‘Talking’ trees; the impacts of ozone and elevated (e) CO_2 on chemical communication networks.

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How do trees talk, and what do they talk about?

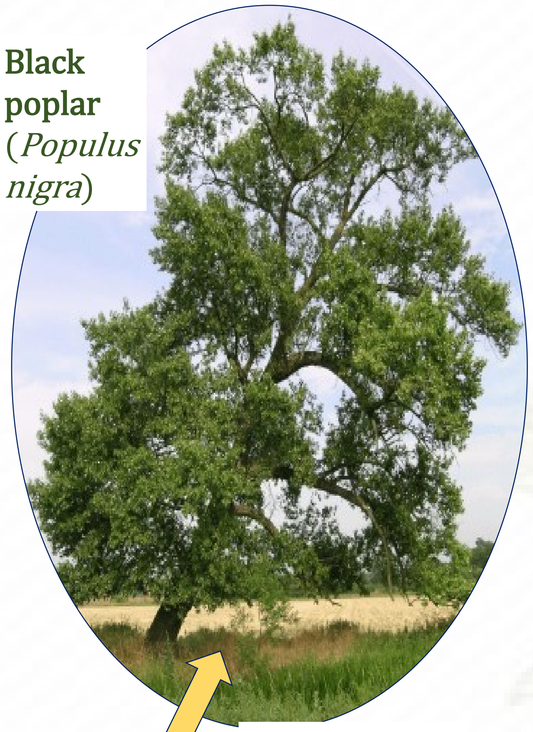
- Plants communicate with other organisms within an ecosystem through the emission of volatile organic compounds (VOCs) (1)
- VOCs, low-molecular-weight compounds that evaporate readily at ambient temperatures, act as airborne signalling molecules, e.g. flower perfumes or the scent of freshly cut grass
- Plants can synthesise a greater range and increased levels of VOCs in response to stress, e.g. herbivory or drought (1)

Who are they talking to, and why does it matter?

- **Neighbouring plants**; receive information about impending herbivore attack, enabling ‘priming’ of their own chemical defences (2)
- **Pollinators**; locate food source partly by using floral scents (3)
- **Predators of herbivores**; use altered VOC profiles of attacked plants to locate their prey (4)
- Reduced herbivore load through attraction of natural enemies, defence priming and effective pollination are factors that are critical to plant fitness
- Interactions between species within an ecosystem are a key feature of biodiversity, and damage to these interactions can severely compromise ecosystem functionality (5)

The model system

Black poplar (*Populus nigra*)



Winter moth (*Operophtera brumata*)

Agrypon flaveolatum Parasitoid wasp of winter moth

Clear conversation is critical to ecosystem functionality . . . But can plants grown under ozone (O_3) and eCO_2 still be ‘heard’?

- O_3 levels in the troposphere are predicted to rise continuously, reaching concentrations above 40ppb over most of the planet by 2100 (6)
- CO_2 has risen in parallel with tropospheric ozone, climbing from around 325 ppm in 1975 to just above 400 ppm in 2019, affecting all terrestrial ecosystems (7,8)
- Numerous studies have demonstrated the potential for tropospheric ozone to alter VOC emissions from plants, sometimes perturbing chemical communication between plants and other community members, such as foraging arthropods (9–11)
- Unravelling the combined effects of rising O_3 in conjunction with CO_2 on ecosystem communication networks remains a key challenge to our understanding of how anthropogenic pollutants, together with climate change, are impacting ecosystems (8)

BIFoR FACE and the University of Reading FADOE rings: overcoming the limitations of the laboratory

Research will focus on characterising the VOC profiles of black poplar saplings grown over 24 months in two semi-natural ecosystems. Trees will develop under a continuous regime of either elevated CO_2 at BIFoR’s FACE (Free-Air Carbon Dioxide Enrichment) facility, or O_3 at the University of Reading’s FADOE (Free Air Diesel & Ozone Enrichment) facility, offering an unprecedented opportunity to gather data in ‘real-world’ scenarios.

- Using a previously characterised model tree (*Populus nigra*), we will grow saplings under eCO_2 (550 ppm) and eO_3 (80 ppb), measuring and characterising baseline VOC profiles throughout development
- Saplings grown under eCO_2 will then undergo a period of exposure to O_3, and vice versa for trees grown under eCO_2
- Trees will be further exposed to controlled herbivory and VOC profiles measured
- Laboratory tests will then be undertaken to measure the orientation response of parasitoid wasps to the VOC profiles of herbivore exposed saplings from the differing treatments

About the author

I am a Forest Edge Doctoral Scholar, funded by the Leverhulme Trust. My background is in animal behaviour, plant defence and conservation. I am interested in behavioural interactions within chemical communication webs, particularly in how these relate to ecosystem processes and function.

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