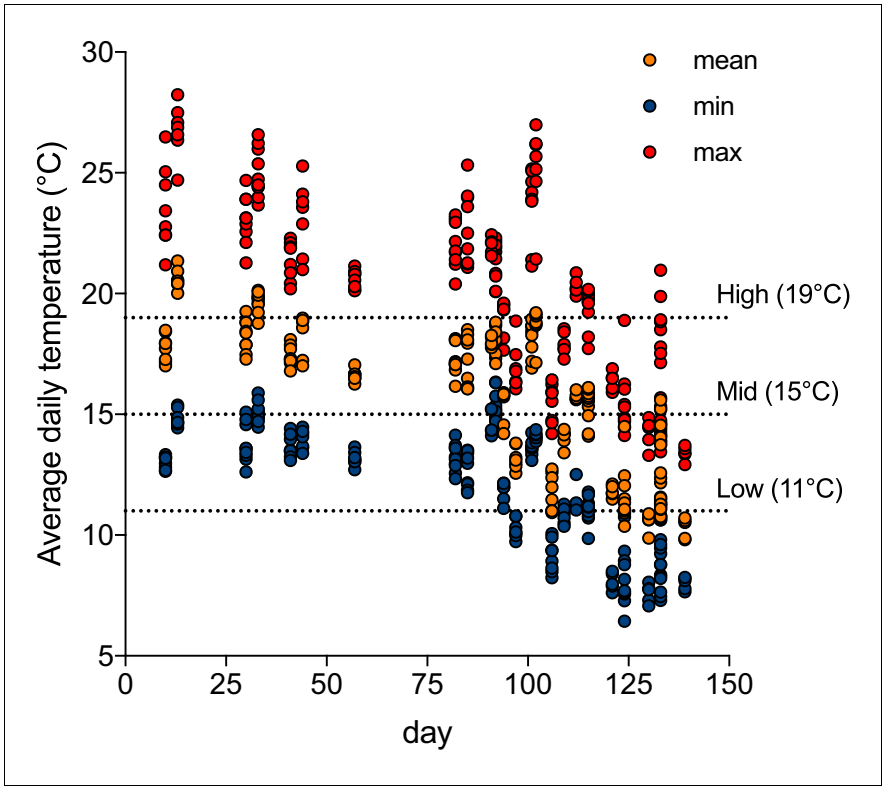


**Figure 2—figure supplement 1.** The daily mean, maximum, and minimum ambient air temperature in Madingley Woods during the field experiments conducted in 2016 and 2017. Day 0 is June 1. Dashed lines correspond to the high, mid, and low temperatures used in the laboratory experiments.

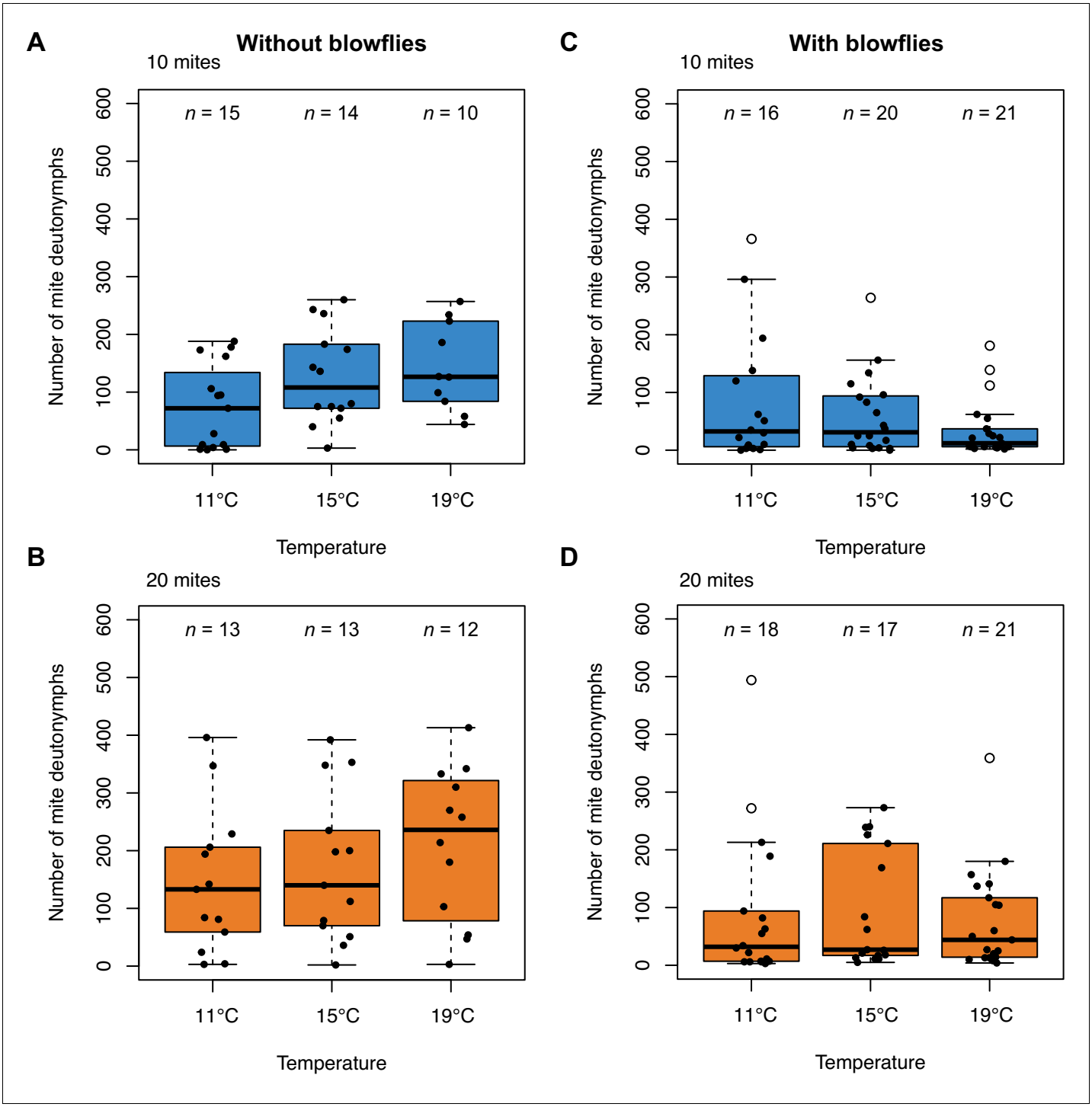


**Figure 2—figure supplement 2.** Reproductive success of mites in relation to temperature, without and with blowflies and across the temperature treatments. Data for each mite treatment (10 and 20 mites) are shown separately. Sample sizes are as indicated above each boxplot. Boxplots show median (solid line), first quartile (bottom of box), third quartile (top of box). Values that fall within 1.5 times of the interquartile range (dotted lines), and outliers (open circles). Each datapoint represents one breeding event.

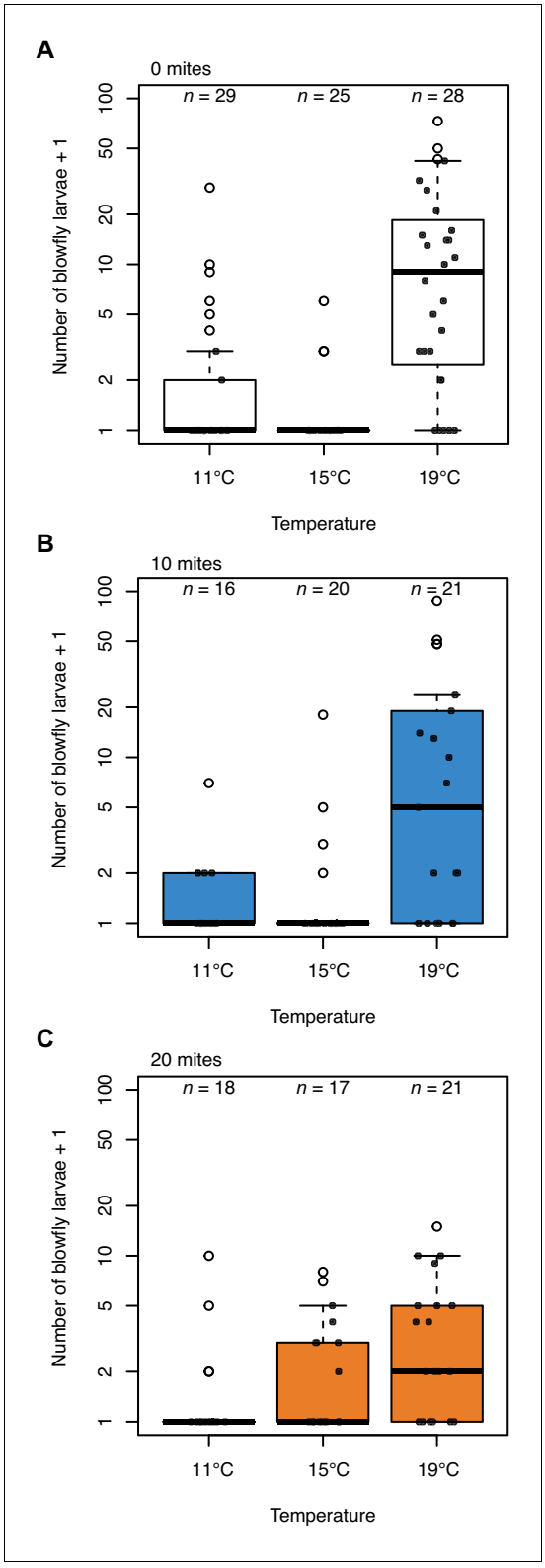


**Figure 3.** Blowfly reproductive success in relation to temperature in the presence of (**A**) 0 mites, (**B**) 10 mites and (**C**) 20 mites. Sample sizes are as indicated above each bar. Boxplots show median (solid line), first quartile (bottom of box), third quartile (top of box),

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values that fall within 1.5 times of the interquartile range (dotted lines), and outliers (open circles). Each datapoint represents one breeding event.

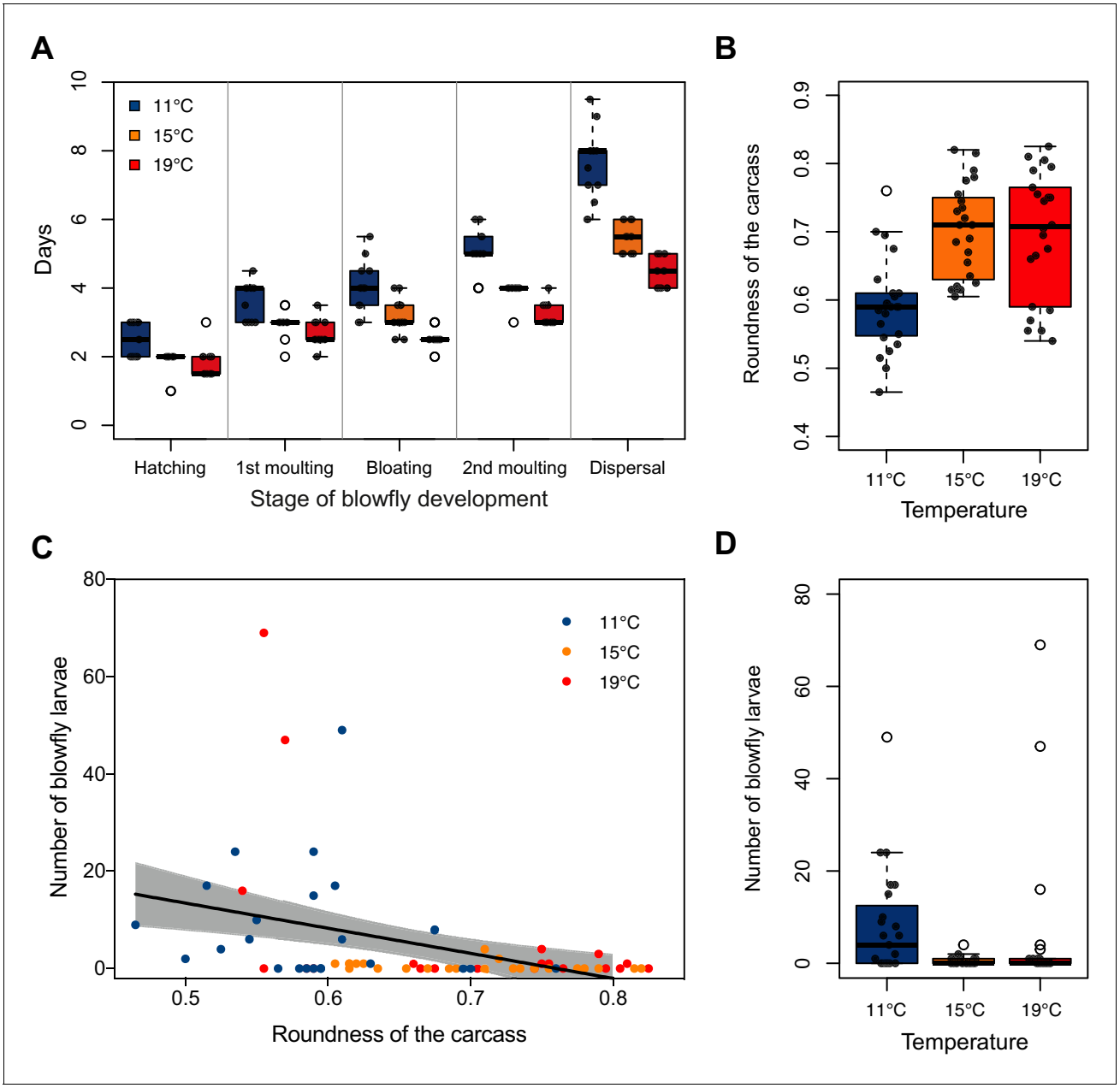


**Figure 4.** Effect of temperature on blowfly and burying beetle performance during carcass preparation. (**A**) The effect of temperature on blowfly development rate ($n$ = 13 mouse carcasses for each temperature treatment) and (**B–D**) the relationship between number of blowfly larvae and roundness of the carcass for the low, mid, and high temperature treatment ($n$ = 23, 23, and, 22 mouse carcasses, respectively). Boxplots show median (solid line), first quartile (bottom of box), third quartile (top of box), values that fall within 1.5 times of the interquartile range (dotted lines), and outliers (open circles). The shaded region represents 95% confidence interval, and the line represents statistically significant regression line from GLM.

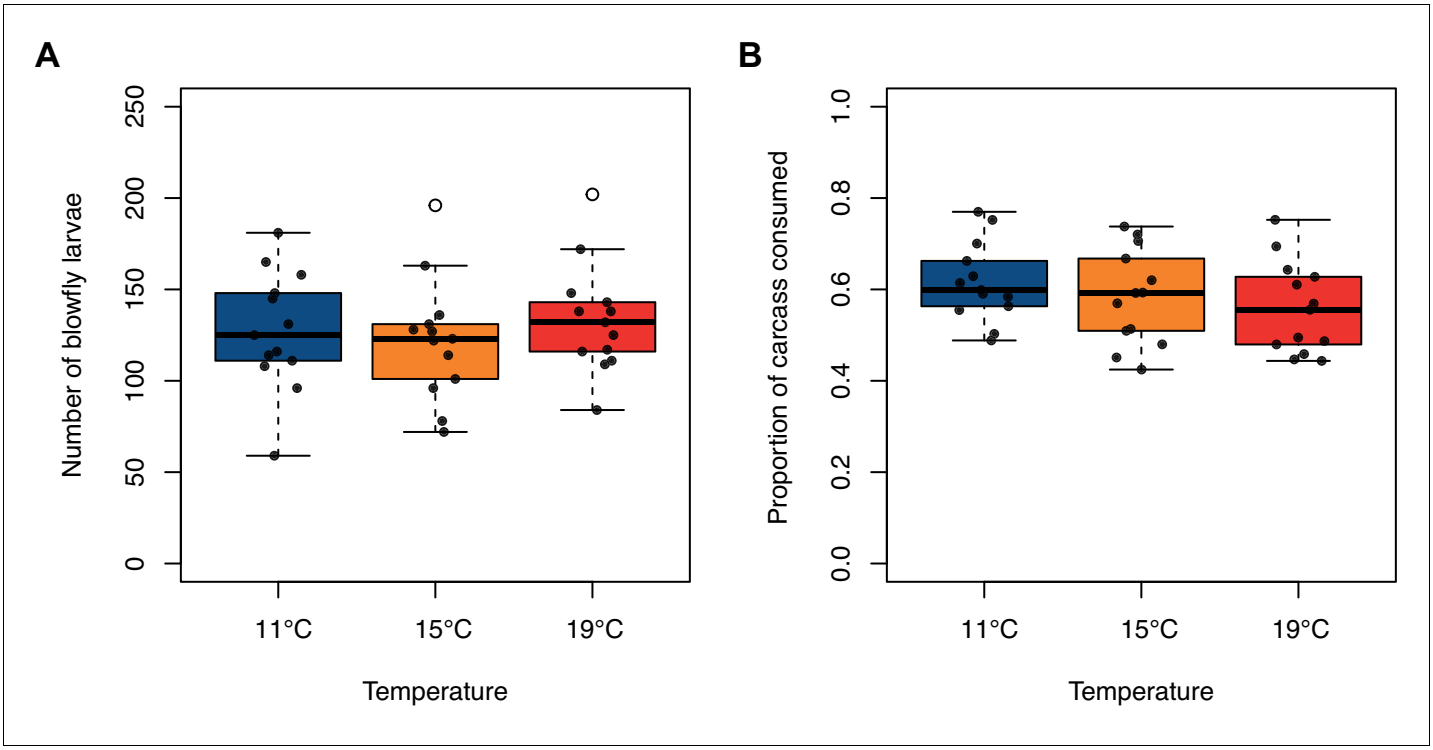


**Figure 4—figure supplement 1.** Effect of temperature on blowfly reproductive performance. (**A**) Number of blowfly larvae produced and (**B**) rate of carcass consumption by blowfly larvae. Boxplots show median (solid line), first quartile (bottom of box), third quartile (top of box), values that fall within 1.5 times of the interquartile range (dotted lines), and outliers (open circles). Each datapoint represents one breeding event. *n* = 13 mouse carcasses for each temperature treatment.

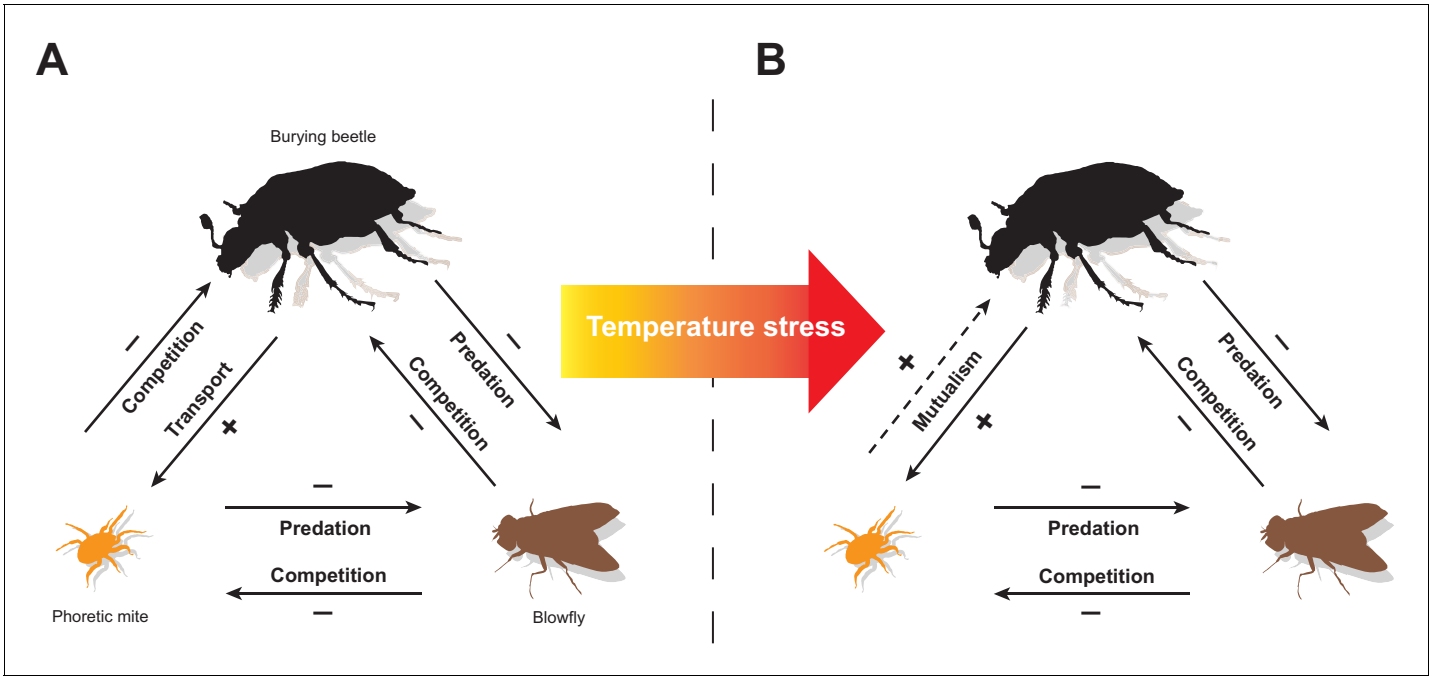


**Figure 5.** A summary of the experimental results, showing how the interactions between burying beetles, mites, and blowflies change in response to an increase in temperature stress (caused by temperatures that are higher or lower than average). Direct interactions between species are shown with solid lines while indirect interactions are shown with dashed lines. The arrow points to the species whose fitness is affected by the focal species. The signs (+/-) indicate positive or negative effects on fitness. Our overall conclusion is that a temperature-enhanced threat from blowflies causes mites to become protective mutualists of their burying beetle hosts.