

The effect of bat populations on crop yield in the American Midwest

Madeline Lerz & Michael Jensen
¹ Rubenstein School of Environment and Natural Resources, University of Vermont, Burlington, VT, USA

INTRODUCTION/BACKGROUND

Background - Ecology

Bats eat some agricultural pests and can act as a form of natural pesticide, but it is unclear to what extent bats impact the agricultural industry, therefore we are exploring how bat populations impact crop yield of corn fields in the midwestern United States. Bat populations and crop yield of corn fields of farms in the Midwestern United States (Illinois, Indiana, Iowa, Michigan, Minnesota, Missouri, Ohio, and Wisconsin) will be measured and compared during the growing season.

Decreasing Bat Populations

- Big brown bat (*Eptesicus fuscus*) populations, one of the most common bats found in the United States, have been steadily decreasing. Additionally, the eastern red bat (*Lasiurus borealis*) populations have also been on the decline. These two species of bats are the most common in the midwestern United States, the area most known for crop production.
- The two main threats to these species are habitat degradation/loss and insecticides. White-nose syndrome is also a major threat to bat populations, although less-so among these two species.

Why Bats are Important

- An ecosystem service provided by bats is pest control. In a Nebraska study, big brown bats preyed upon an average of 16.2 species and eastern red bats preyed upon an average of 28.6 species. (Whitby, 2020). With fewer bats, more insects would be around to damage and interfere with crops and crop production. A South African study found that without bat predation, a macadamia orchard faced an increase in insect damage ranging from 9-23% (Taylor, 2018). Additionally, bats are important pollinators.

OBJECTIVES

Objectives:

- Determine how decreasing bat populations impact crop yield in corn fields.
- Compare crop yield in fields with large bat populations to fields with small bat populations.

Hypotheses:

- Bats have an impact on crop yield of corn fields in the Midwestern United States.
- We predict as bat populations decrease, corn field crop yield decreases because bats are not present to eat agricultural pests.

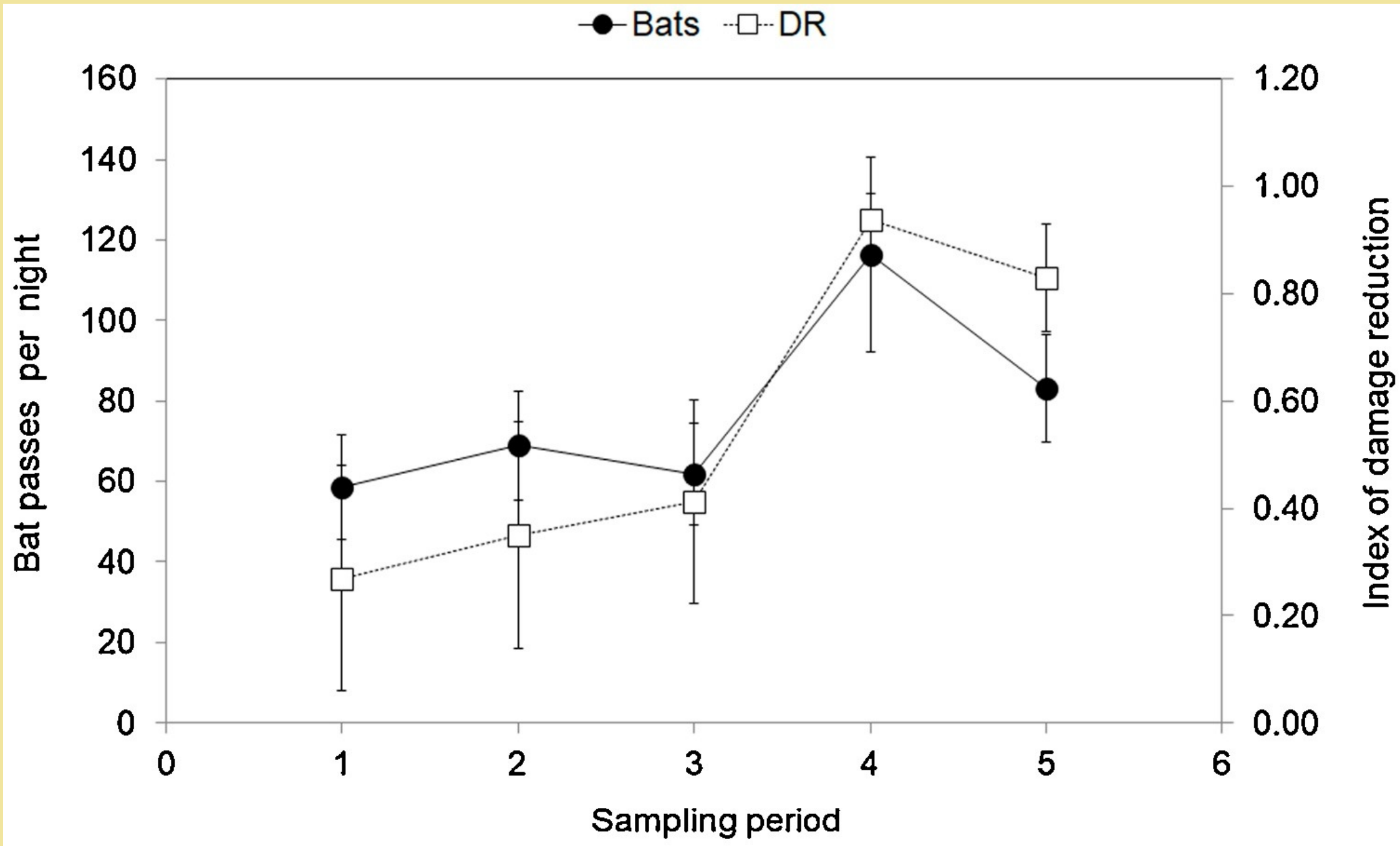


Fig. 1 Bat activity (dark circles) and the damage reduction (white squares) in grape clusters among 3 sampled vineyards in Chile.

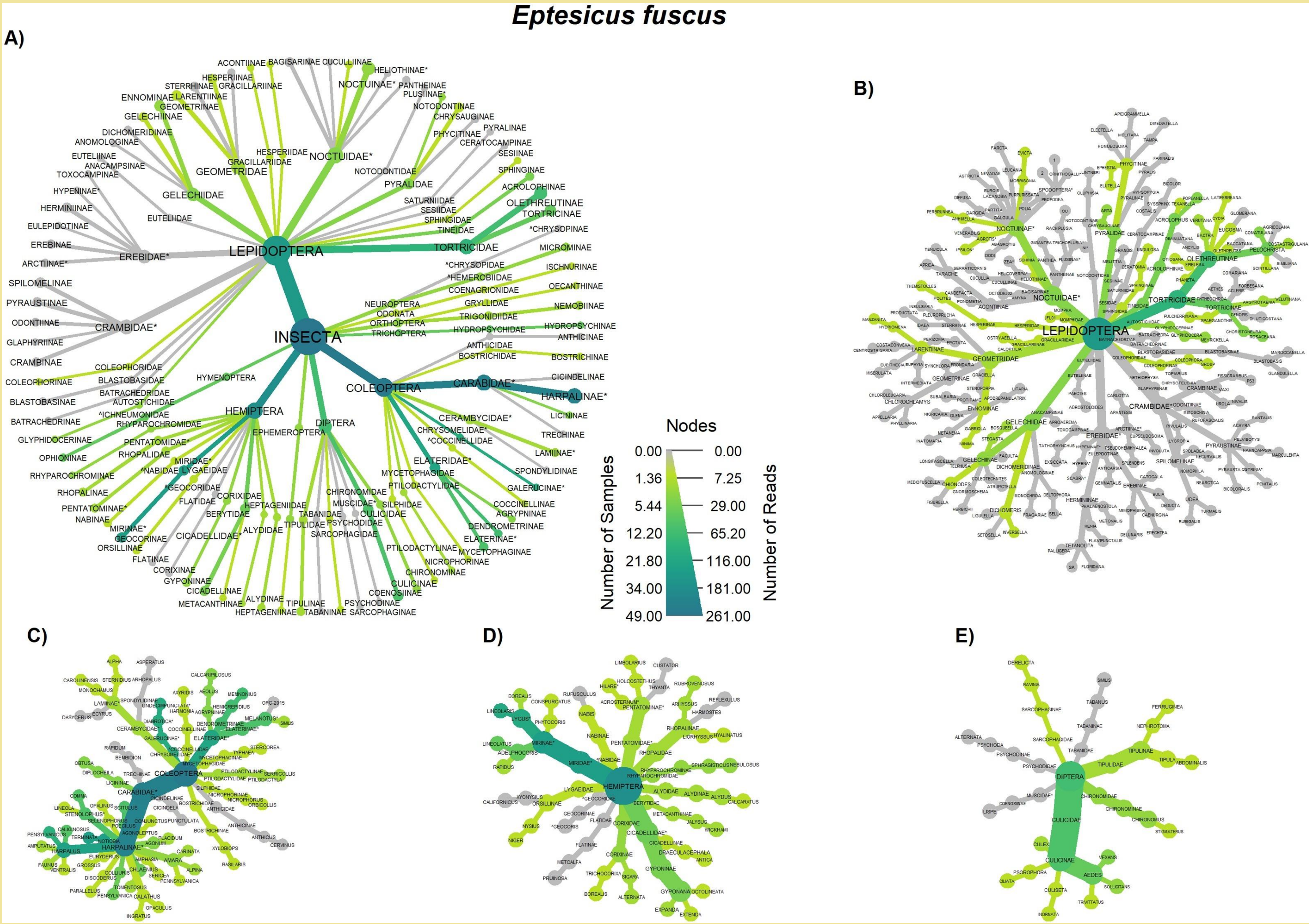


Fig. 2 The diet of the big brown bat in Lancaster County, Nebraska. The different colors represent number of samples and frequency of remains found in guano. Subsets of different insect families are included.

METHODS

Experimental Design:

- Bat populations and crop productivity of corn farms in Midwestern states will be measured during the corn growing season (April-August)
- Bats will be captured with mist nets and then marked with leg bands.
- Two bat count surveys will be completed for each field.
- Crop yield data will be derived from annual harvest yield data for the farms where mark-recapture studies were completed.
- Bat population estimates and crop productivity data will be compared to determine if a correlation is present.



A banded Eastern red bat and mist nets.

INTENDED ANALYSIS

- To estimate total bat population for each survey location we will be using the formula $N = (M \cdot C) / R$, where N is total population size, M is marked animals in first sample, and C is total caught in second sample, and R is recaptured in second sample.
- The independent, or predictor variable of the study is bat population, while the dependent (response) variable is annual corn yield.
- Both variables are continuous, so a regression will be performed to determine whether the correlation between bat population and crop yield is significant.

Literature Cited

Whitby, M. D., Kieran, T. J., Glenn, T. C., & Allen, C. (2020). Agricultural pests consumed by COMMON bat species in the United States Corn Belt: The importance of DNA primer choice. *Agriculture, Ecosystems & Environment*, **303**.

Taylor, P. J., Grass, I., Alberts, A. J., Joubert, E., Tschardtke, T. (2018). Economic value of bat predation services- A review and new estimates from macadamia orchards. *Ecosystem Services*, **30**, 372-381.

Weier, S.M., Grass, I., Linden, V.M.G., Tschardtke, T., Taylor, P.J. (2018). Natural vegetation and bug abundance promote insectivorous bat activity in macadamia orchards, South Africa. *Biological Conservation*, **226**, 16-23.

Rodriguez-San Pedro, A., Allendes, J. L., Beltran, C. A., Chaperon, P.N., Saldarriaga-Cordoba, M. M., Silva, A. X., Grez, A. A. (2020). Quantifying ecological and economic value of pest control services provided by bats in a vineyard landscape of central Chile. *Agriculture Ecosystems & Environment*, **302**.

Tremlett, C. J., Moore, M., Chapman, M. A., Zamora-Gutierrez, V., Peh, K. S. H. (2019). Pollination by bats enhances both quality and yield of a major cash crop in Mexico Palabras clave. *Journal of Applied Ecology*, **57**, 450-459.