1. ABOUT THE DATASET

------------

Title: Data supporting the PhD thesis “Predicted consequences of population asynchrony arising from climate warming in aphid-parasitoid systems”

Creator(s):

Stuart M.K. Edwards

Organisation(s):

University of Reading

Rights-holder(s): University of Reading

Publication Year: 2024

Description:

This dataset supports the PhD thesis “Predicted consequences of population asynchrony arising from climate warming in aphid-parasitoid systems”, where I parameterise the Rosenzweig-MacArthur model with temperature dependent variables using published data to investigate how differences in thermal adaptation affect interactions between crop pests and their parasitoids in a changing climate. I determine the relative importance of temperature-dependence in the model variables, and I introduce a new model parameter to explore the importance of asynchrony in development rate between species. I then explore temperature variability in these models to explore the impacts of diurnal and seasonal variation on pest-parastoid dynamics and predict outcomes under a full range of climate model projections for alternative climate change scenarios. Finally, I experimentally tested some of the model assumptions under laboratory conditions. This dataset contains data associated with all four data chapters of the above named thesis. The datasets contain calculated temperature dependent rates of all five variables of the Rosenzweig-MacArthur model, along with additional temperature dependent rates for the variables we added to the model.

Cite as: Edwards,S.M.K, (2024) Data supporting the PhD thesis “Predicted consequences of population asynchrony arising from climate warming in aphid-parasitoid systems”. University of Reading. Dataset. https://doi.org/10.17864/1947.001332

Related publication: Edwards, S. M. K. (2023) Predicted consequences of population asynchrony arising from climate warming in aphid-parasitoid systems. PhD thesis, University of Reading. https://doi.org/10.48683/1926.00117449

Contact: stuart.edwards24@btinternet.com

2. TERMS OF USE

------------

Copyright 2024 University of Reading. This dataset is licensed under a Creative Commons Attribution 4.0 International Licence: https://creativecommons.org/licenses/by/4.0/.

3. PROJECT AND FUNDING INFORMATION

------------

Title: Predicted consequences of population asynchrony arising from climate warming in aphid-parasitoid systems

Dates: 2017-2022

Funding organisation: SE was supported by the BBSRC Collaborative training partnership for Fruit Crop Research, with funding from NIAB EMR, AHDB Horticulture and the University of Reading.

4. CONTENTS

------------

File listing separated by data chapters.

**Chapter 2: Predicted effects of temperature on pest-parasitoid dynamics in a changing climate:** *Trait\_Data.xlsx*

This chapter identified the importance of temperature-dependent variables of the Rosensweig-MacArthur model when applied to pest-parasitoid systems. In particular the chapter set out to identify the most important traits, their sensitivity to temperature and how this influences population dynamics of crop pests throughout a growing season.

We filtered the FoRAGE database (Uiterwaal et al., 2022) for all relevant data on functional response parameters for parasitoids. This search yielded a total 22 datapoints from 8 publications and 9 parasitoid species for two key model variables, parasitoid attack rate (the number of hosts encountered per m2 per day) and handling time (the proportion of time spent handling a prey item per day). To obtain parameter values for the remaining variables (intrinsic rate of increase, assimilation efficiency and instantaneous mortality rate) of the Rosenzweig-MacArthur model we supplemented these data with 15 additional publications providing data for these parasitoid species and their associated hosts (detailed citations are provided in the thesis chapter). These were identified by searching the Web of Science and Google Scholar using the scientific names of the parasitoid in addition to “temperature”.

The attached dataset for this chapter Trait\_Data.xlsx contains the final collated dataset of temperature dependent variables used to parameterise the Rosenzweig-MacArthur model.

**Chapter 3: Predicted consequences of population asynchrony arising from climate warming in aphid-parasitoid systems:** *Chapter3\_DifferentTopt.xlsx & Chapter3\_DifferentEnvTol.xlsx*

We present a simple adaptation of the Rosenzweig-MacArthur predator-prey model incorporating multiple scenarios of species sensitivity to temperature using the addition of a variable representing differences in thermal optima and thermal specialisms.

The datasets for this chapter contain derived plausible unimodal thermal performance curves for the temperature dependence of development rate using the Sharpe-Schoolfield model. Scenarios were created for different thermal tolerances (*Chapter3\_DifferentTopt.xlsx*) and different thermal specialisms (*Chapter3\_DifferentEnvTol.xlsx*). Further details on how these data were used to create our new variable for the Rosenzweig-MacArthur model are detailed within the body of the chapter.

Temperature dependence of development rate for real host-parasitoid pairings were taken from studies used in Furlong & Zalucki (2017).

**Chapter 4: Modelling the impact of temperature variability on pest-parasitoid population dynamics:** *Trait\_Data.xlsx*

We parameterised the model using temperature dependent data as outlined in chapter 2 (file: Trait\_Data.xlsx).

This study utilises simulated weather data produced by Harkness et al. (2020). In total, 19 General Circulation Models (GCM’s) from the CMIP5 ensemble used in IPCC Assessment Report 5 (AR5) (IPCC, 2014) were used to produce local-scale future daily weather scenarios. Two representative concentration pathways (RCPs) were used, representing a midrange (RCP4.5) and a high emission scenario (RCP8.5). We selected two time periods, the baseline (1981-2010) and a future time period (2041- 2060).

**Chapter 5: Testing Assumptions:** *Chapter5\_Experimental\_Data.xlsx*

Chapter5\_Experimental\_Data.xlsx contains data used within chapter 5 of the thesis.

This chapter set out to test assumptions of the Rozensweig-MacArthur model using experiments, notably considering the timing and length of exposure to extreme temperatures. The dataset contains results of experimental data for parameters temperature dependent development rate, net reproductive rate and instantaneous mortality rate at varying heatwave scenarios as detailed within the thesis.

5. METHODS

-----------

For detailed accounts of how these datasets were transformed and analysed see “Predicted consequences of population asynchrony arising from climate warming in aphid-parasitoid systems”

6. REFERENCES

------------

References for additional and supplementary data used:

Furlong, M.J. and Zalucki, M.P. (2017) ‘Climate change and biological control: the consequences of increasing temperatures on host-parasitoid interactions, Current Opinion in Insect Science, 20,pp.39-44.doi /10.1016/j.cois.2017.03.006.

Harkness, C., Semenov, M. A., Areal, F., Senapati, N., Trnka, M., Balek, J., & Bishop, J. (2020). Adverse weather conditions for UK wheat production under climate change. Agricultural and Forest Meteorology, 282–283(November 2019), 107862. <https://doi.org/10.1016/j.agrformet.2019.107862>

IPCC (2014) Summary for Policymakers, Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. IPCC. doi: 77 10.1017/CBO9781107415324

Uiterwaal, S. F. and DeLong, J. P. (2020) ‘Functional responses are maximized at intermediate temperatures’, Ecology, 101(4), pp. 1–10. doi: 10.1002/ecy.2975.