Mines bigger than yours:
Responses of leaf-mining larvae to elevated carbon dioxide.

Liam Crowley, Jerry Pritchard, Jon Sadler and Scott Hayward.

School of Biosciences, University of Birmingham, Birmingham, B15 2TT.

Background

It remains unclear how insect herbivory will affect the response of woodlands to increasing concentrations of atmospheric carbon dioxide (eCO_2). Herbivores may consume more to compensate for increasing plant C:N[1], or, alternatively, plants may be better able to defend against herbivores, resulting in reduced feeding and stunted herbivore growth[2]. The Birmingham Institute of Forest Research (BIFoR) Free Atmosphere Carbon Enrichment (FACE) facility provides a unique opportunity to investigate these responses in a mature woodland. Leaf-miners are an excellent model group of herbivores to study in this system as they are sessile, abundant and their entire larval life history is captured in the trace they leave as they feed.

Objectives

- Record the density and diversity of leaf-miners within the experimental arrays at the BIFoR FACE facility.
- Investigate the potential effects of eCO2 on miner abundance and mean mine area.

Methods

- Total of 3 treatment (+150ppm CO_2) and 3 control arrays.
- 200 English Oak, *Quercus robur,* leaves surveyed in each array (total 1200) in 2017 and 2018 and number of mines recorded.
- 20 leaves containing mines imaged and mine area calculated using ImageJ software (Fig. 1).
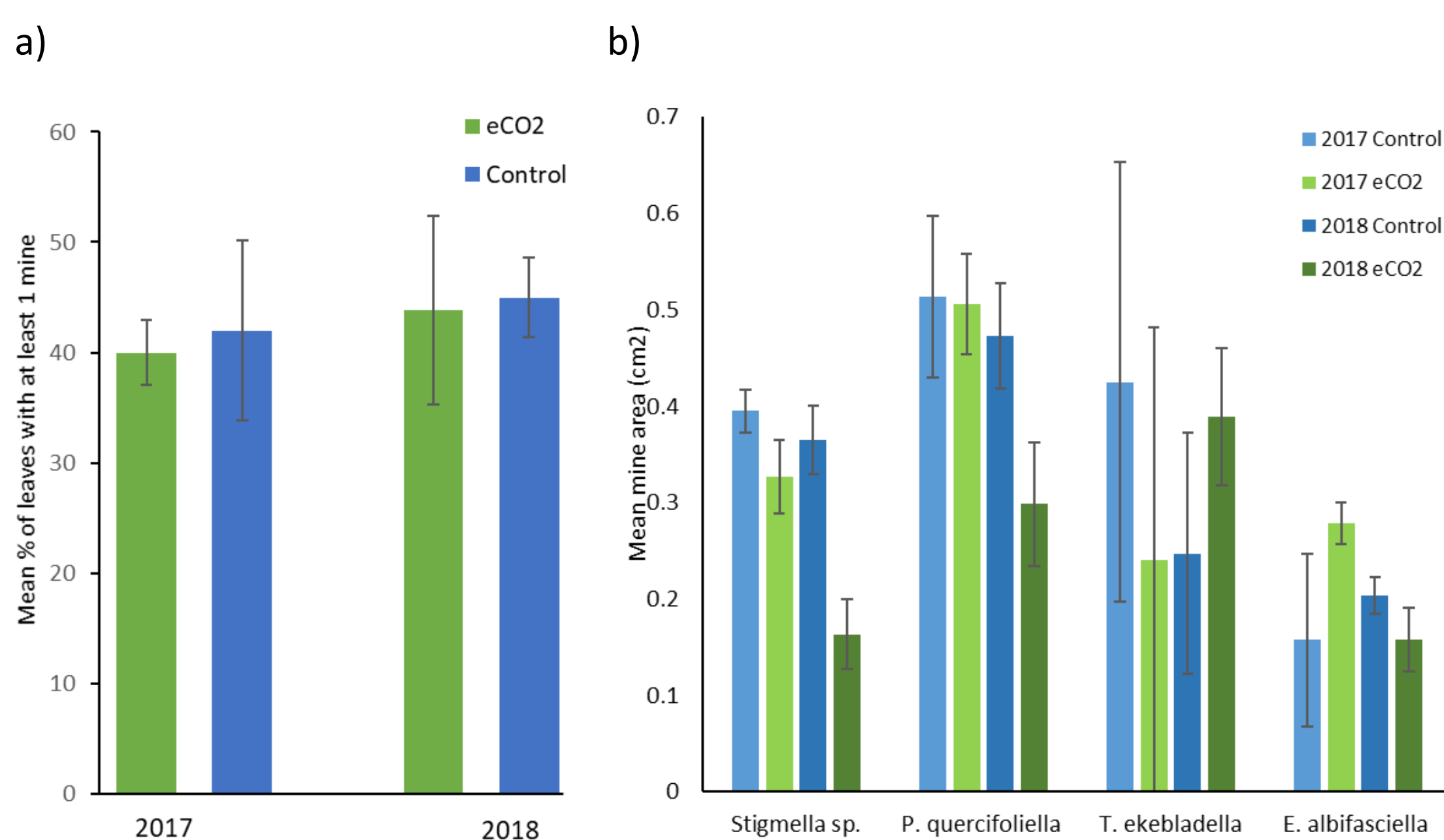- The miner responsible was identified to species/genus level.

Figure 1.

Results

The most abundant leaf-miners were *Stigmella spp.*, *Phyllonorycter quercifoliella*, *Ectoedemia albifasciella* and *Tischeria ekebladella*.

A total of 743 mines in 2017 and 757 mines in 2018 were recorded. The presence of at least 1 mine was recorded from 41% and 44% of these leaves in 2017 and 2018 respectively (Fig. 2a).

There was no significant difference in density of mines between eCO_2 and control in either year(Fig. 2a).

There was no significant difference in mean mine area in 2017, however there was a consistent decreases under eCO_2 in 2018 for 3 of the species (Fig. 2b).

*Figure 2 – a) Mean % of leaves with at least 1 mine under eCO2 and control in 2017 & 2018.
b) Mean mine area under eCO2 and control for each species in 2017 & 2018*

Take home message

- The high density of mines (>40% of leaves) demonstrates importance of leaf-miners at ecosystem level and the key species were identified.
- The data suggest that eCO2 had no effect on leaf miner abundance.
- Whilst there was no clear response in the first year, after a second year of fumigation there was a clear decrease in mean mine area.
- Future work should address whether this decrease in herbivory is driven by a decrease in nutritional value or an increase in defensive compounds.

References:

1 – Couture *et al.,* (2015). *Nature plants,* 1(3).

2 – Cornelissen, (2011). *Neotropical entomology*, 40(2).

Email: lxc661@student.bham.ac.uk

@Liam_M_Crowley

UNIVERSITY OF BIRMINGHAM

BIFOR
BIRMINGHAM INSTITUTE OF FOREST RESEARCH