Project Proposal

Grace Skinner

Project Title:

Designing and implementing an analytical database for understanding insect declines

Supervisor:

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Keywords:

Insect declines, ecological data science, meta-analysis

Project ideas/questions:

Despite a previous lack of insect representation in biodiversity studies (Outhwaite et al., 2020), an increase in papers reporting on insect population trends has been observed in recent years (Hallmann et al., 2017, Powney et al., 2019, Sánchez-Bayo and Wyckhuys, 2019, Outhwaite et al., 2020, Wagner et al., 2021). However, conclusions drawn remain contradictory, based on contrasting methodologies and limited evidence. Furthermore, the reasons behind these trends are unclear, especially when considering specific species or geographical locations (Hallmann et al., 2017, Powney et al., 2019, Wagner et al., 2021). We therefore need more evidence to gain a fuller understanding of insect biodiversity change. To achieve this, we need a meta-analytic pipeline to make best use of pre-existing datasets (Outhwaite et al., 2020, Wagner et al., 2021).

Insects face a multitude of threats including habitat loss, biological factors, pollution, and climate change (Deutsch et al., 2008, Sánchez-Bayo and Wyckhuys, 2019, Wagner et al., 2021), thus increasing our ability to determine the species-specific extents of these issues will enable better informed management decisions. This will enable preservation of vital ecosystem services, due to insect contribution to pollination, nutrient cycling, and the food chain as a necessary link between primary producers and consumers (Hallmann et al., 2017, Powney et al., 2019, Wagner et al., 2021).

Proposed methods:

I will augment a data analysis pipeline that can be used to analyze the meta-analysis data held by the Natural History Museum. The aim is to build a database that will enable the user to easily access relevant information based on their hypotheses. I will use R to write a set of functions that takes disparate spreadsheets as an input, and output the appropriate data for the proposed questions, which could be species, location, or threat specific. This data is then ready to be passed to functions in the metafor package (for conducting meta-analyses).

If progressing efficiently, there is the option to bring in environmental raster data that can be used as covariates. Additionally, environmental attributes can be brought in to demonstrate the pipeline and its use to ecology.

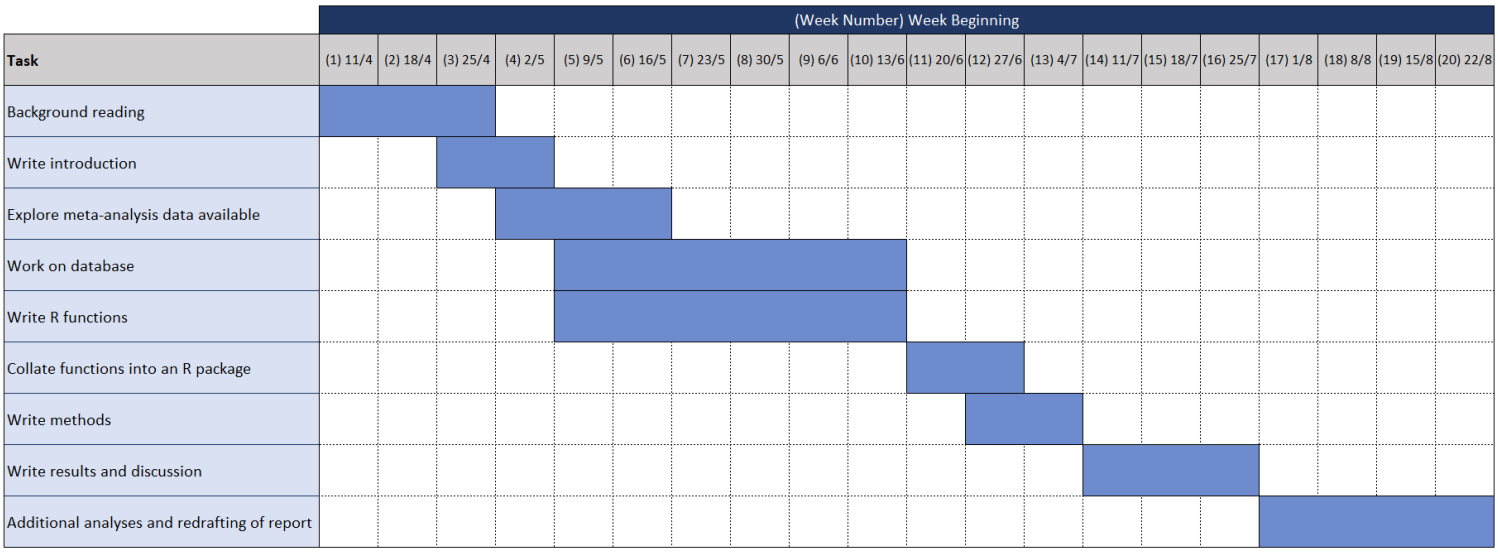
Anticipated outcomes/outputs:

A database in a format which enables easy access to relevant information based on the researchers' hypotheses. Functions will be put together into an R package.

Project feasibility:

This project provides a baseline of work to aim towards, with potential additional tasks to complete if time allows. If the project is not going as planned, there is plenty of existing data available to analyze, meaning there is no chance of not being able to produce anything. This project also avoids the problems associated with field or lab projects.

Gantt chart:



Budget:

All money provided will contribute towards travel to the Natural History Museum.

References:

DEUTSCH, C. A., TEWKSBURY, J. J., HUEY, R. B., SHELDON, K. S., GHALAMBOR, C. K., HAAK, D. C. & MARTIN, P. R. 2008. Impacts of climate warming on terrestrial ectotherms across latitude. *Proceedings of the National Academy of Sciences,* 105**,** 6668-6672.

HALLMANN, C. A., SORG, M., JONGEJANS, E., SIEPEL, H., HOFLAND, N., SCHWAN, H., STENMANS, W., MÜLLER, A., SUMSER, H. & HÖRREN, T. 2017. More than 75 percent decline over 27 years in total flying insect biomass in protected areas. *PloS one,* 12**,** e0185809.

OUTHWAITE, C. L., GREGORY, R. D., CHANDLER, R. E., COLLEN, B. & ISAAC, N. J. 2020. Complex long-term biodiversity change among invertebrates, bryophytes and lichens. *Nature ecology & evolution,* 4**,** 384-392.

POWNEY, G. D., CARVELL, C., EDWARDS, M., MORRIS, R. K., ROY, H. E., WOODCOCK, B. A. & ISAAC, N. J. 2019. Widespread losses of pollinating insects in Britain. *Nature communications,* 10**,** 1-6.

SÁNCHEZ-BAYO, F. & WYCKHUYS, K. A. 2019. Worldwide decline of the entomofauna: A review of its drivers. *Biological conservation,* 232**,** 8-27.

WAGNER, D. L., GRAMES, E. M., FORISTER, M. L., BERENBAUM, M. R. & STOPAK, D. 2021. Insect decline in the Anthropocene: Death by a thousand cuts. *Proceedings of the National Academy of Sciences,* 118.

“I have seen and approved the proposal and the budget”

Name:

Signature:

Date: