

Drought effects on tree-enemy interactions in temperate woodlands

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The changing climate poses a major threat to forest ecosystems in the UK and globally. In UK woodlands, the most important climate change-related risk is changing precipitation patterns. With the frequency and severity of summer droughts predicted to increase, forest trees adapted to a wetter climate are likely to suffer. The impact of droughts might be particularly severe on drought-sensitive tree species on certain soil types (e.g. shallow, freely-draining soils and clay soils) in southern and eastern England.

In addition to the direct and well-documented effects of drought on tree performance, drought has the potential to alter the interactions between trees and other organisms such as insect herbivores and plant pathogens, with stressed trees being more susceptible to pest/pathogen outbreaks. While some of these effects might be direct (e.g. the potential effect of drought on the survival of insect species pupating in the soil), many are likely to be mediated by the host plant. For example, drought-induced changes in leaves might make drought-stressed trees more or less suitable as food for primary consumers, which could in turn alter the dynamics of consumer populations. Host-plant mediated effects of drought on primary consumers can also carry over to higher trophic levels (to affect natural enemies such as parasitoids attacking herbivorous insects), and could potentially feedback to influence enemy pressure on trees. While the potential effects of rising temperatures on tree-enemy interactions have received substantial attention, we still lack a clear understanding of how primary and secondary consumers are likely to respond to summer drought. Since primary consumers such as insect herbivores can – even at relatively low densities – affect the performance of their host trees, it is worrying that the effects of abiotic and biotic stressors on tree performance are still mostly studied in isolation from each other.

Building on previous research by the supervisors, their students and collaborators, this project will use the oak (*Quercus robur*; a dominant species in many temperate woodlands) and its associated insect herbivores

and diseases (notably powdery mildew) as a model to investigate drought effects on tree-enemy interactions. The project will address two broad questions of key relevance to our understanding of drought effects in temperate woodlands: 1) How is the abundance and performance of oak-associated insects and pathogens affected by drought? 2) How is oak performance affected by the combined effects of drought and enemy attack? A core part of the project will involve experimental manipulations of drought and enemy pressure conducted both in the field and in more controlled settings (e.g. using potted seedlings in a greenhouse).

Oak drought stress experiment using potted seedlings at the UKCEH. Photo credit: Elsa Field.



Herbivorous insects and other primary consumers associated with trees form important nodes in the wider forest food web. This project has the potential to reveal to what extent the impacts of drought extend beyond the direct effects on trees. The project will also provide invaluable understanding of how climate change is likely to alter the potential impacts of pest outbreaks in European forests, and into whether multiple stressors contribute to tree health decline as predicted by the 'spiral model of tree health decline'.

Training opportunities:

The student will receive training in multiple disciplines (ecology, forest entomology, tree pathology) and research skills including experimental design, ecological field techniques, taxonomy and statistical analysis. Through a CASE studentship, the student will also undertake a placement at Bartlett Tree Experts, where they will benefit from a hands-on introduction to arboricultural practices, and receive training in the application of their science to tree care and pest management.

Student profile:

The project is suitable for a student with a degree in biological or environmental sciences or a related discipline. We are looking for an enthusiastic student with good oral and written communication skills who is keen to engage in both field- and desk-based research. Experience of ecological field research would be an advantage.

Funding particulars:

This is a CASE studentship in collaboration with Bartlett Tree Experts (<https://www.bartletttree.co.uk>).

<https://research.reading.ac.uk/scenario/>