



Bacterial  
Plant Diseases  
Programme



Training citizen scientists to carry out tree health surveys

# ACUTE OAK DECLINE IS CAUSED BY A COMBINATION OF BACTERIA, BEETLES, AND ENVIRONMENTAL STRESS



## Iconic oak trees are dying from Acute Oak Decline (AOD)

Oak trees are important for the UK environment, landscape, economy, and culture. They produce timber, support woodland biodiversity and are culturally significant. Their unique features have made them a much-loved symbol of national identity.

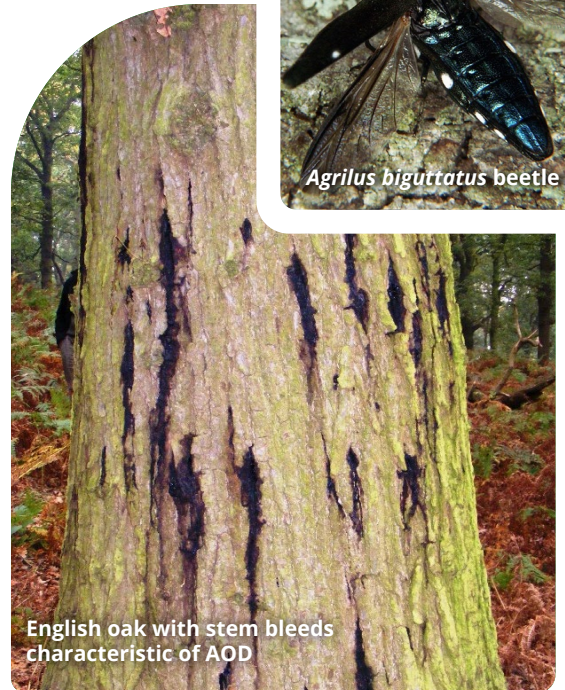
However, they are threatened by an emerging disease, acute oak decline (AOD). Affected trees have long cracks in their bark which seep dark fluid. Beneath the cracks the stem tissues are diseased

and rotting. The flow of water and essential nutrients is interrupted leading to the deterioration and potentially death of the tree. Thousands of oaks are affected in England, and the situation is worsening.

AOD is a complex disease with no single cause. Affected trees are weakened by unfavourable environmental conditions and colonised by beetles including the native oak jewel beetle, *Agrilus biguttatus*, and damaging bacteria like *Brenneria goodwinii*.



*Agrilus biguttatus* beetle



English oak with stem bleeds characteristic of AOD



Wound inoculating oak trees with bacterial suspension

## This research explored the combination of factors that leads to AOD

We studied disease development in trees weakened by environmental stress. Rain-exclusion shelters were constructed to mimic drought conditions and trees inoculated with beetle eggs and bacteria. Tree responses were monitored as the larvae hatched.

To determine if the beetles transmit the bacteria, they were fed oak leaves coated with bacteria. Beetles were then washed and dissected to find out if the bacteria survived.

To find out if the larvae affected the bacteria, larval chemicals were extracted by suspending beetle larvae in methanol. These chemicals were then added to bacterial growth media and the effects on growth and bacterial gene activity analysed.

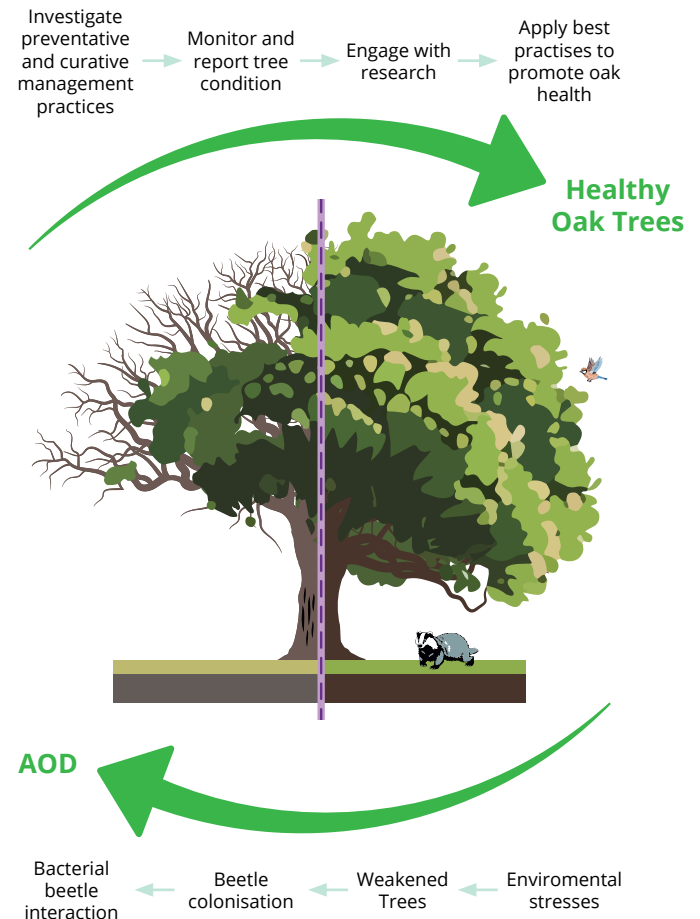
Interviews, questionnaires and training days were used to find out people's attitudes to oak trees and options for the management of AOD.

## Discoveries

**We established that AOD is caused by a combination of bacteria, beetles and environmental stress.**

- 🔍 Acute oak decline symptoms are only caused by the combination of bacteria, particularly *Brenneria goodwinii*, and *Agrilus biguttatus*.
- 🔍 The bacteria can survive in the beetle gut and ovipositor (egg-laying organ).
- 🔍 Chemical compounds from *Agrilus biguttatus* larvae make the bacterium more pathogenic by speeding up the multiplication of bacterial cells and triggering pathogenicity genes that cause disease.
- 🔍 Disease development is worse when trees are placed under more severe nutrient and water stress.
- 🔍 *Brenneria goodwinii* is found on other tree species, but only causes disease on oak.
- 🔍 Nearly a quarter of people surveyed value oaks more than other trees and nearly 60% want action to be taken to conserve oaks. Land managers with veteran oaks are willing to commit time and resources to conserving them.

## The road from AOD to healthy oak trees



### For more information contact:

Prof Sandra Denman - email: [sandra.denman@forestresearch.gov.uk](mailto:sandra.denman@forestresearch.gov.uk)

To explore the underlying research visit

<https://bacterialplantdiseases.uk/bac-stop/>



## Recommendations

**Increased monitoring is essential as ways of managing the disease are investigated.**

- 🌿 Train and encourage the public and forest managers to monitor trees and report symptoms so that national AOD occurrence is recorded.
- 🌿 Monitor *Agrilus biguttatus* populations and distribution across the UK, and test whether bacterial interaction with other insects also triggers pathogenic bacterial responses.
- 🌿 Investigate the best management practices to promote the health and resilience of oak trees to avoid tree weakening.



An interdisciplinary research consortium working together to understand bacterial plant diseases to protect UK farms, forests and gardens.

[www.bacterialplantdiseases.uk](http://www.bacterialplantdiseases.uk)

