



Tree diseases: wider ecological impacts and management implications

Ruth Mitchell

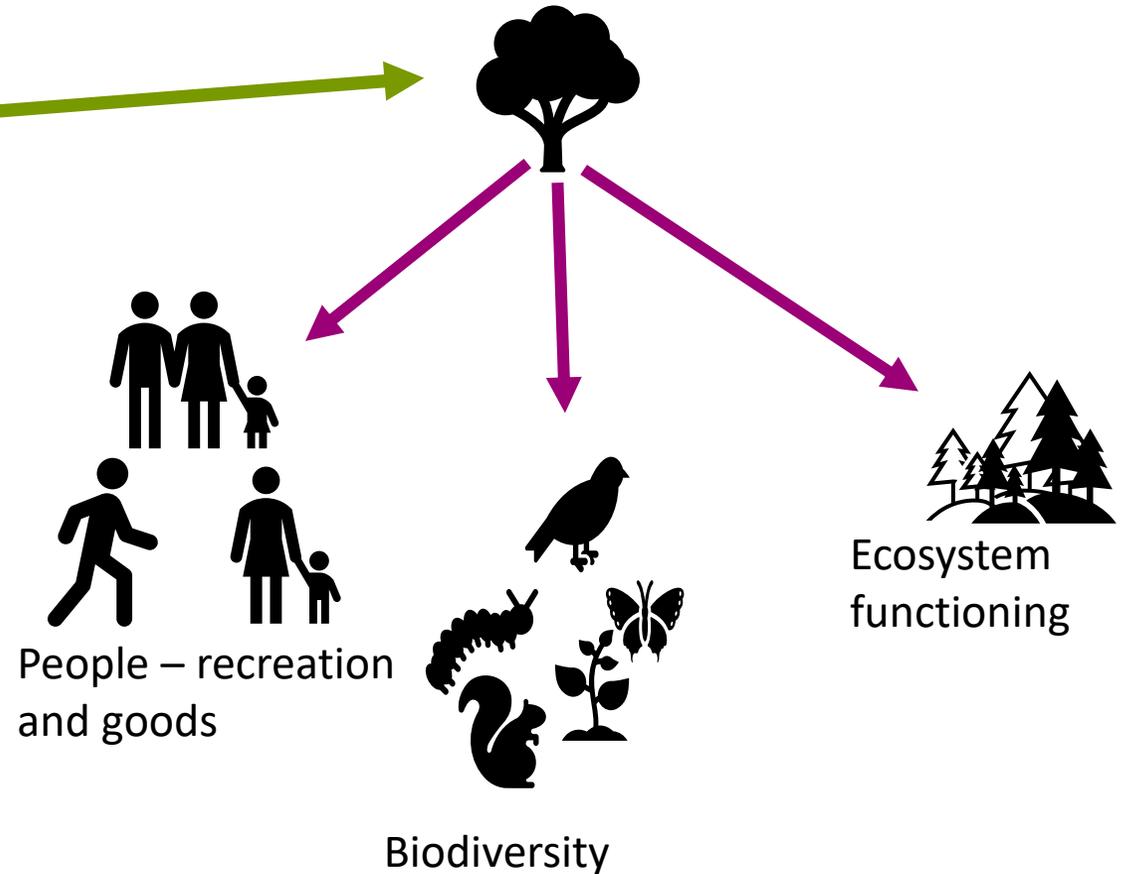
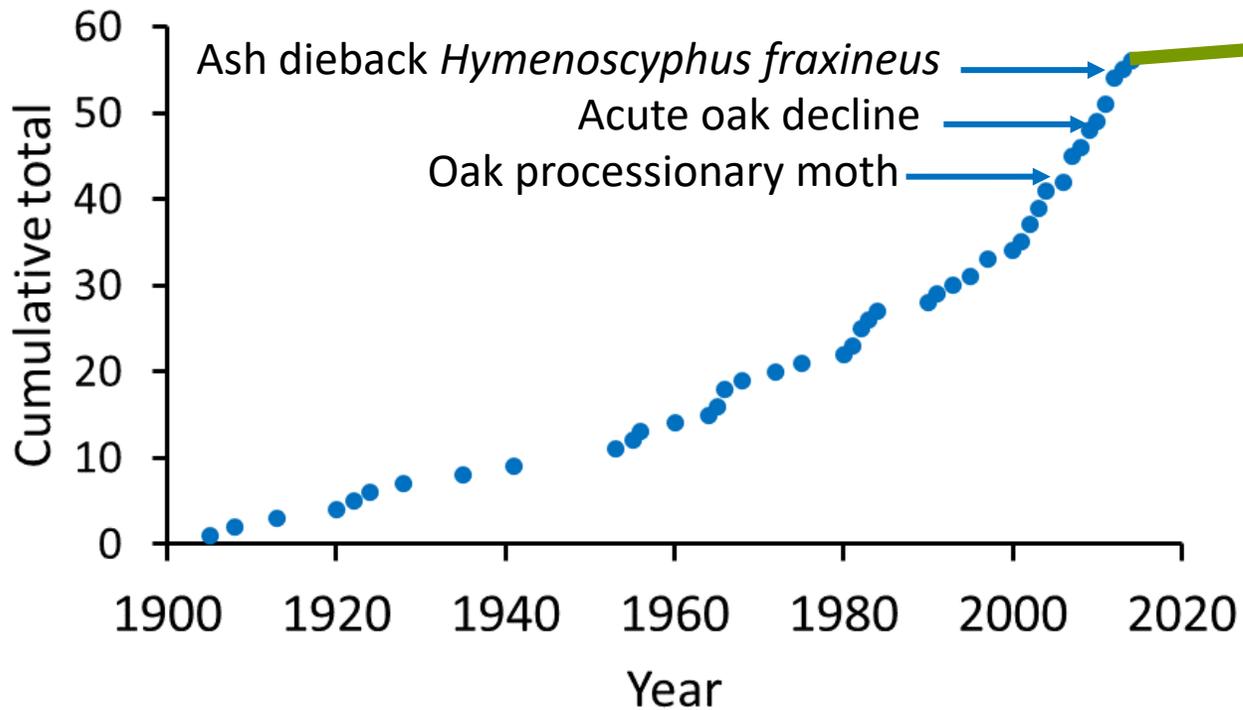
BiFor Conference 27th January 2021



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Tree diseases and cascading consequences

Cumulative number of new tree pests
and pathogens



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 ash/oak associated biodiversity
2. Assessment of alternative tree species:
 - 2.1 Biodiversity
 - 2.2 Ecosystem function
3. Tools and case studies
4. Loss of oak and ash



Objectives

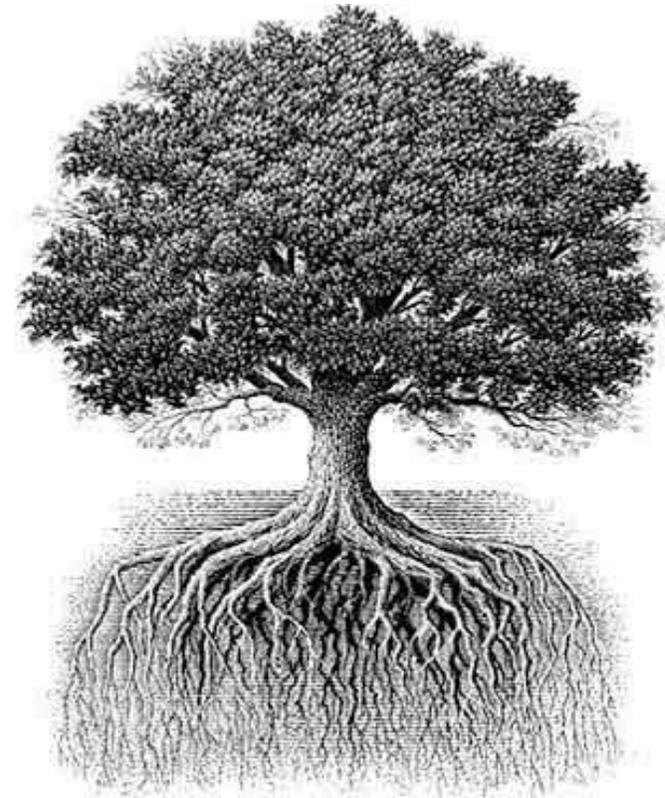
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How associated species uses a tree



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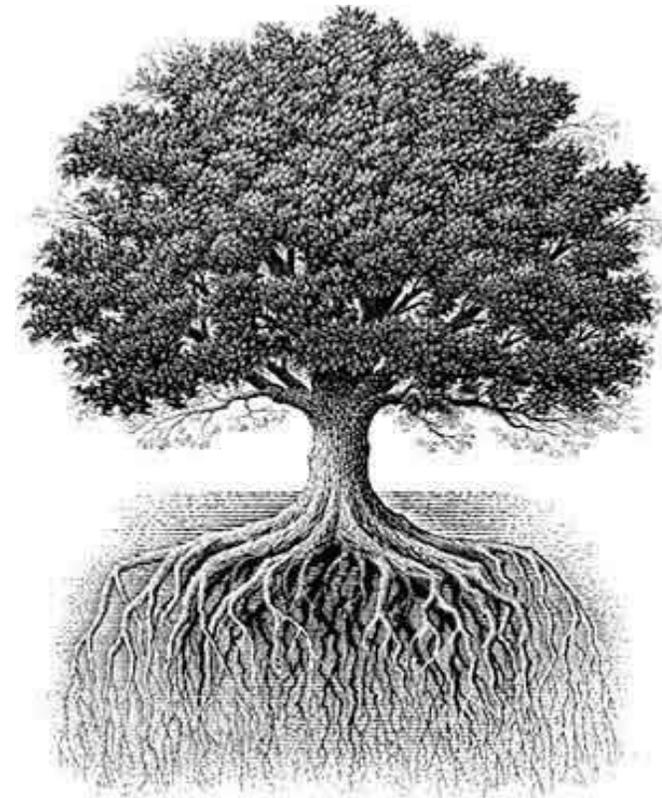
Food
Nesting/breeding
Habitat

Woodland
environment- ground
flora

How associated species uses a tree



Level of association with host



Food
Nesting/breeding
Habitat

Woodland
environment- ground
flora

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 = ash or oak

Biodiversity supported

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

955 ash-associated species*:

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

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:

67

2300 oak-associated species*:

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

Level of association

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

Species not previously at risk now at risk:

290



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

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



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Assessment of alternative tree species for mitigation



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- Tree species already present with ash/oak woodlands
- Non-native tree species that will grow in the same climatic and soil conditions as ash/oak
- Alternative trees ≠ replanting but could do
- Encourage natural regeneration of species already present

Ash

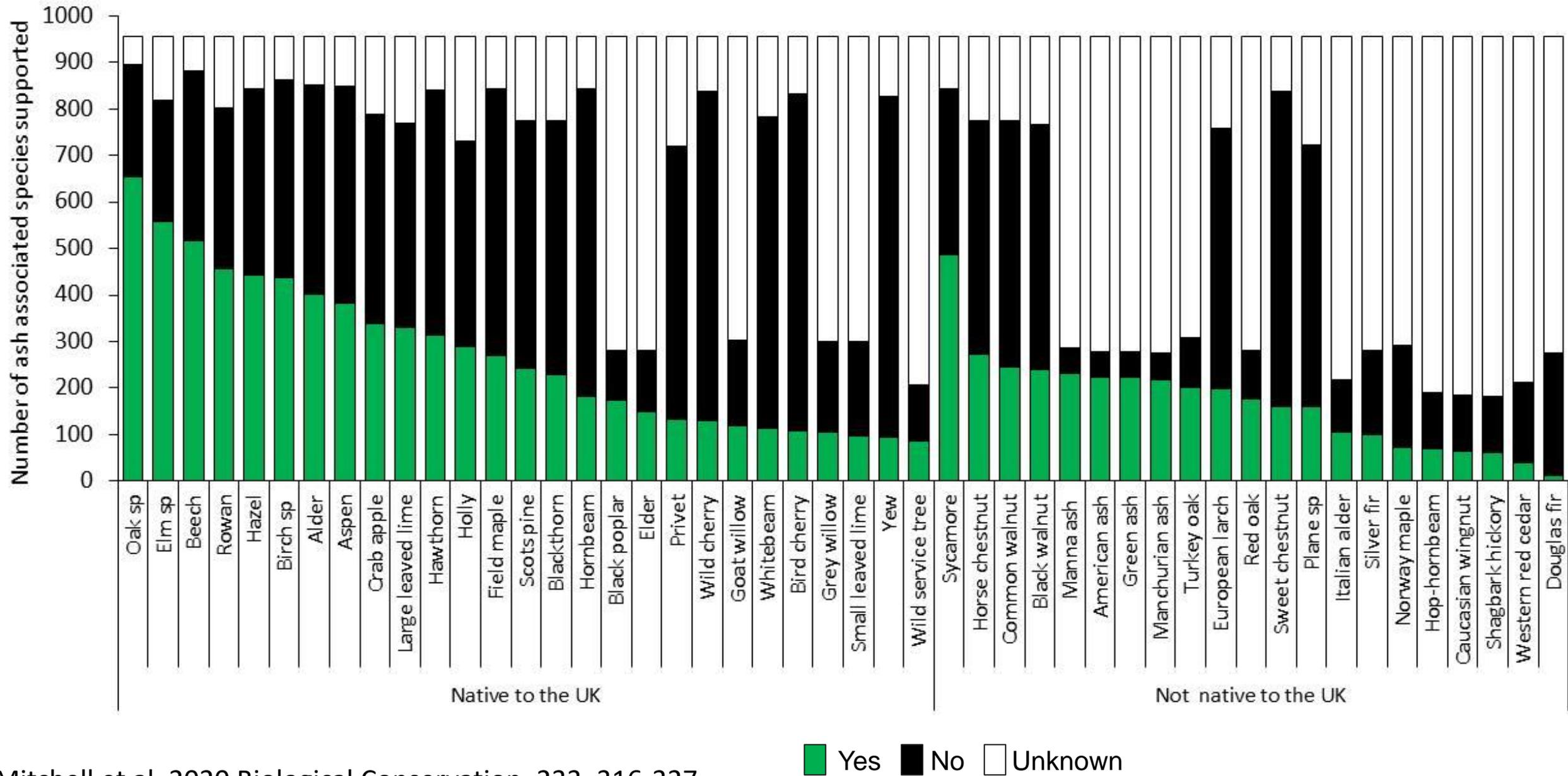
- 48 alternative tree species assessed
- 955 ash-associated species
- 45840 assessments!

Oak

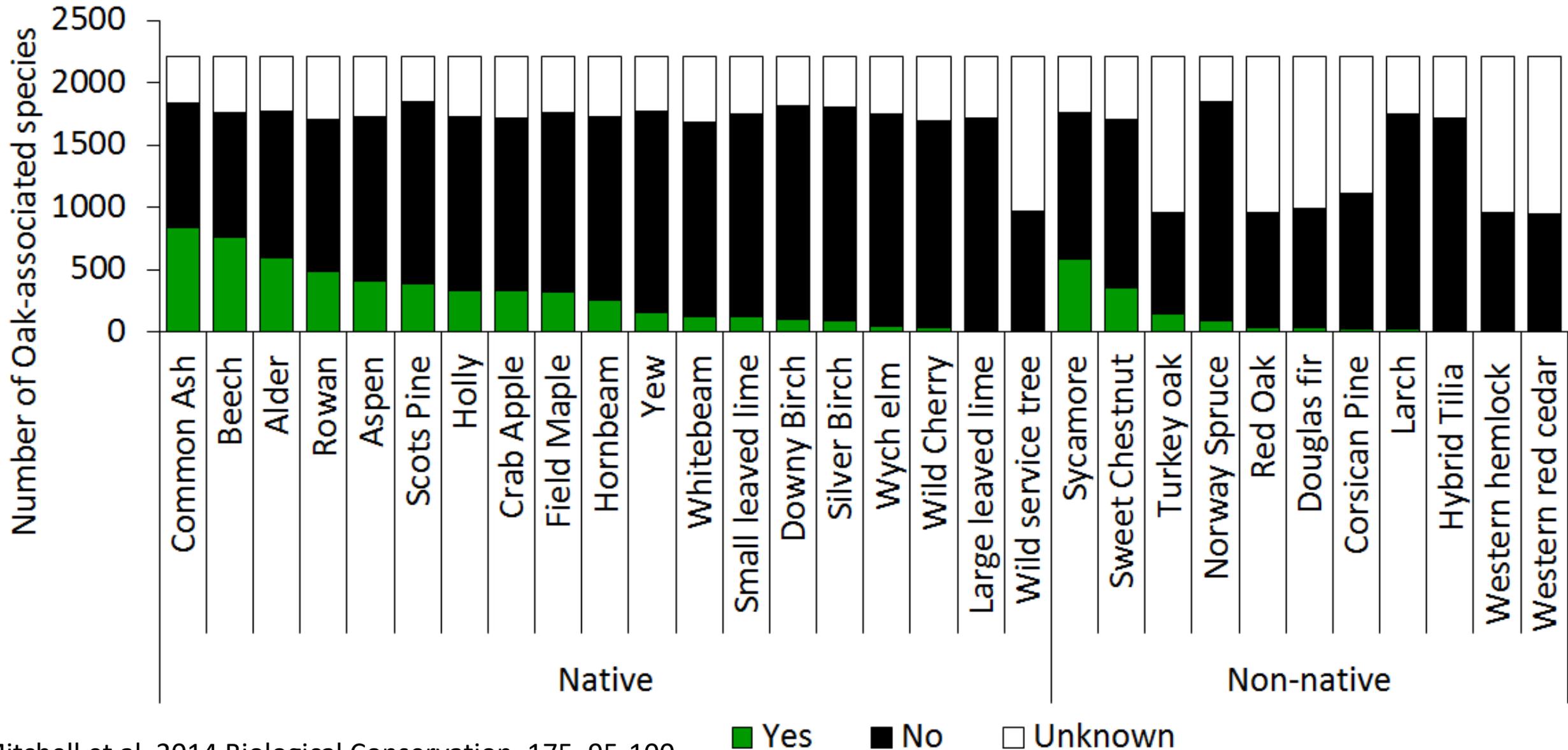
- 30 alternative tree species assessed
- 2300 oak-associated species
- 69000 assessments!



Suitability of other tree species to replace ash



Suitability of other tree species to replace oak



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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, sweet chestnut
- Functions: decomposition,
- Soil temperature,
- Soil: total C and N, mineralizable N and pH
- PCA of data





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Tree species

Functions

Ecosystem services

Common ash ◆

Sycamore ◆

Common Lime ◆

Pedunculate oak ◆
Sessile oak ◆

Sweet chestnut ◆

Beech ◆

Turkey oak ◆
Red oak ◆

Faster decomposition
Higher soil N
Lower soil C
More alkaline soil
Higher soil temperature

**Warmer temperatures
and less climate
regulation.
Faster nutrient cycling.**

Slower decomposition
Lower soil N
Higher soil C
More acid soil
Lower soil temperature

**Cooler temperatures
and greater climate
regulation.
Slower nutrient cycling.**

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AshEcol and OakEcol Databases



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Databases contain:

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

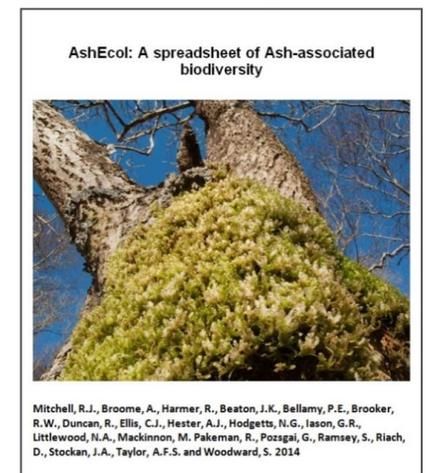
C	D	E	F
Species - English	Tree alternative - Latin	Tree Alternative - English	Association
Mothball Crust	<i>Abies alba</i>	Silver fir	No
Mothball Crust	<i>Acer campestre</i>	Field maple	No
Mothball Crust	<i>Acer platanoides</i>	Norway maple	No
Mothball Crust	<i>Acer pseudoplatanus</i>	Sycamore	No
Mothball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

Databases are:

- User-friendly version for **woodland managers** to assess impact of ash dieback on biodiversity and plan interventions.
- AshEcol Available on Natural England web site

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

- OakEcol available at: <https://www.hutton.ac.uk/oak-decline>

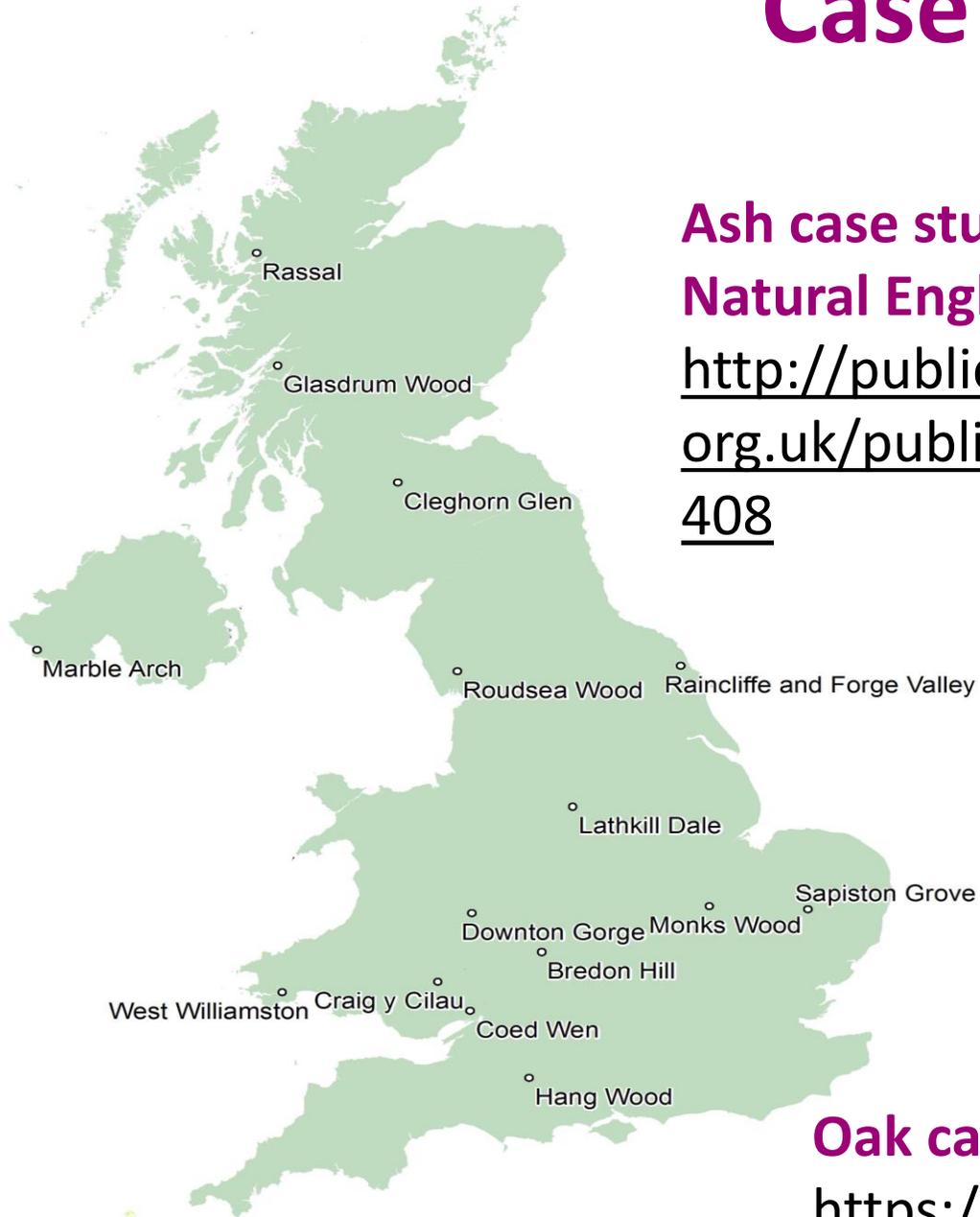


Impact assessment and management response

1. Assess biodiversity potentially present
2. Short list ash/oak-associated species for conservation – using **AshEcol/OakEcol** databases
3. Identify alternative trees and shrub species are needed to maintain these – using **AshEcol/OakEcol** databases
4. Assess site – which alternative trees are present?
5. Determine management



15 ash woodlands

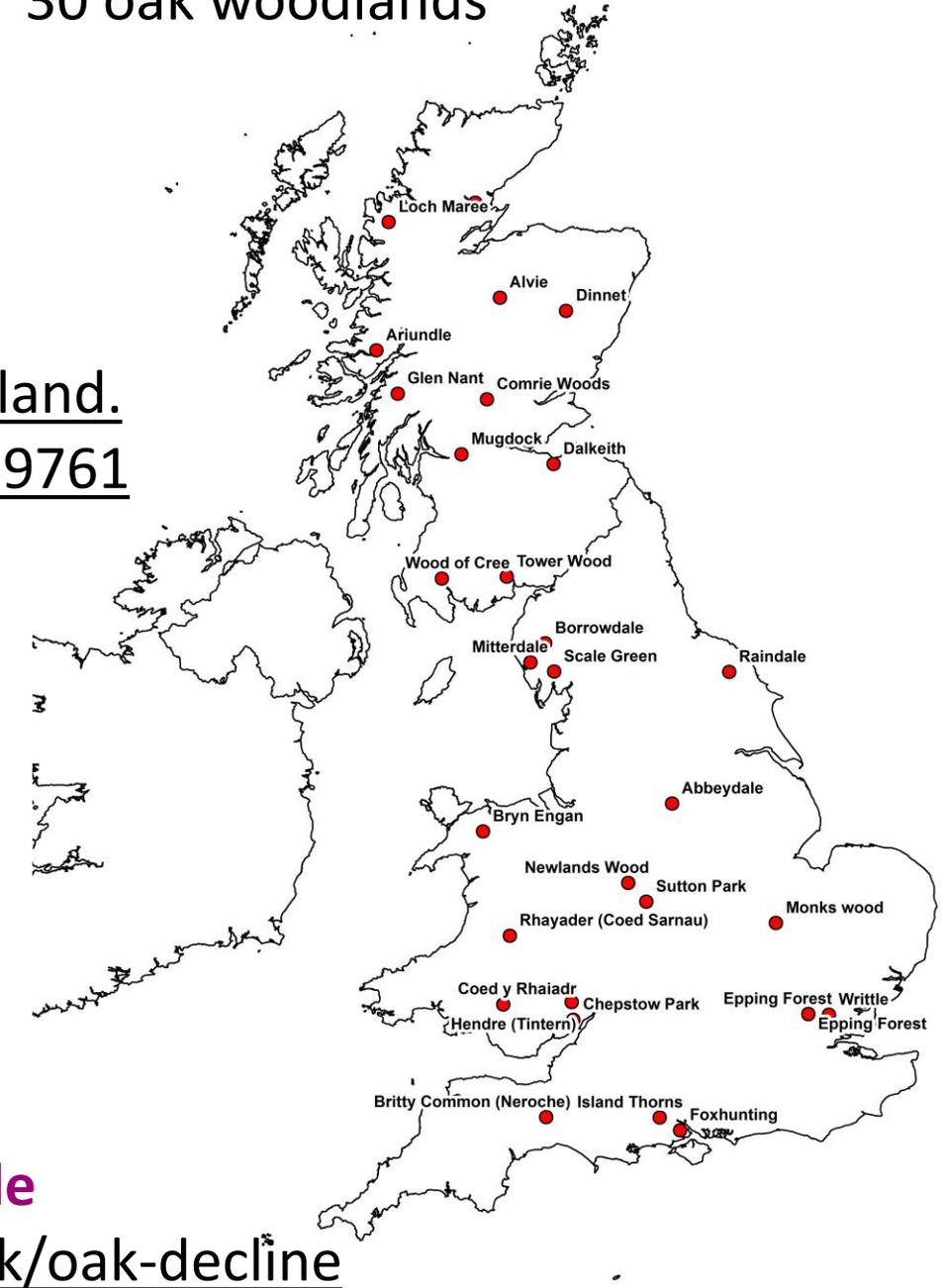


Case studies

**Ash case studies available on
Natural England website**

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

30 oak woodlands

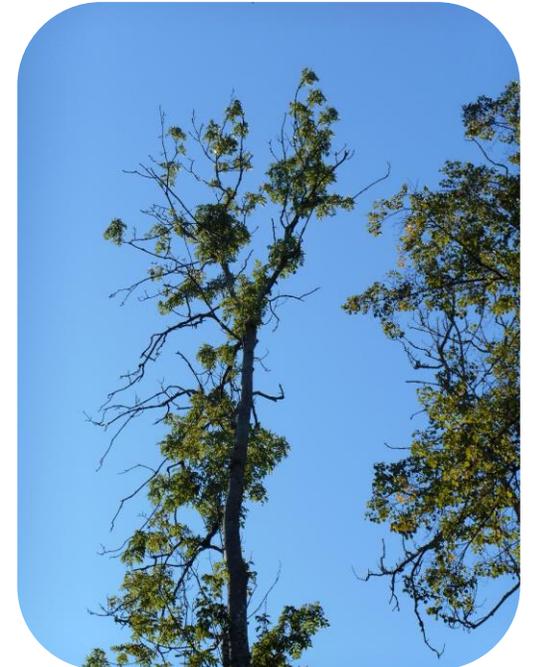


Oak case studies available

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

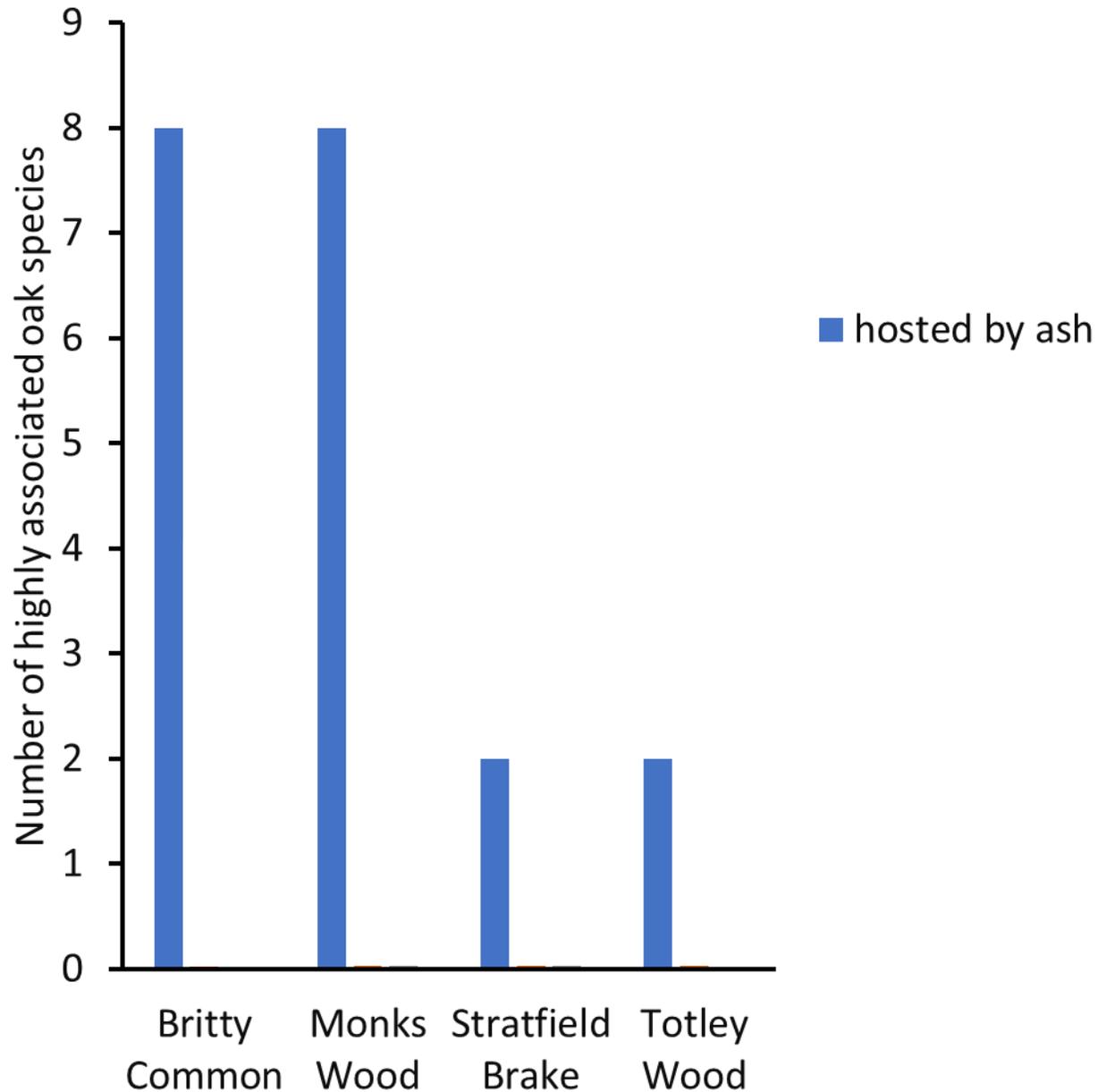
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The impact of loosing oak and ash

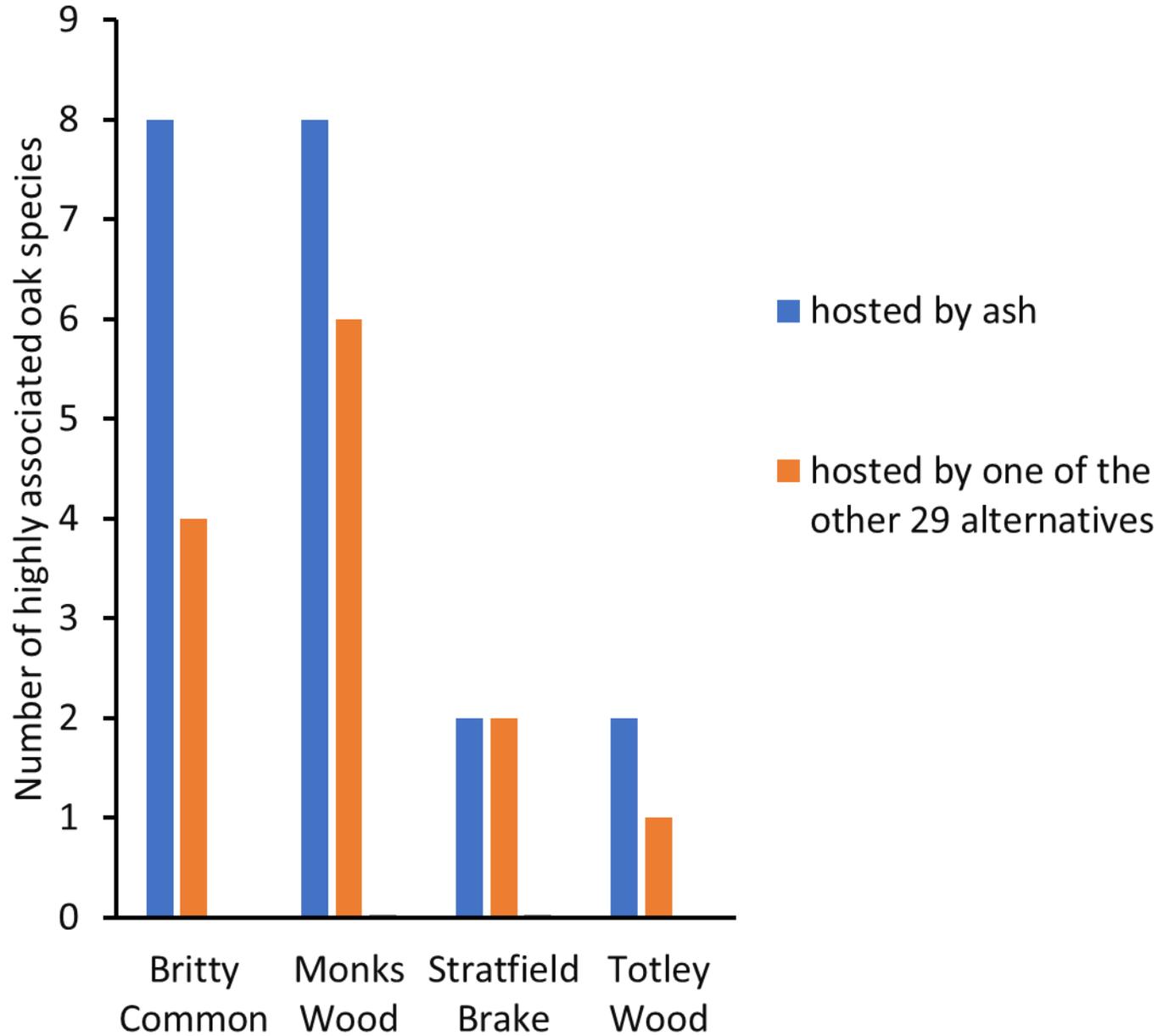


- 4 example sites with oak and ash
- Species data from NBN
- No. of highly associated oak species that are also hosted by ash calculated

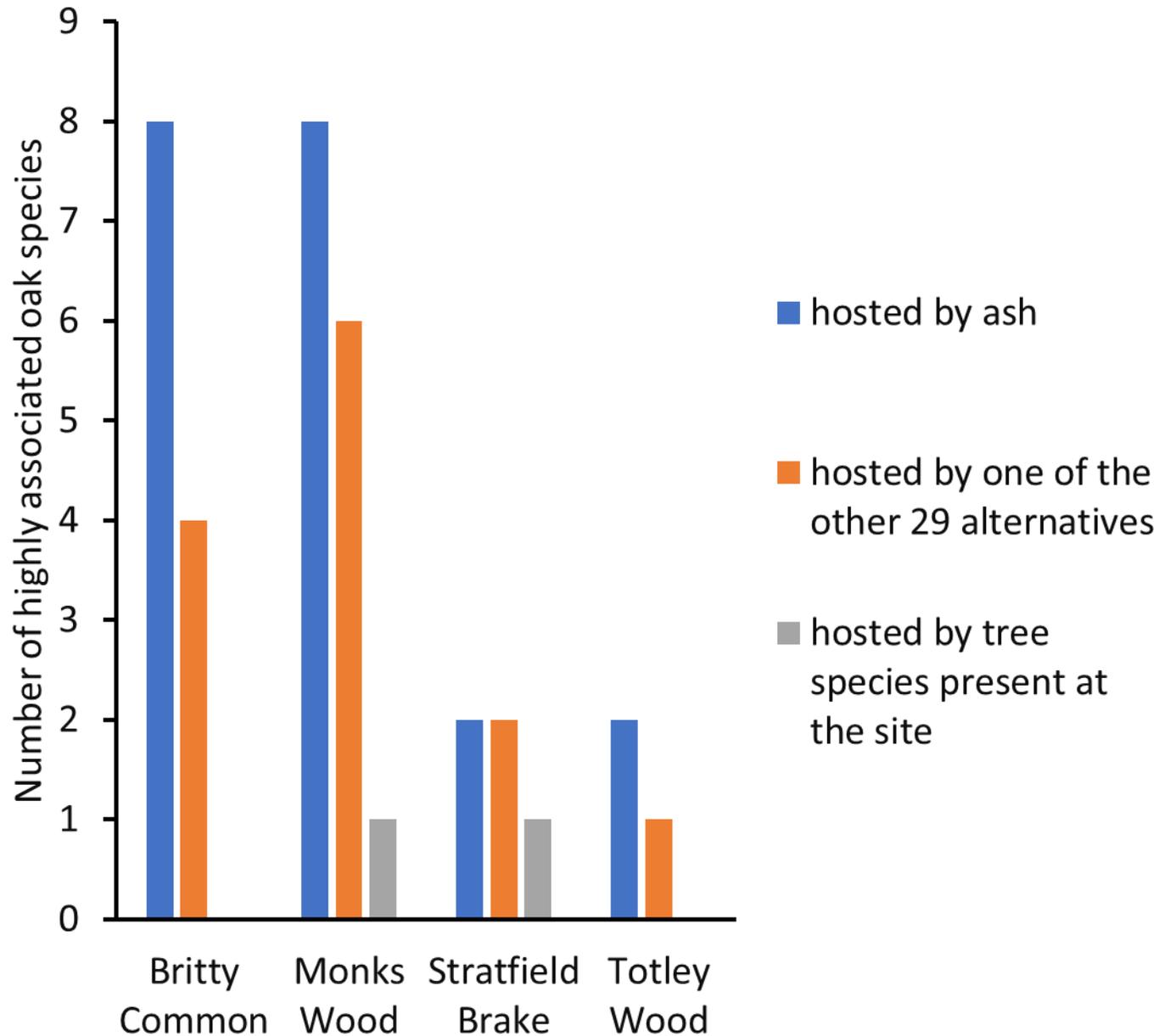
The impact of loosing oak and ash



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The impact of loosing oak and ash



Number of species lost will increase if oak and ash lost

More species may be hosted on a site if tree species diversity increased – but is this desirable?

Summary

- 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:

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- NE
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- DEFRA