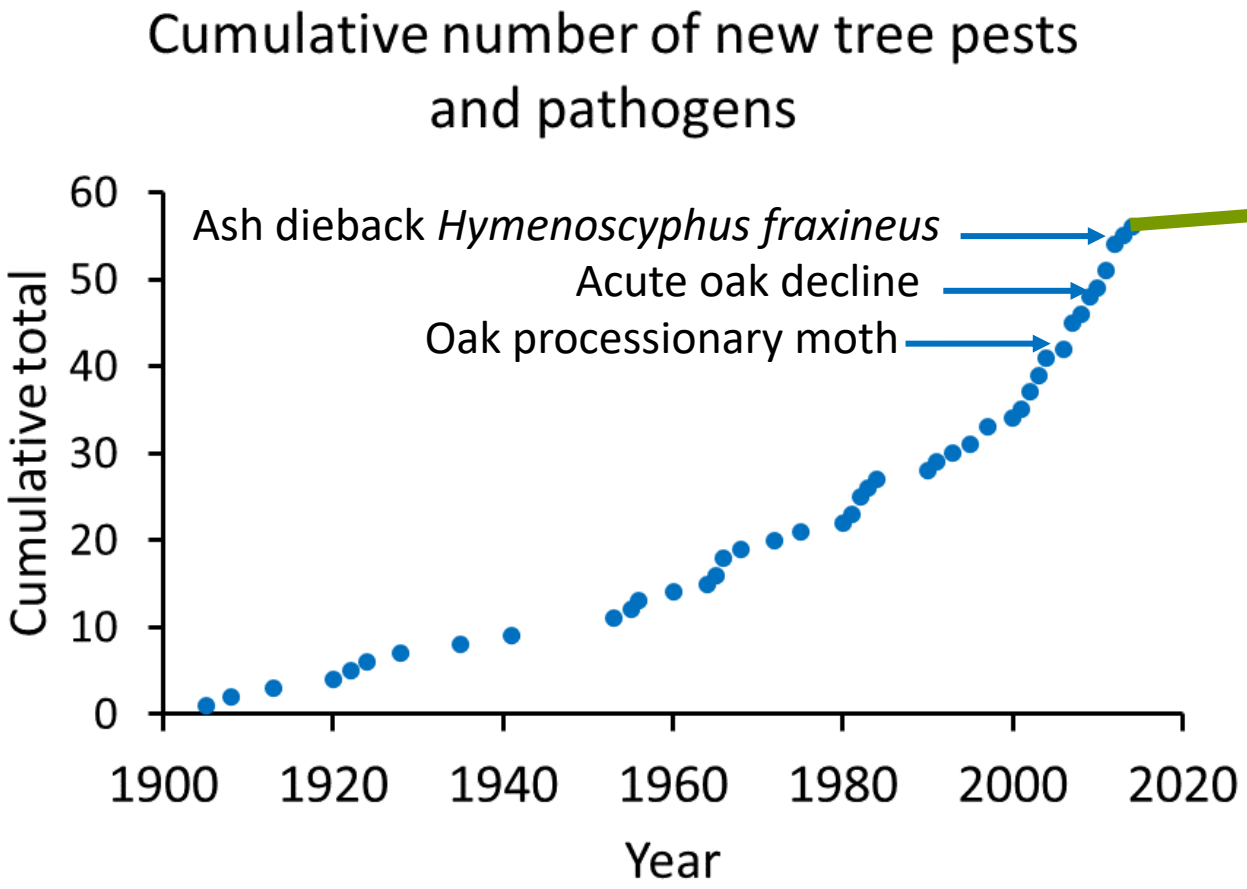
Collapsing foundations: the ecology of the British oak and ash, implications of its decline and mitigation options

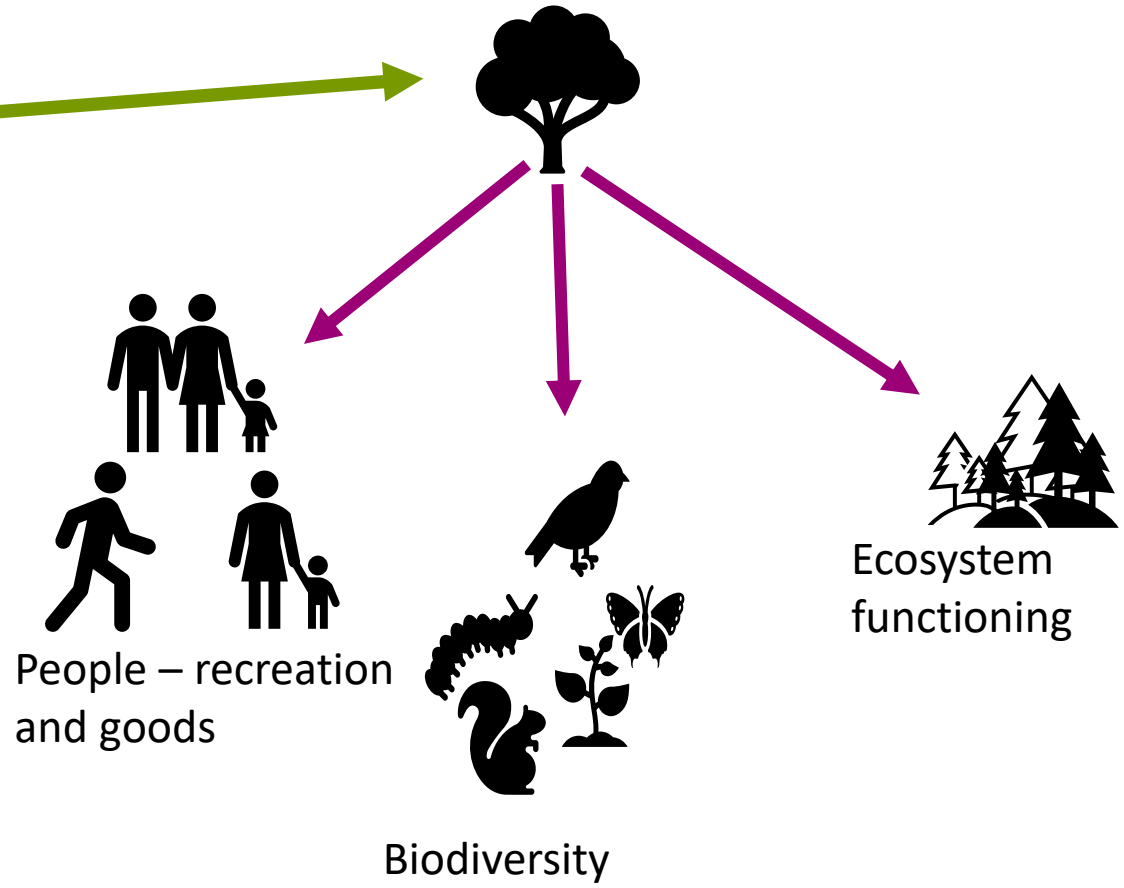
Ruth Mitchell

The James Hutton Institute

Small Woods and Action Oak 26th February 2021

Tree diseases and cascading consequences





Data taken from Freer-Smith et al. 2017 Biodivers. Conserv. 26:3167-3181

Each pest/pathogen has cascading effecting on more than just one tree species

Objectives

1. Identification of oak/ash associated biodiversity

2. Assessment of alternative tree species:

    2.1 Biodiversity

    2.2 Ecosystem function

3. Tools and case studies



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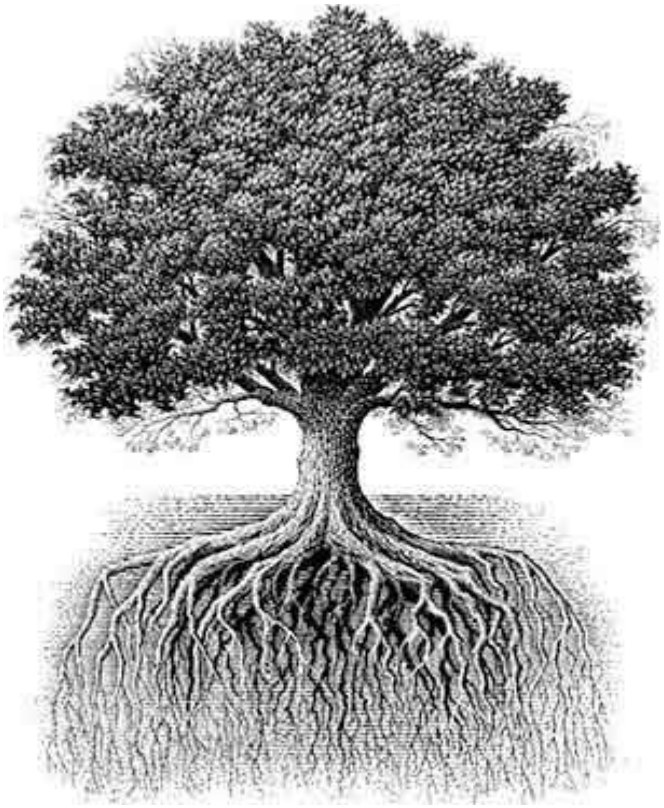
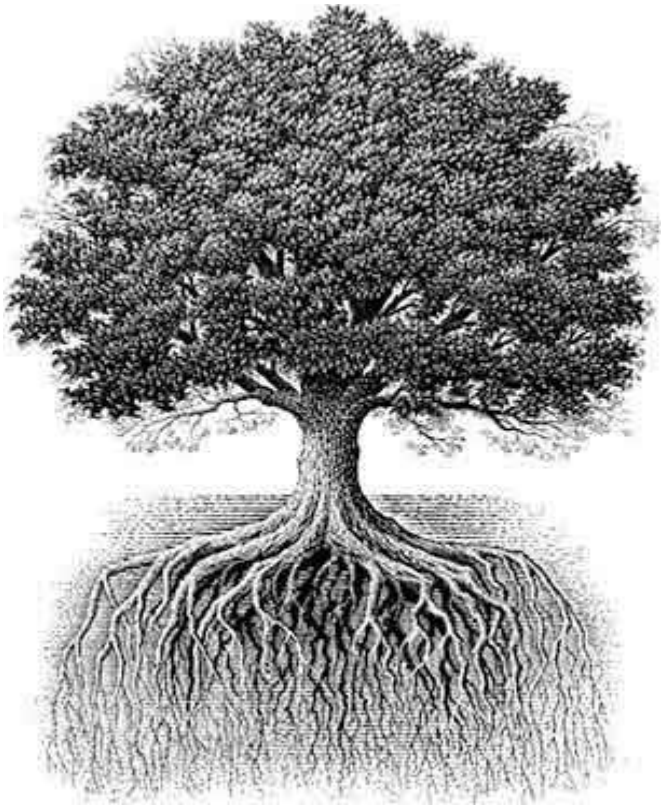
How associated species uses a tree



Food
Nesting/breeding
Habitat

Woodland environment- ground flora

How associated species uses a tree



Food
Nesting/breeding
Habitat

Woodland environment- ground flora

Level of association with host

Association	Definition
Obligate	Only found on **the host**
High	Rarely uses tree species other than **the host**
Partial	Uses **the host** more frequently than its availability
Cosmopolitan	Uses **the host** as frequently as, or less than, its availability

The host = oak or ash

Biodiversity supported

*Note: does not include all fungi or bacteria and other micro-organisms

2300 oak-associated species*:

- 38 birds
- 229 bryophytes
- 108 fungi
- 1178 invertebrates
- 716 lichens
- 31 mammals

955 ash-associated species*:

- 12 birds
- 58 bryophytes
- 68 fungi
- 241 invertebrates
- 548 lichens
- 28 mammals

Birds
Dr Paul Bellamy
RSPB

Lichens
Dr Chris Ellis
Royal Botanic Garden Edinburgh

Mammals
Dr Glenn Iason
Dr Scott Newey
JHI

Fungi
Dr Andy Taylor
JHI

Invertebrates
Dr Jenni Stockan
Dr Nick Littlewood
JHI

Bryophytes
Mr Nick Hodgetts
Hodgetts Botanical services

Level of association

- 326 obligate species:
  57 fungi, 257 invertebrates, 12 lichens
- 229 highly associated:
  51 fungi, 104 invertebrates, 74 lichens

Level of association

- 45 obligate species:
  11 fungi, 30 invertebrates, 4 lichens
- 62 highly associated species:
  6 bryophytes, 19 fungi, 24 invertebrates, 13 lichens

Species not previously at risk now at risk:
290

Species not previously at risk now at risk:
67

Mitchell et al. 2020 Biological Conservation, 233, 316-327; Mitchell et al. 2014 Biological Conservation, 175, 95-100

Impact of loosing oak and ash

Species only use oak and ash

Ground flora

- Light demanding species increase due to increase light
- Similar to coppicing
- Ash: long-term loss of species due to increased shade
- Oak: depends on replacement tree species

Mitchell et al. new Journal of Botany, 6, 2-15

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Assessment of alternative tree species for mitigation

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- Tree species already present with oak/ash woodlands
- Non-native tree species that will grow in the same climatic and soil conditions as oak/ash

- Alternative trees ≠ replanting but could do
- Encourage natural regeneration of species already present

Oak

- 30 alternative tree species assessed
- 2300 oak-associated species
- 69000 assessments!

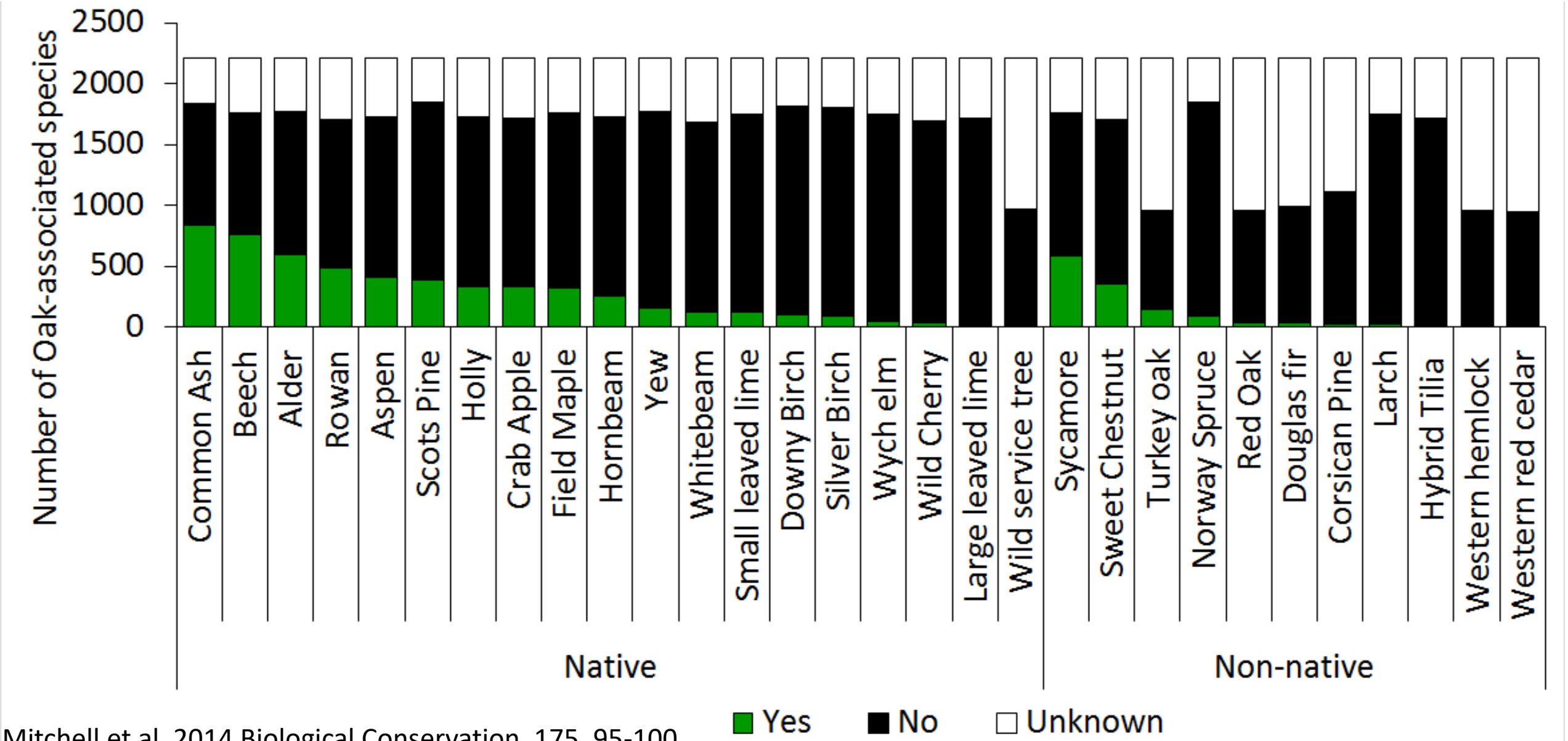
Ash

- 48 alternative tree species assessed
- 955 ash-associated species
- 45840 assessments!



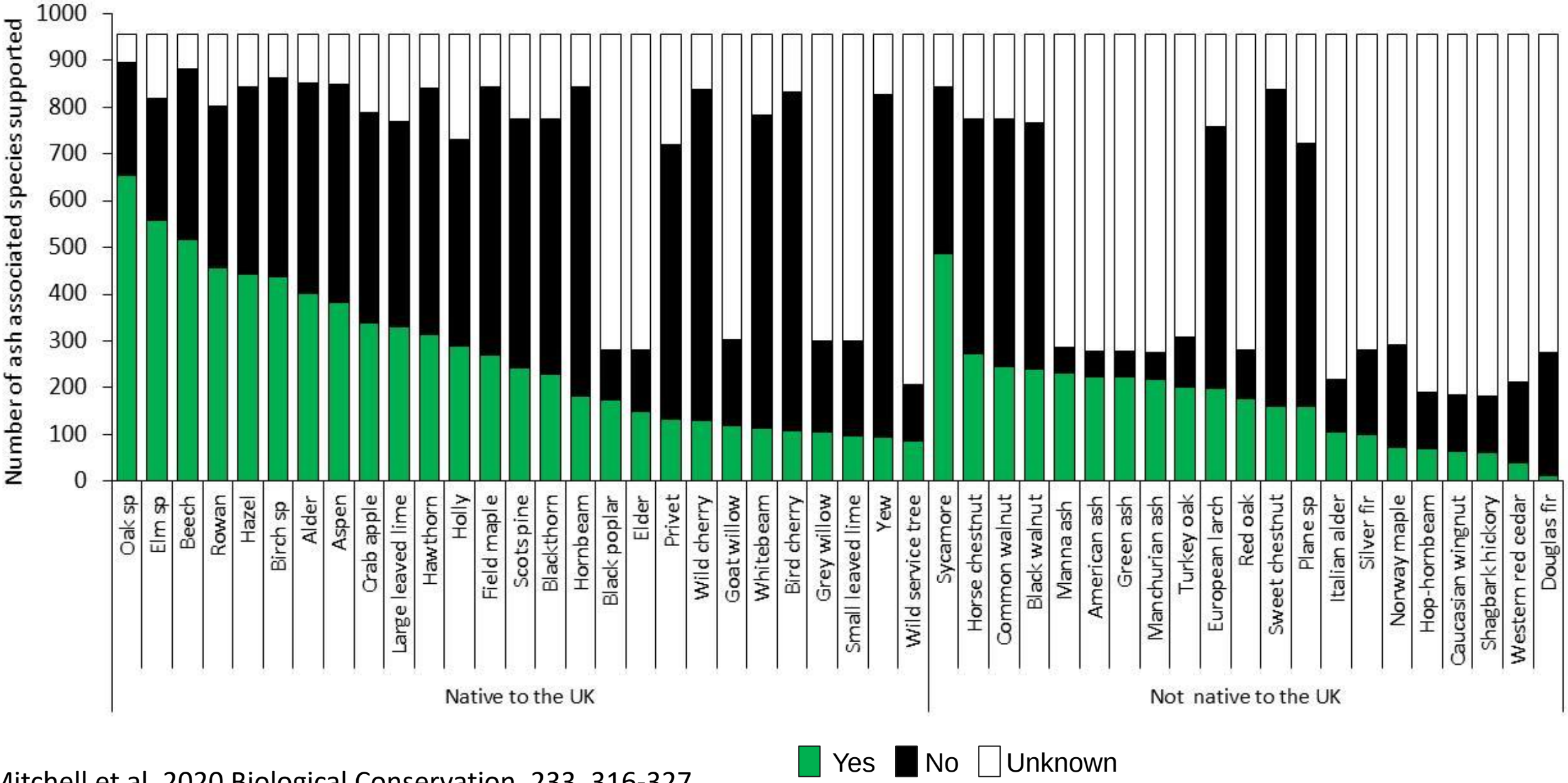



Suitability of other tree species to replace oak



Mitchell et al. 2014 Biological Conservation, 175, 95-100

Suitability of other tree species to replace ash



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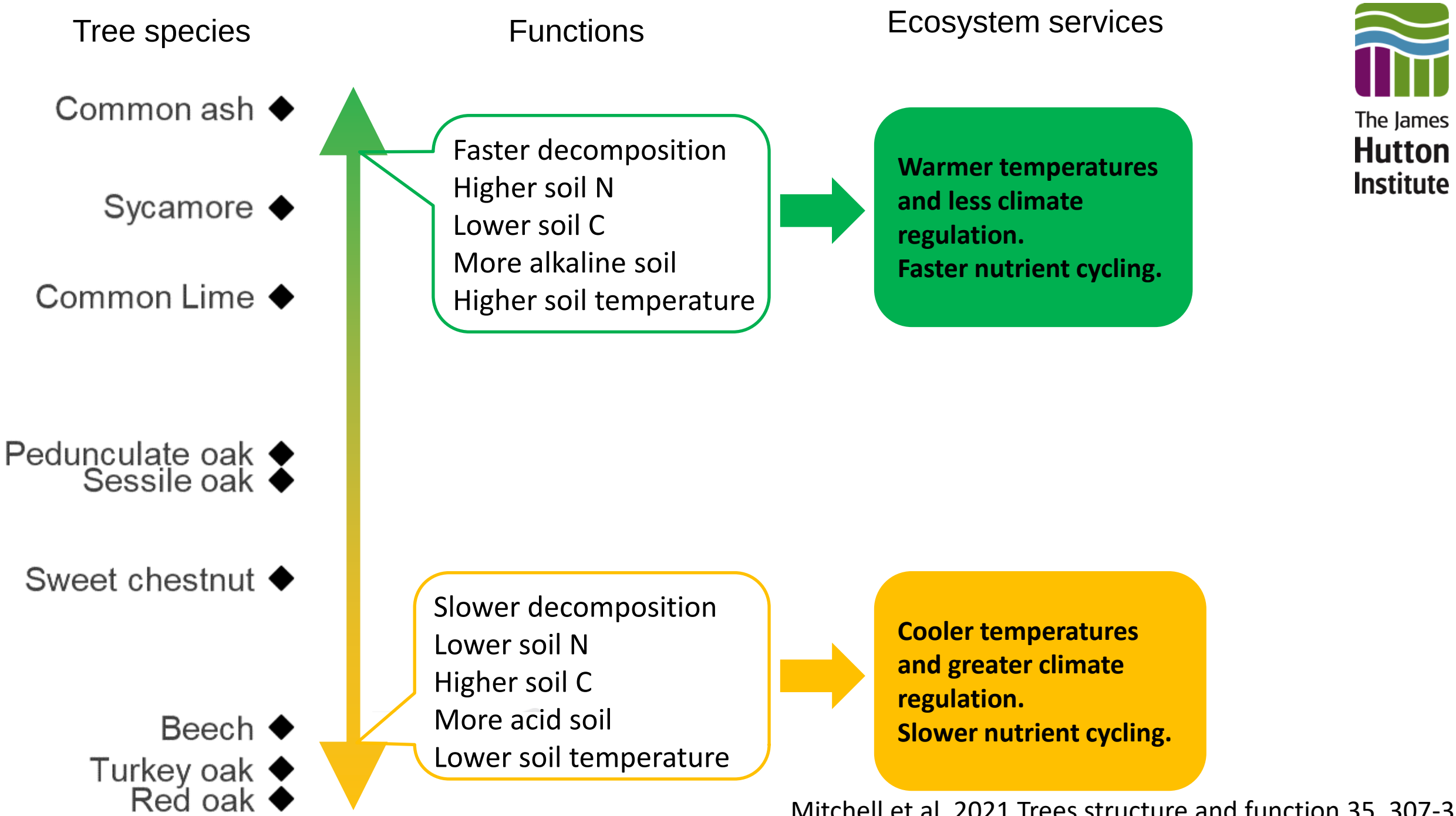
Testing functional differences between tree species

- 6 botanic gardens
- 9 tree species: 2 native oaks, red oak, turkey oak, ash, beech, sycamore, lime, sweat chestnut
- Functions: decomposition,
- Soil temperature,
- Soil: total C and N, mineralizable N and pH



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Mitchell et al. 2021 Trees structure and function 35, 307-317

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OakEcol and AshEcol Databases

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Databases contain:

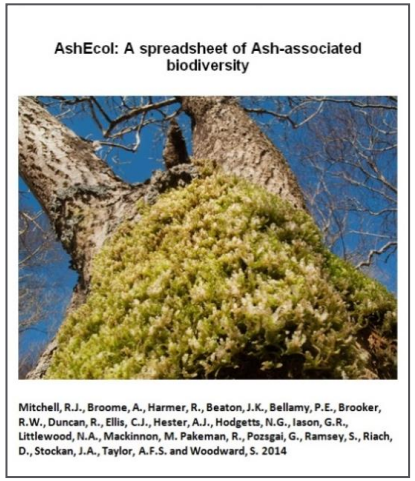
- Lists of all oak and ash associated species
- Level of association with oak/ash
- Conservation status
- How the species uses the tree
- If the species will or will not use any of the alternative tree species

C	D	E	F
Species - Englis	Tree alternative - Latin	Tree Alternative - English	Association
Mothball Crust	Abies alba	Silver fir	No
Mothball Crust	Acer campestre	Field maple	No
Mothball Crust	Acer platanoides	Norway maple	No
Mothball Crust	Acer pseudoplatanus	Sycamore	No
Mothball Crust	Aesculus hippocastanum	Horse chestnut	Likely
Mothball Crust	Alnus cordata	Italian alder	Likely
Mothball Crust	Alnus glutinosa	Alder	No
Mothball Crust	Betula pubescens/pendula	Birch sp (silver and downy)	No
Mothball Crust	Carpinus betulus	Hornbeam	No
Mothball Crust	Carya ovata	Shagbark hickory	Likely
Mothball Crust	Castanea sativa	Sweet chestnut	No
Mothball Crust	Corylus avellana	Hazel	No
Mothball Crust	Crataegus monogyna	Hawthorn	No
Mothball Crust	Fagus sylvatica	Beech	Yes
Mothball Crust	Fraxinus americana	American ash	Likely
Mothball Crust	Fraxinus mandschurica	Manchurian ash	Likely
Mothball Crust	Fraxinus ornus	Manna ash or south	Likely
Mothball Crust	Fraxinus pennsylvanica	Green ash or red ash	Likely
Mothball Crust	Ilex aquifolium	Holly	Unknown

Databases are:

- User-friendly version for **woodland managers** to assess impact of ash dieback on biodiversity and plan interventions.
- OakEcol available at: https://www.hutton.ac.uk/oak-decline
- AshEcol Available on Natural England web site

http://publications.naturalengland.org.uk/publication/5273931279761408



Impact assessment and management response

1. Assess biodiversity potentially present

2. Short list oak/ash-associated species for conservation – using **OakEcol/AshEcol** databases

3. Identify alternative trees and shrub species are needed to maintain these – using **OakEcol/AshEcol** databases

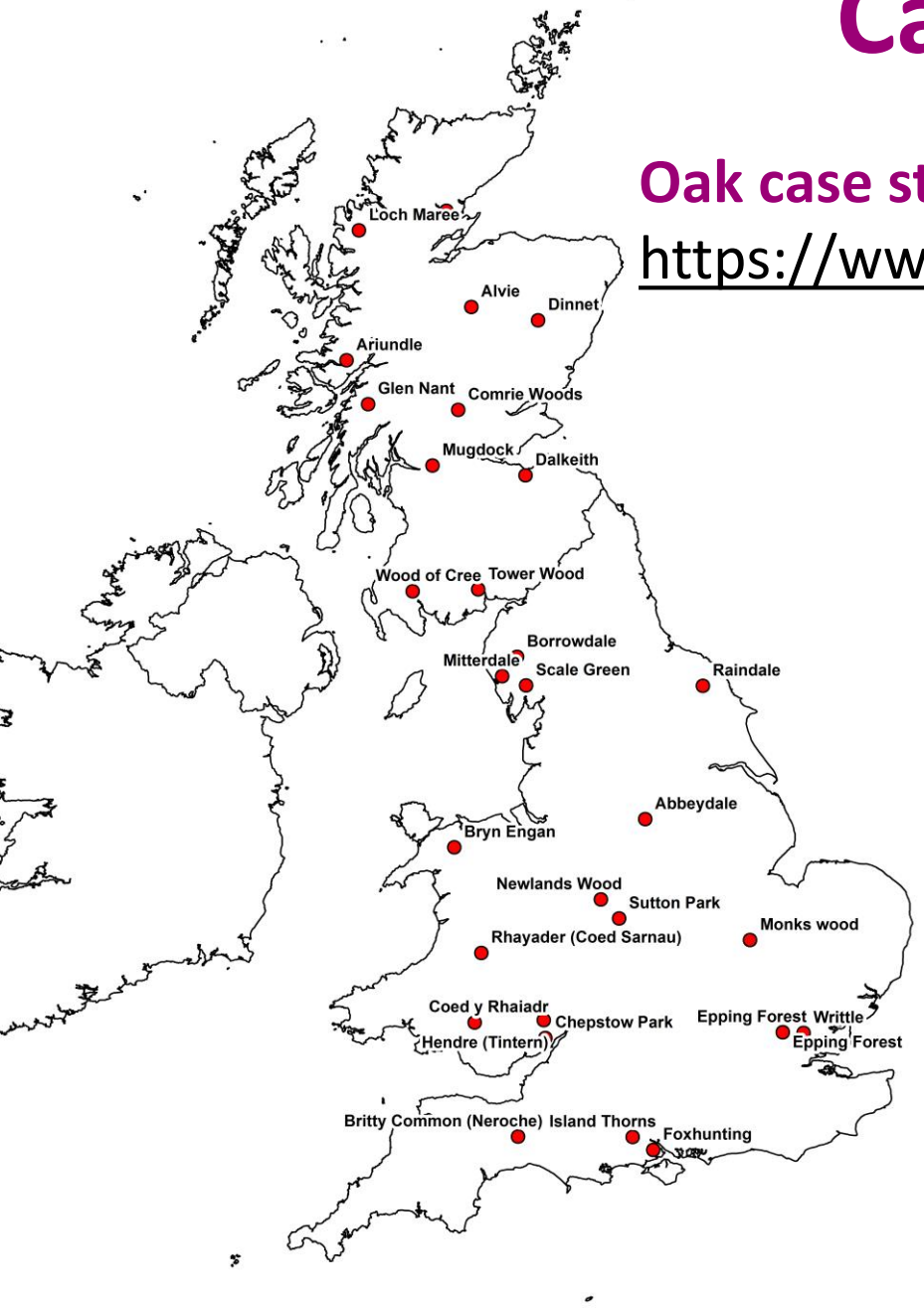
4. Assess site – which alternative trees are present?

5. Determine management

30 oak woodlands

Case studies

15 ash woodlands



Oak case studies available

https://www.hutton.ac.uk/oak-decline

Ash case studies available on Natural England website

http://publications.naturalengland.org.uk/publication/5273931279761408

Key messages from case studies

- Mitigation not possible for obligate species
- Mitigation possible for many highly and partially associated species BUT depends on diversity of woodland
- Intervention often required – herbivore control, increase regeneration
- Potential for establishing additional tree species at the sites?
- *Alternative hosts often lacking in scenarios of loss of oak and ash*

Summary

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- Cascading effect putting many additional species at risk of decline
- Mitigation possible for some species, but not obligates, may depend if replacement tree species present on site
- Functional differences and biodiversity supported should be taken into account
- Lack of data of the suitability of non-natives
- Cumulative impact assessments required for multiple tree diseases?

For more information:

www.hutton.ac.uk/oak-decline
www.hutton.ac.uk/ash-dieback
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Thank you for listening and thanks to:

The team:

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- Andy Taylor

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- JNCC
- NE
- NRW
- DEFRA