

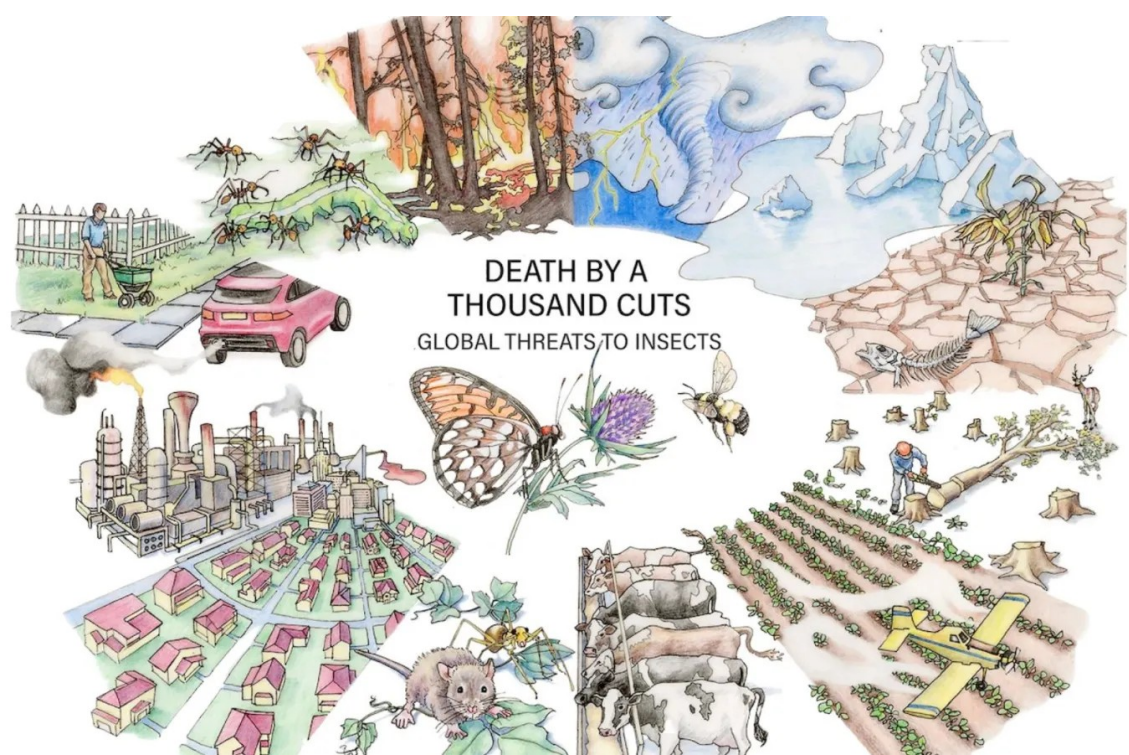
# Elevated temperatures increase the severity of a viral pathogen and variability of immune response in an insect herbivore

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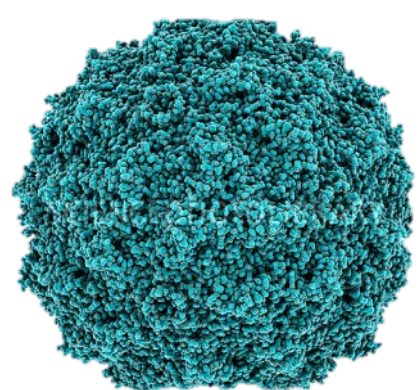


## MOTIVATION



Insect decline in the Anthropocene: Death by a thousand cuts  
D.L. Wagner, E.M. Grames, M.L. Forister, M.R. Berenbaum, D. Stopak, PNAS 2021

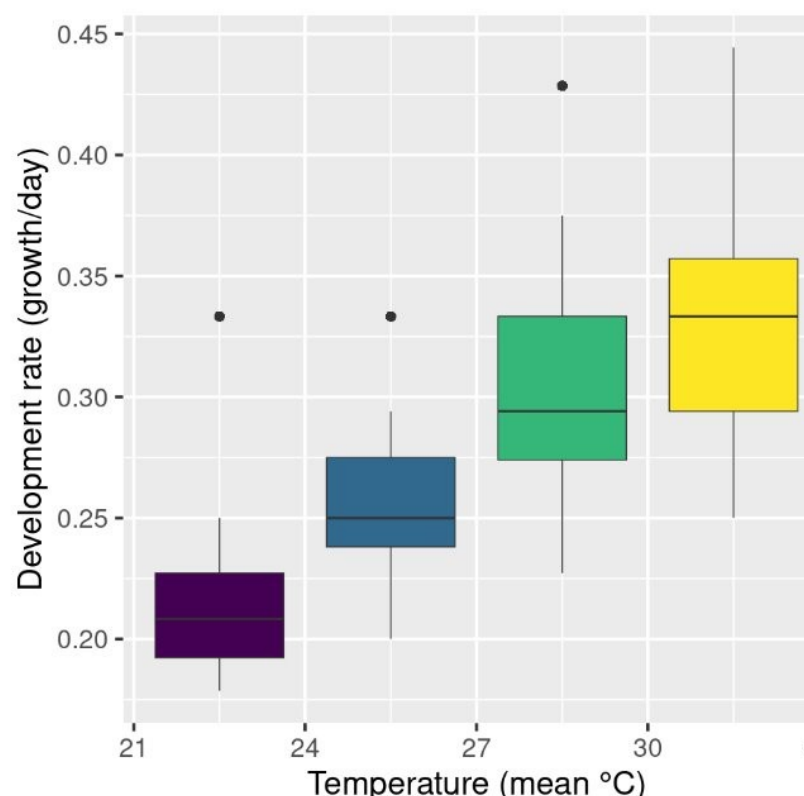
## EXPERIMENTAL DESIGN



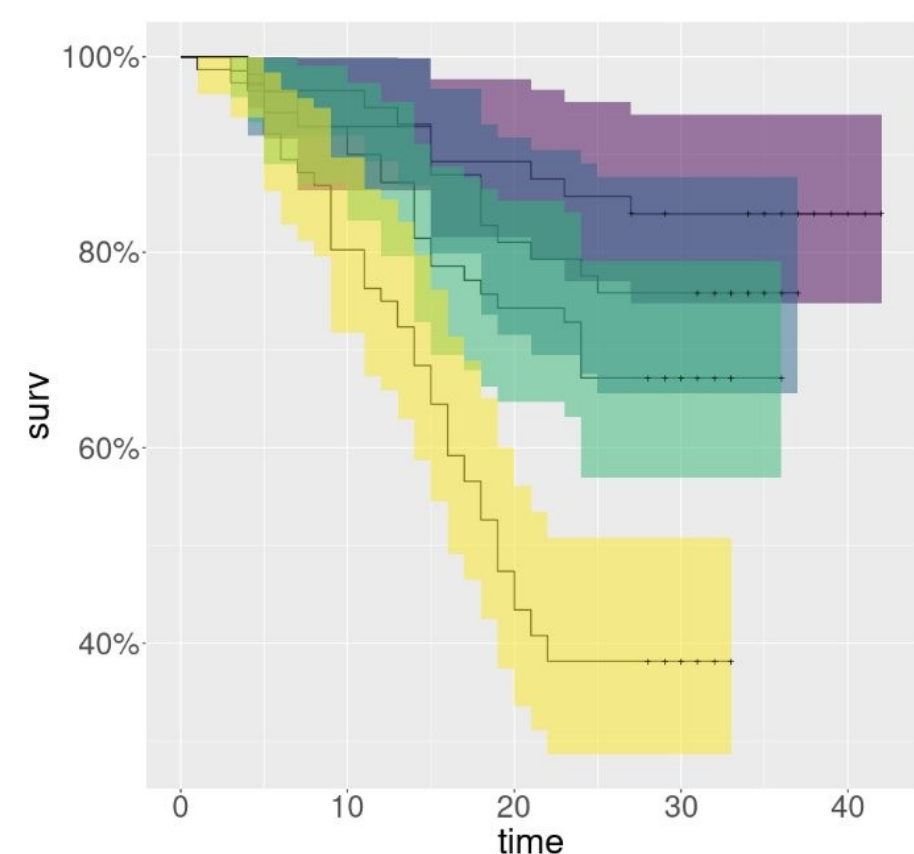
*Plantago lanceolata* Ribwort Plantain  
*Junonia grisea* Western Buckeye  
*Junonia coenia* densovirus

	Temp 1 (25°C/20°C)	Temp 2 (28°C/23°C)	Temp 3 (31°C/26°C)	Temp 4 (34°C/29°C)
Infected (n)	60	60	60	60
Control (n)	60	60	60	60

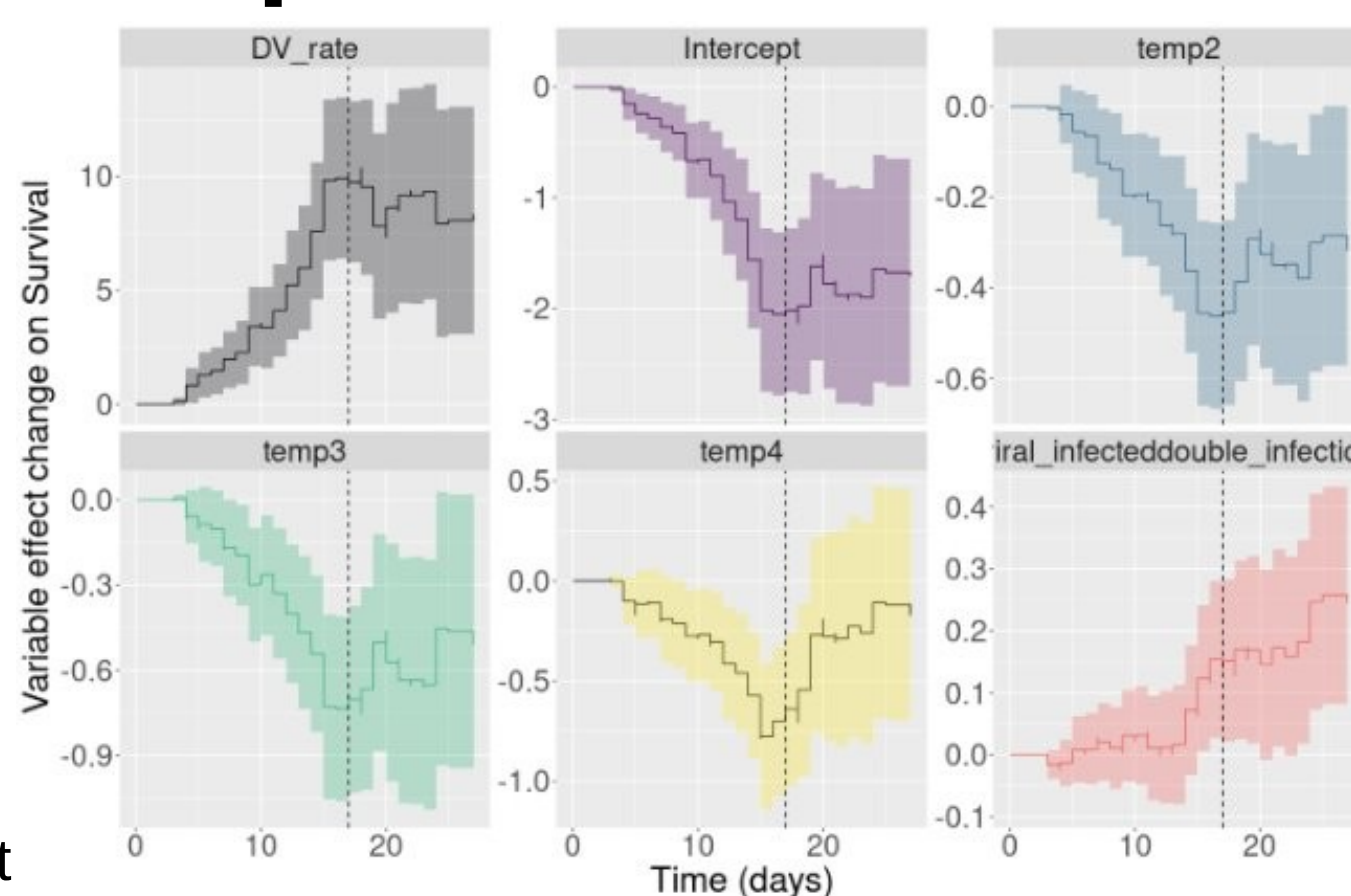
## RESULTS: Development & Survival



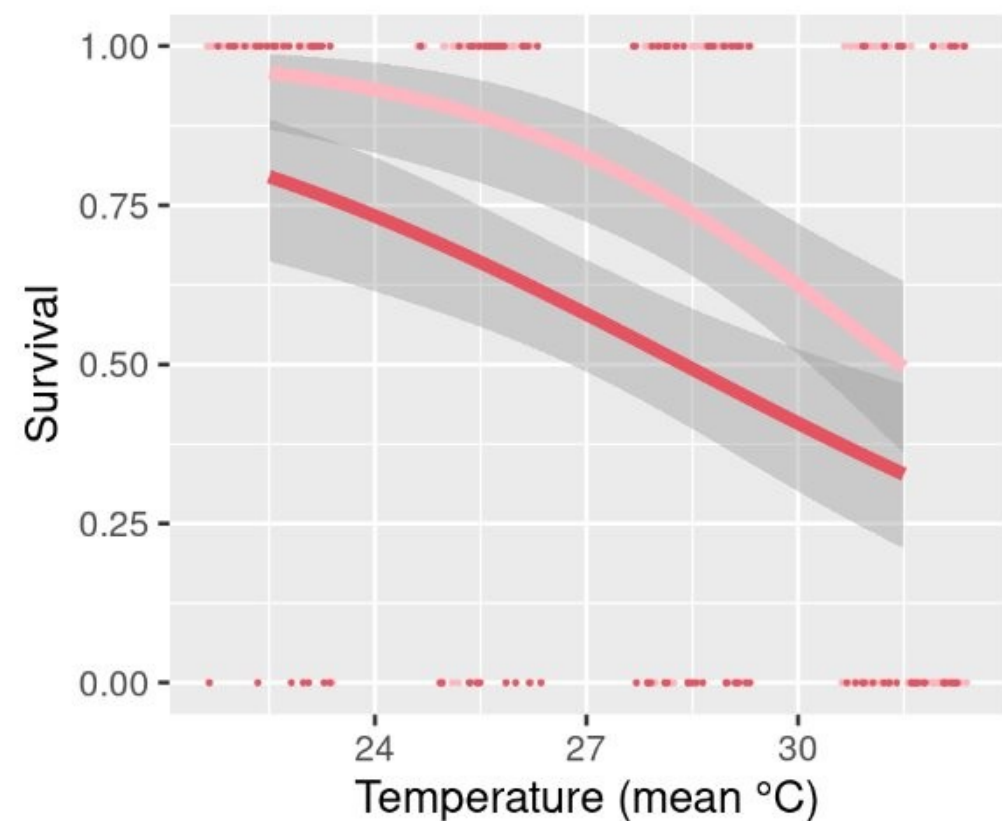
**Figure 1.** Buckeye caterpillars at the highest temperature treatment group (35°C/29°C) had faster development times (1.8 days faster)



**Figure 3.** Cox proportional hazard curves show caterpillars at the highest temperature treatment group (34°C/29°C) had decreased survival

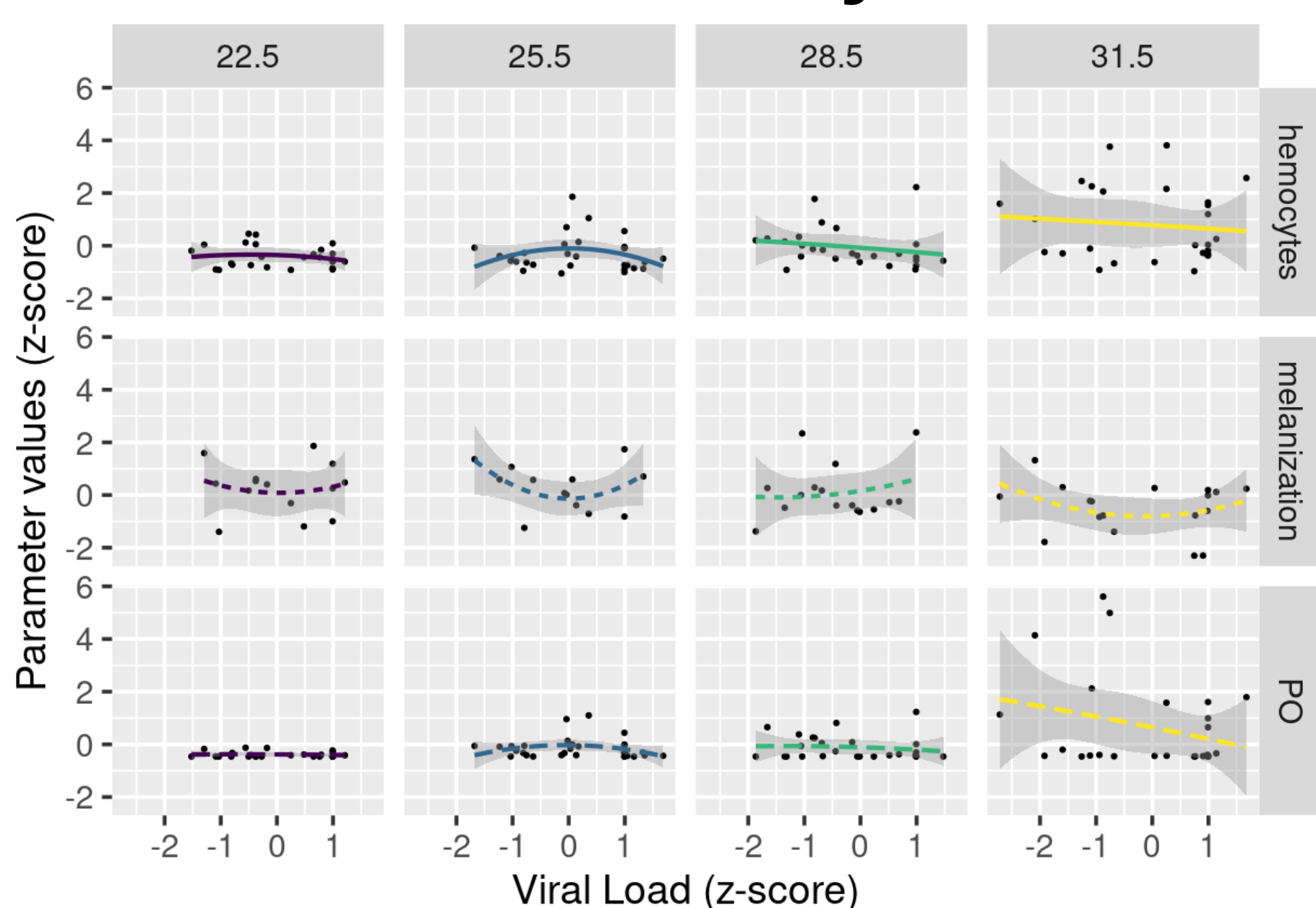


**Figure 2.** Additive regression models show that development rate influenced mortality until eclosion (~15-20 days). Buckeyes were most vulnerable to elevated temperatures at eclosion and mostly unaffected as adults.

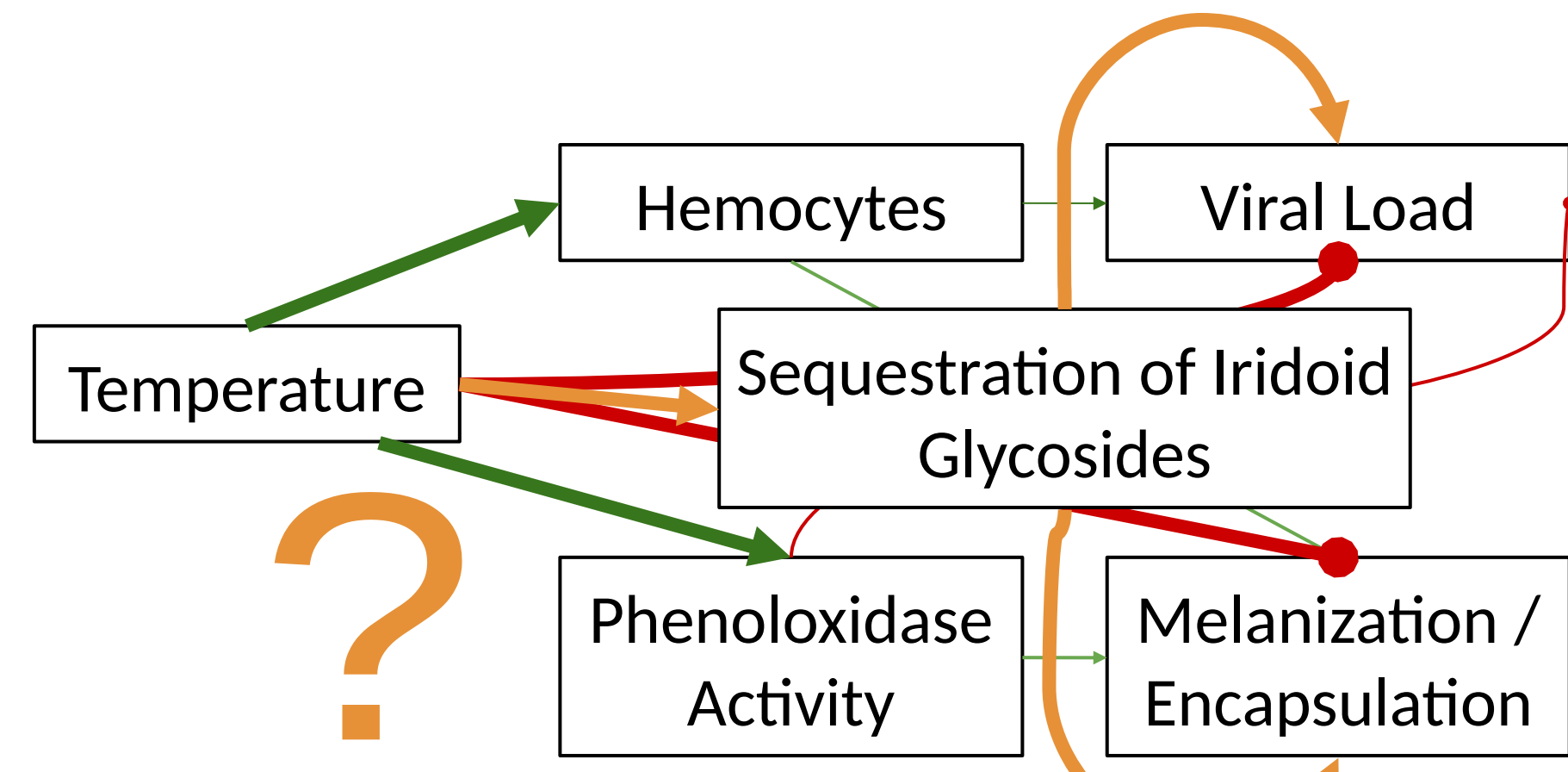


**Figure 4.** Buckeye caterpillars at the highest temperature treatment group (34°C/29°C) had lower survival rates regardless of infection route (0.35 decrease in log odds)

## RESULTS: Immunity



**Figure 5.** Caterpillars at the highest temperature treatment group (35°C/29°C) had increased variability in viral loads at 5th instar (z-score range: -2.72, 1.68) and increased variability in immune response parameters (z-score range: -0.969, 5.61)



## REFERENCES

Harvey et al. 2022, Eco Monographs; Wagner et al. 2021, PNAS; Knerl & Bowers 2013, J. Chem. Ecol; Bowers 1980, Evolution; Bowers et al. 1992, Ecology; Smilanich et al. 2009, Ecol. Lett.; Smilanich et al. 2018, Journal of Invertebrate Pathology; Richards et al. 2012, Journal of Chemical Ecology; Kingsolver 2003, Integrative and Comparative Biology; Muchoney et al. 2022, Ecology Letters; Christensen et al. 2024, Ecology; Bruemmer et al. 2005, J. Mol. Biol.; Mutuel et al. 2010, Virology; Wang et al. 2013, J. Virol; Cong, et al. 2020, Systematic entomology

## ACKNOWLEDGMENTS

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