Dr David Lonsdale,
consultant

Keith Sacre,
Barcham Trees

Lessons from pests in the past; prospects for the future

Part 1

- Learning from the history of introduced pests: biological principles illustrated by examples

- Known threats to the UK’s trees: a few examples

Pest: definition (Collins Dictionary)

- any organism that damages crops, injures or irritates livestock or man, or reduces the fertility of land

Other possible definitions of a pest:

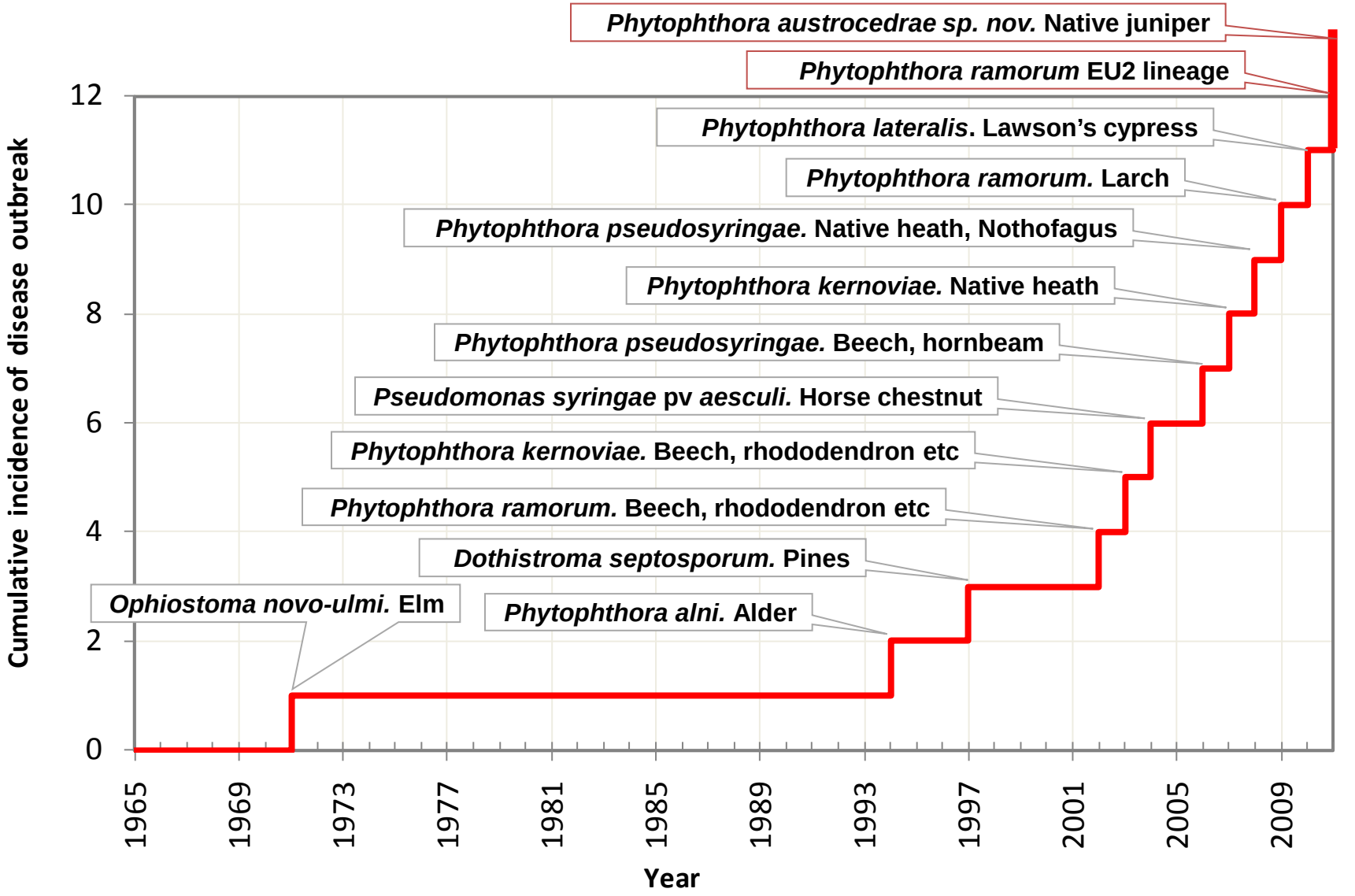
- an organism that harms human interests simply because of its normal behaviour on its native host species

- an organism that causes significant harm in response to altered circumstances

How might an organism become a pest?

- Unusual lack of natural enemies
- Super-abundance of the natural host species (owing to human influence)
- Availability of a new host species (hence, lack of previous co-evolution)
- Genetic change (e.g. mutation, gene recombination) or hybridisation
- New or altered environmental conditions

New tree disease outbreaks UK 1970-2011



Forest Research

Examples of pests currently in the UK, as illustrations of biological principles

Dutch elm disease, caused by *Ophiostoma novo-ulmi*

Dutch elm disease: aggressive form

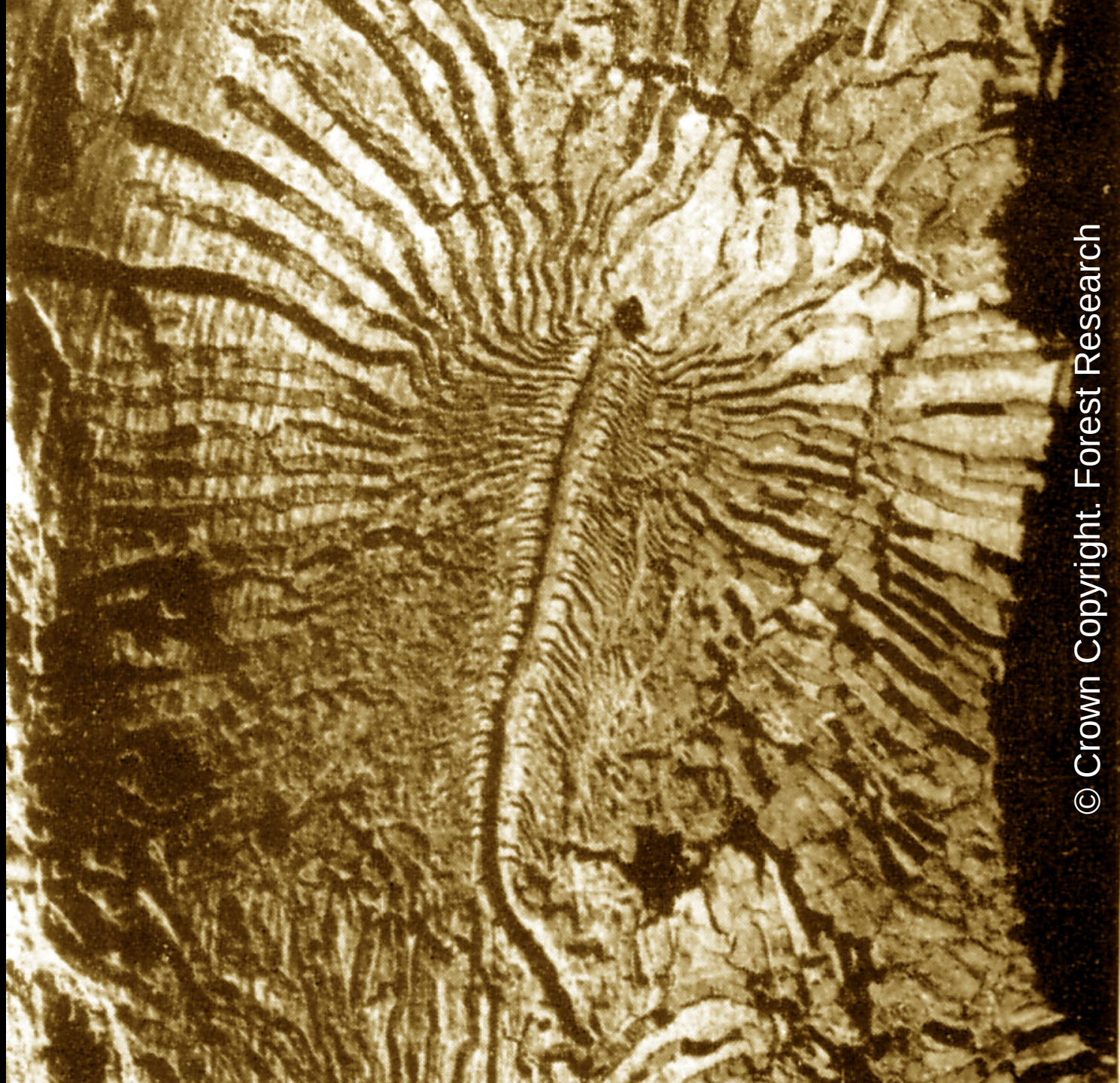
- The causal fungus *Ophiostoma novo-ulmi* arose by hybridisation and was later introduced into the UK with N. American log imports.

- The less aggressive *O. ulmi* already occurred in the UK. Before its introduction into the UK, *O. novo-ulmi* was not recognised as a new species. (“in effect, a “**wolf in sheep’s clothing**”).

- English elm is highly susceptible and is genetically uniform.

- The fungus is spread by readily available insect vectors.

Larval galleries of *Scolytus scolytus*, the main vector of the Dutch elm disease fungus in the UK



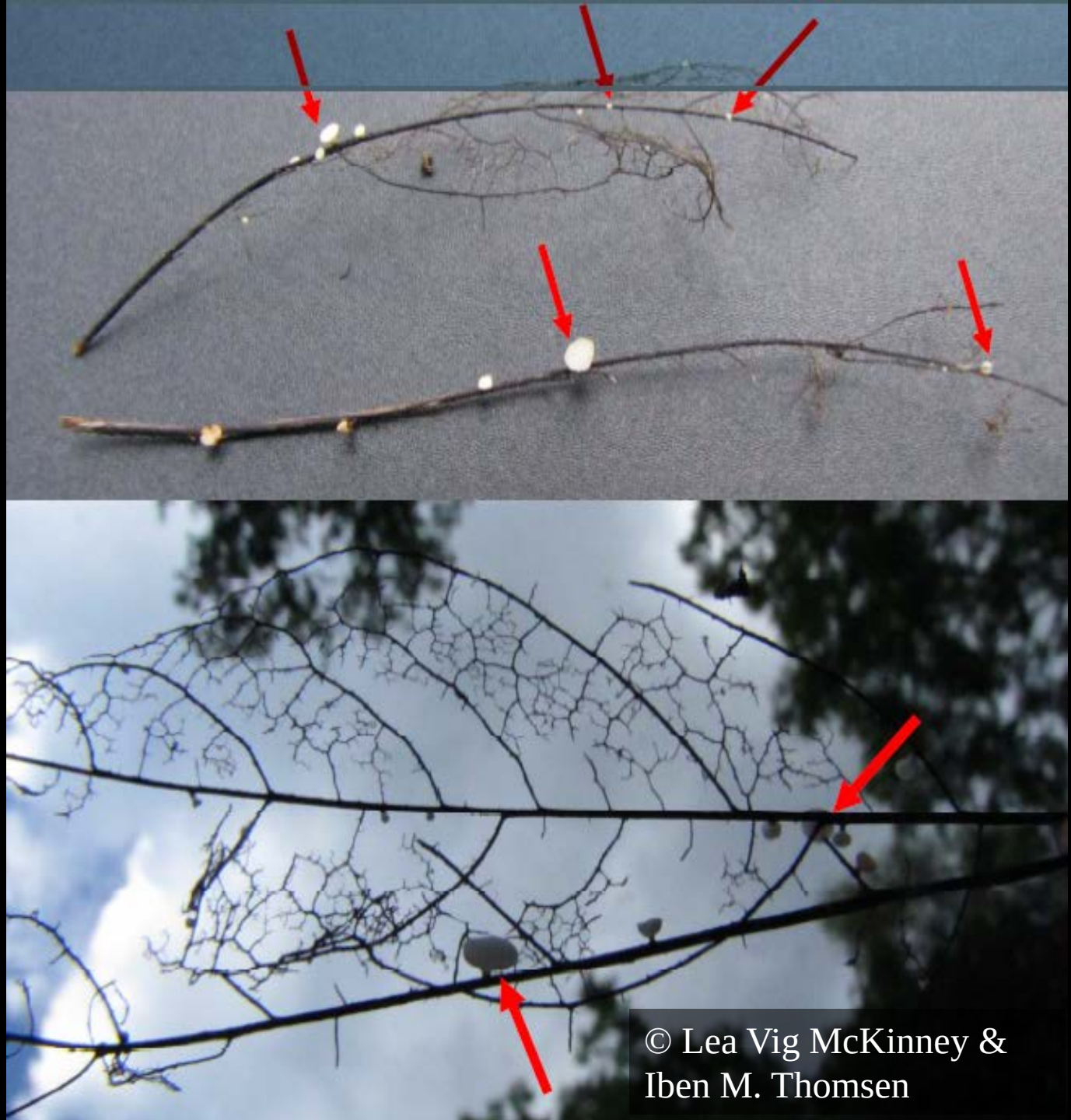
Ash dieback, caused by *Hymenoscyphus fraxinea* (aka *Chalara*): another "wolf in sheep's clothing"

- The causal fungus co-evolved with Asiatic species of *Fraxinus* and causes them no harm.
- At first, the fungus was not recognised as 'new'. It resembles *Hymenoscyphus albidus*, which has co-evolved with European *Fraxinus* spp. as a harmless endophyte.
- First occurrence in Europe was c. 1992 in the Baltic region.
- Airborne dispersal has led to colonisation of most of northern and central Europe.

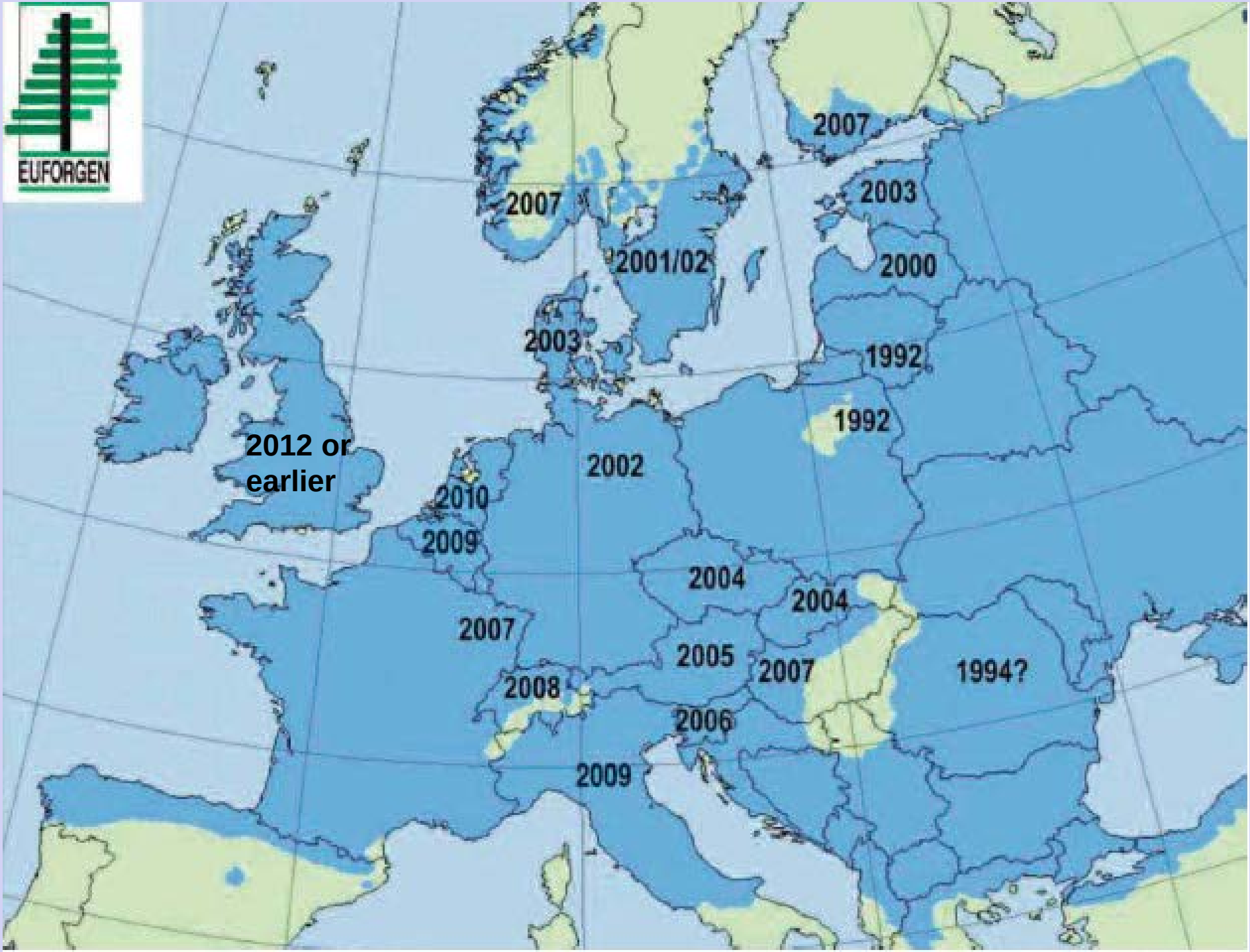
Photo: Thomas Kirisits

Hymenoscyphus albidus (*Chalara fraxinea*): fruit bodies of this non-pathogenic fungus on petioles of *Fraxinus excelsior.*

The related *H. fraxineus* grows from the leaves into the woody branches, causing dieback.



Ash dieback: lesion in bark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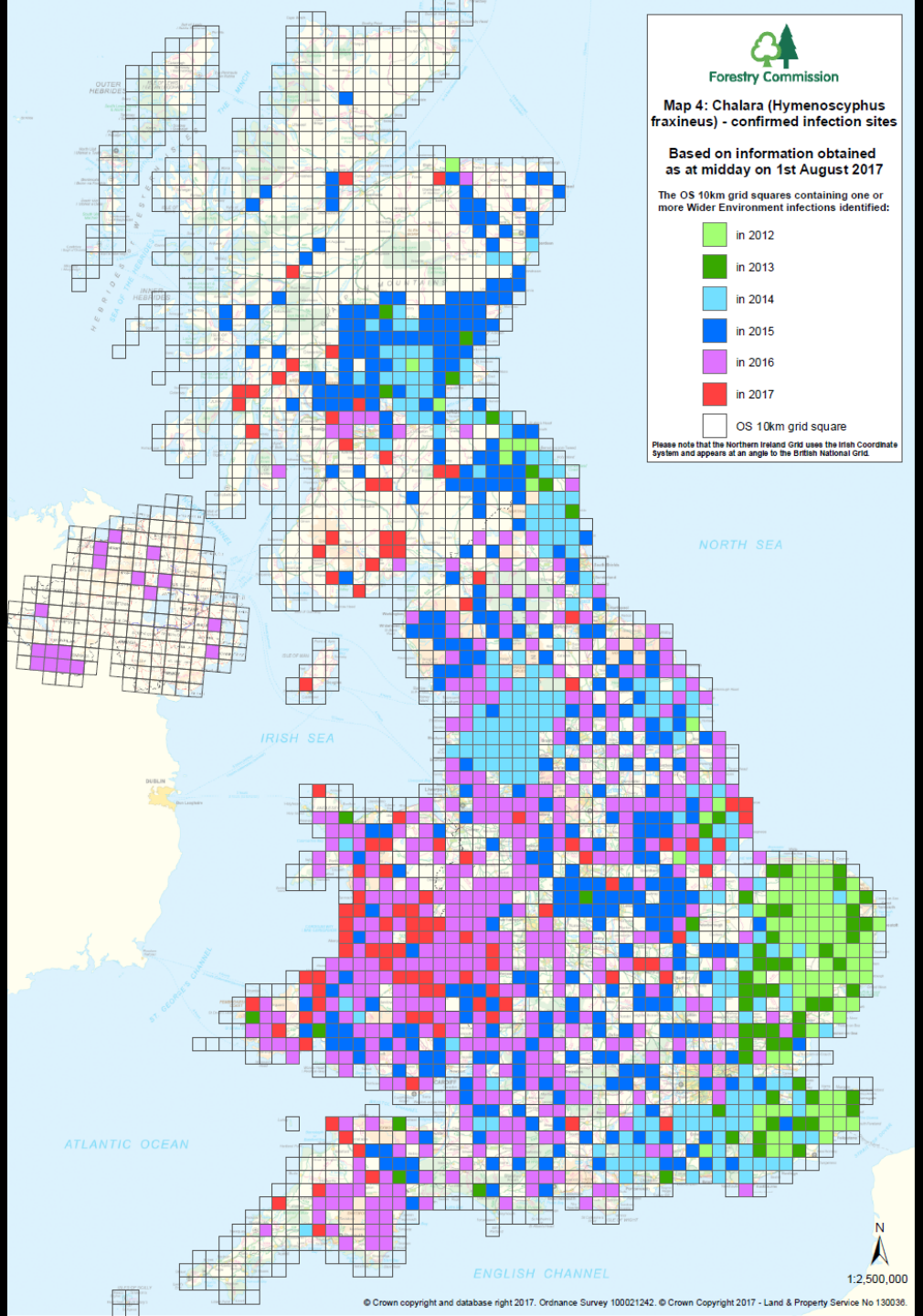
Ash dieback in Great Britain: Forestry Commission survey data



Beech bark disease in North America

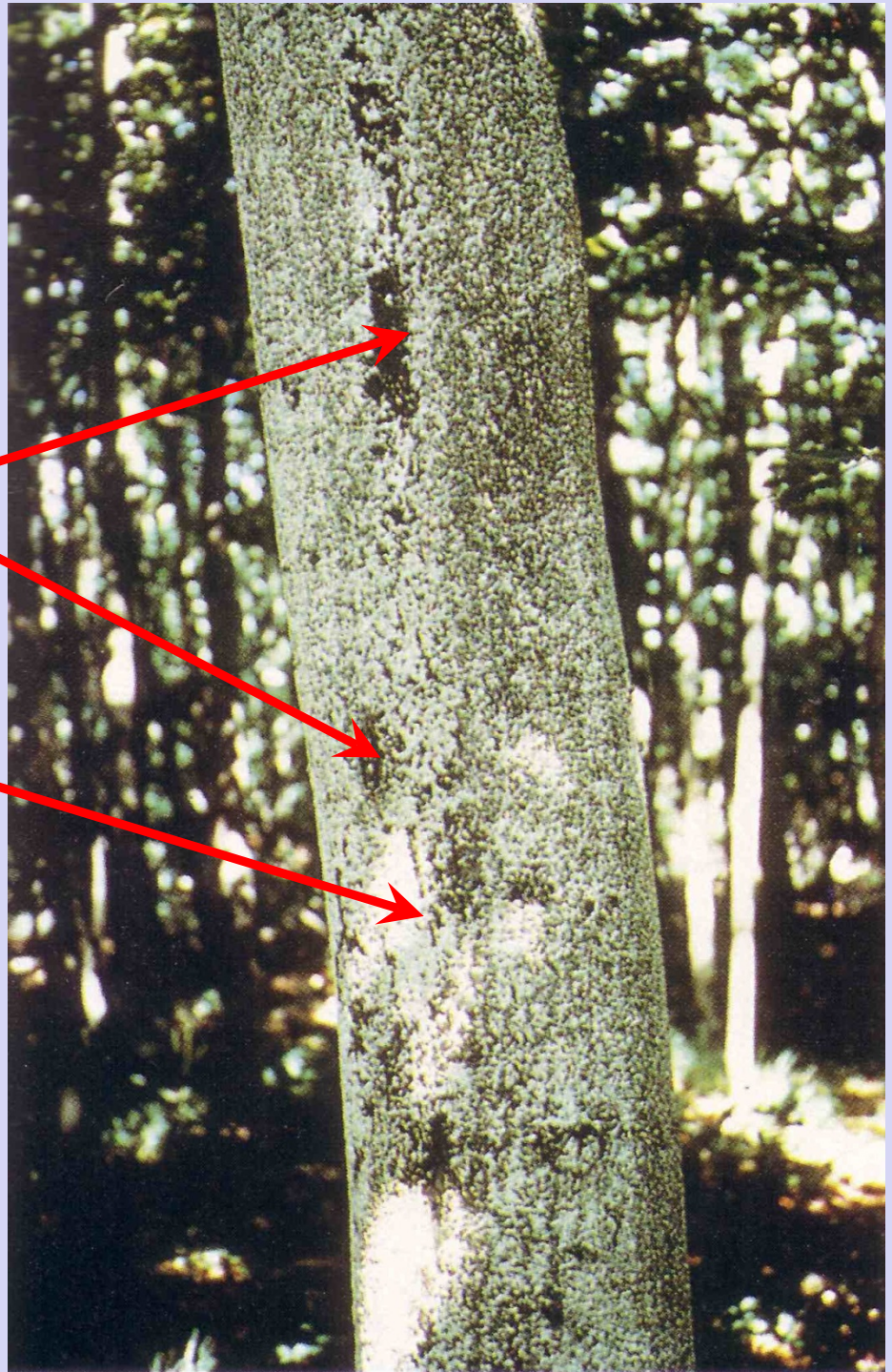
Cryptococcus fagisuga, native to the UK and much of Europe, was introduced to N. America and transformed a hitherto unknown American fungus, *Neonectria faginata*, into a major pest.

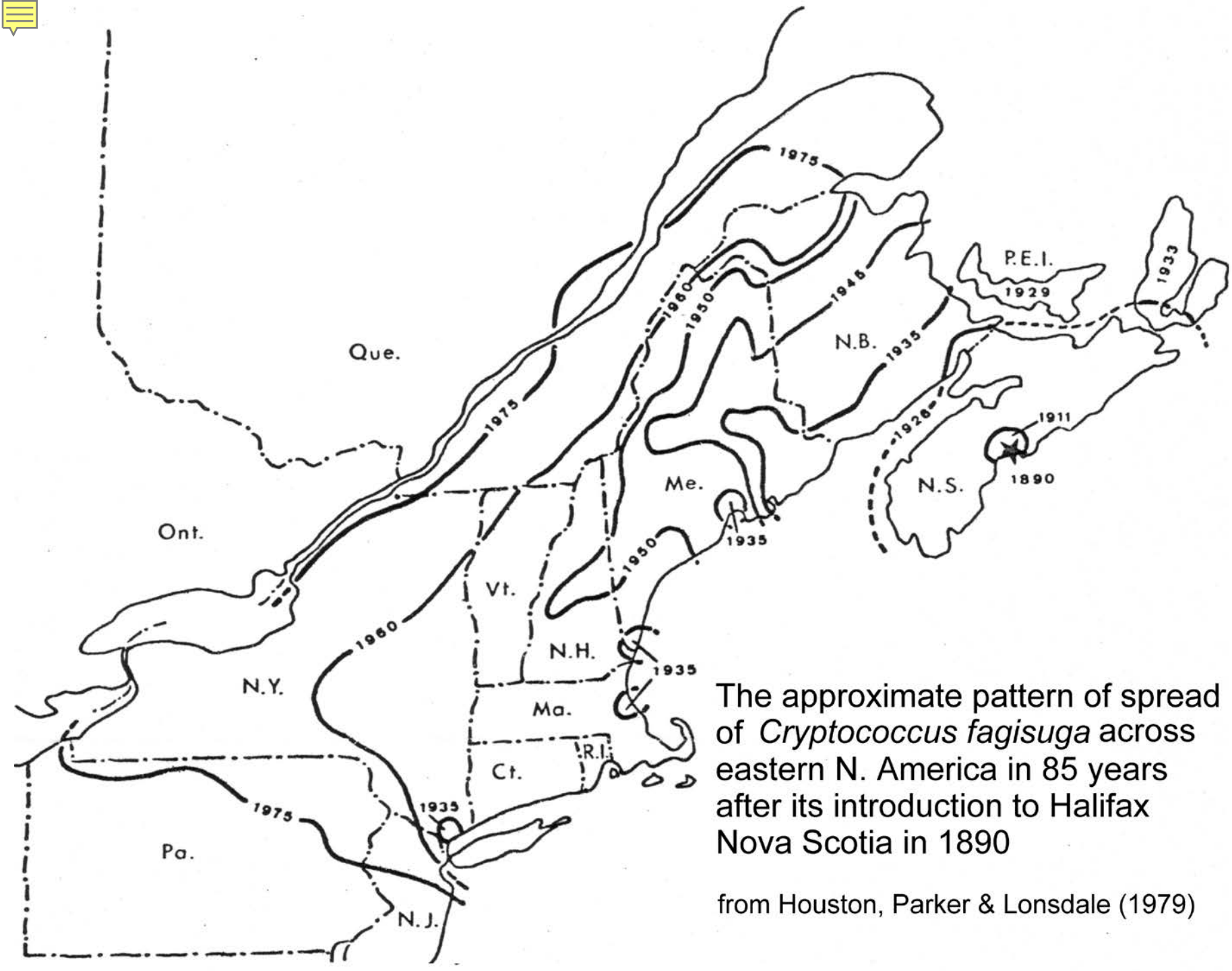
Beech bark disease

Tarry exudations from areas of bark killed by a fungus (*Neonectria* sp.)

Beech scale insect *Cryptococcus fagisuga* (shown by its white, waxy secretion): more aggressive on *Fagus grandifolia* than on *F. sylvatica*

In N. America, the fungus *Neonectria faginata* was unknown before it was activated as a pest by the introduction of *C. fagisuga*





The approximate pattern of spread of *Cryptococcus fagisuga* across eastern N. America in 85 years after its introduction to Halifax Nova Scotia in 1890

from Houston, Parker & Lonsdale (1979)

Gypsy moth *Lymantria dispar*

- Native to Eurasia
- Periodic outbreaks of this insect are normal
- Very wide range of host tree species
- Very severe outbreaks in N. America, following accidental release c. 1869

American sweet chestnut, *Castanea dentata*: 19th century. Now very rare as a large tree, owing to sweet chestnut blight

another example of an introduced organism causing severe harm to a host species with which it has not co-evolved

Sweet chestnut blight

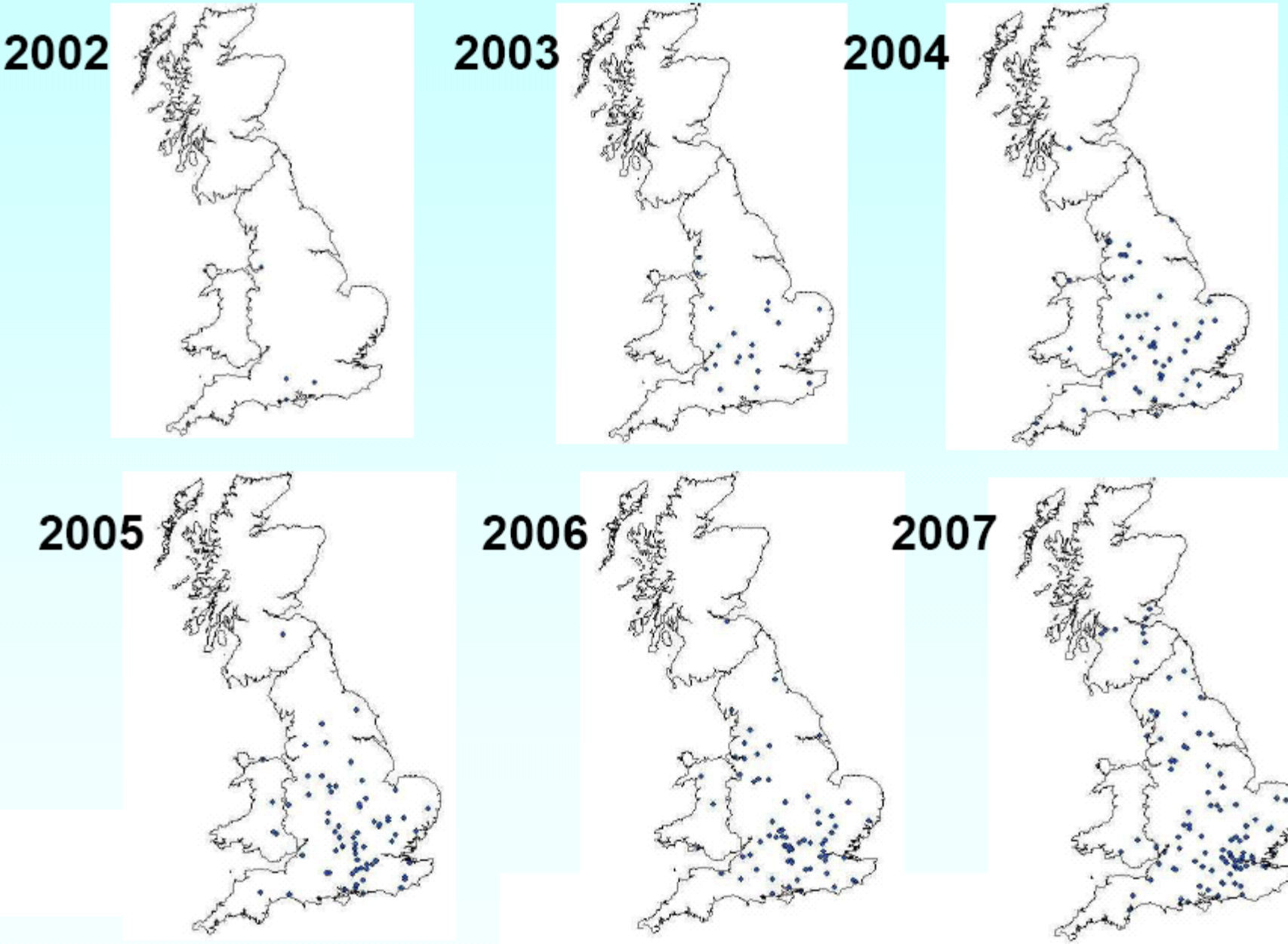
The causal fungus *Cryphonectria parasitica* is thought to have co-evolved with Asiatic species of *Castanea.* The American and European species of sweet chestnut are more susceptible.

An example of a new disease, caused by a previously unknown bacterium

Bleeding canker of *Aesculus hippocastanum.* The bacterium *Pseudomonas syringae* pv. *aesculi* previously caused only a leaf-spot on *A. indica.*

- Originally not recognised as a new disease: symptoms resemble those induced by *Phytophthora* spp.

Rapid spread: Forest Research UK data - HC bleeding canker



Phytophthora ramorum, killing Coast live oak in California. *Phytophthora* spp. typically have a wide host range and are very easily spread

Phytophthora ramorum: exudations from areas of dead bark

Photo: Joseph OBrien, USDA Forest Service, Bugwwood.org

General killing of soft tissue by *Phytophthora ramorum* in shoot of Douglas fir

Phytophthora ramorum spreading on Larch plantations, SW England, Autumn 2009

Slide, courtesy of Prof. Clive Brasier

defoliating mature larch

young larch

larch bleeding stem lesions

Examples of known pests that could reach the UK

Emerald ash borer *Agrilus planipennis:* lack of co-evolution is a factor in its aggressiveness outside E. Asia

Emerald Ash borer *Agrilus planipennis*

- Believed to have arrived in N. America on timber pallets. Cost already runs into $ billions. Also introduced into Russia west of the Urals.

- Co-evolved with east Asiatic *Fraxinus* spp. which are not seriously harmed

- Resistance is mostly lacking in American and European *Fraxinus* spp.

- Mated females may be able to fly more than 10 km

Oak wilt (*Ceratocystis fagacearum*): general symptoms

Canker stain of London plane, caused by *Ceratocystis platani*; which is thought to have co-evolved with *Platanus occidentalis* in N. America. Its Introduction to Europe has led to serious mortality in *P. x acerifolia*

Xylella fastidiosa: severe leaf scorch on *Quercus* sp. in Florida, USA

Xylella fastidiosa: a xylem-limited fastidious bacterium

- cause of bacterial leaf scorch with many host species: some lethally affected, including *Olea europea*
- vectors are sucking insects, especially leafhoppers
- known since the 1970s in the Americas (previously mistaken for Rickettsia-like organisms; found in SE and SW Asia in the 1990s and in S. Europe in 2013
- several strains are known, one of which is probably capable of causing disease in northern Europe
- now causing a devastating disease in Italian olive groves
- eradication is being attempted in Italy, Corsica and the southern French mainland (different subspecies).

Philaenus spumarius: a vector of *Xylella fastidiosa* in Italian olive groves. This froghopper is common in the UK

Plant Pathology (2008) **57**, 792–808 Doi: 10.1111/j.1365-3059.2008.01886.x

LETTER TO THE EDITOR

The biosecurity threat to the UK and global environment from international trade in plants

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Native plant communities, woodlands and landscapes in the UK and across the world are suffering from pathogens introduced by human activities. Many of these pathogens arrive on or with living plants. The potential for damage in the future may be large, but current international regulations aimed at reducing the risks take insufficient account of scientific evidence and, in practice, are often highly inadequate. In this Letter I outline the problems and discuss some possible approaches to reducing the threats.

Keywords: biosecurity, forests, invasive pathogens, natural ecosystems, plant diseases, plant health

Brasier (2008): quotations

Plant passports and certificates

"Examples of consignments of trees or ornamentals arriving in the UK having a 'pest-free' export certificate but, nonetheless, being visibly infested with pests are becoming all too frequent."

For semi-mature and mature trees and shrubs

"prohibition would seem the wisest approach."

For more regular plant consignments

"limit the level of plant imports to the minimum necessary for subsequent propagation … importing small parcels of juvenile plant material [surface treated seed, tissue culture, unrooted cuttings, or small numbers of rooted plants] under licence … rigorous quarantine testing before release" …..

Protective systems: pros and cons

Plant passports and certification schemes

- Further failures seem inevitable, at least for cryptic or latent pests.

Port and other site inspections (potentially with the aid of rapid diagnostic methods)

- Human resources are limited.
- Latent and cryptic infection / infestation can go undetected.

UK Plant Health Risk Register (with Rapid Pest Risk Analyses)

- An excellent summary of information, with risk assessments
- Pathways of introduction are taken into account but the regulations deal with **individual organisms**; **not with the pathways**
- Includes only **known pests; not the UNKNOWN**

Sentinel plantings in exporting countries

- An excellent scheme with potential to discover ‘new pests’ but limited to particular host tree species planted as sentinels in particular geographic regions
- Does not, in itself, take account of climate in importing countries
- Too early to assess effectiveness in detecting “new” pests

BIOSECURITY A Nursery Grown Response

Arboricultural Association Conference. Exeter University. 2017

Problems with imported pest and disease:
HERE NOW.....

Horse Chestnut Leaf Miner

Oak Processionay Moth

Chalara

Massaria

On their way perhaps

Asian long horned beetle

Emerald Ash Borer

Ceratocystis fimbriata

Biosecurity

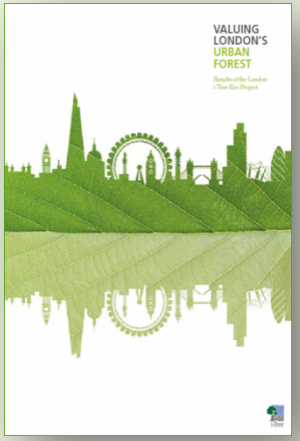
The impact of just three of these should they arrive in London

Asian long horn beetle

Emerald Ash Borer

Plane wilt

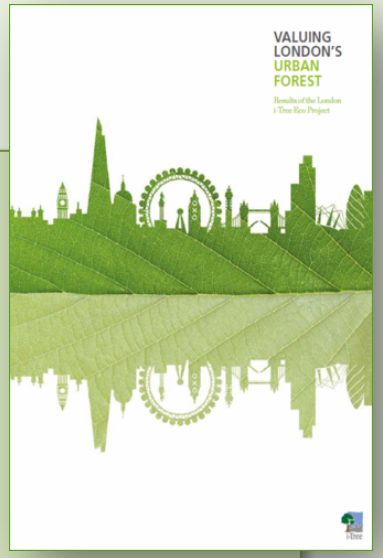
And the cost: ..... **TO LONDON**



Asian Longhorn Beetle

- *Acer spp*
- *Aesculus*
- *Albizia*
- *Alnus*
- *Betula*
- *Carpinus spp*
- *Cercidiphyllum*
- *Corylus spp*
- *Fagus spp*
- *Fraxinus spp*
- *Koelreutaria*
- *Platanus*
- *Populus*
- *Prunus*
- *Robinia*
- *Salix spp*
- *Sophora*
- *Sorbus spp*
- *Quercus palustris*
- *Quercus rubra*
- *Ulmus spp*

Asian Longhorn Beetle:



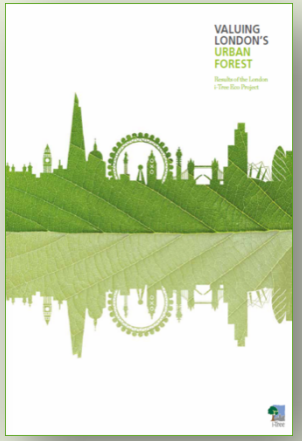
Could impact on some 3.8 million trees

Which represents 31% of the whole population

Replacing these trees would cost

£23 billion

Ash



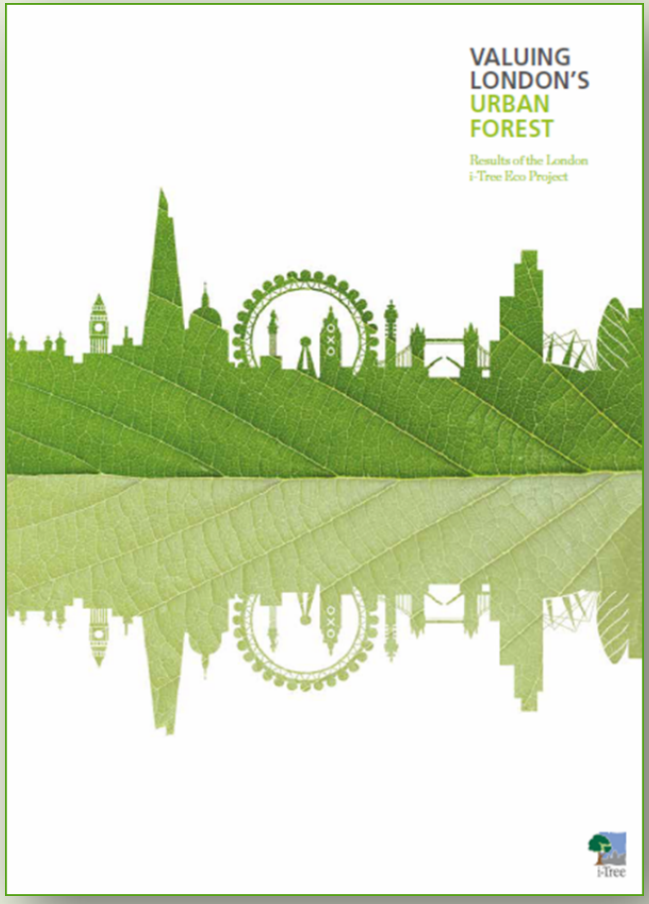
Emerald Ash Borer

Ash

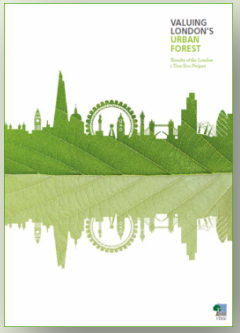
374,195 trees

59763km² leaf area

6358 mt leaf biomass



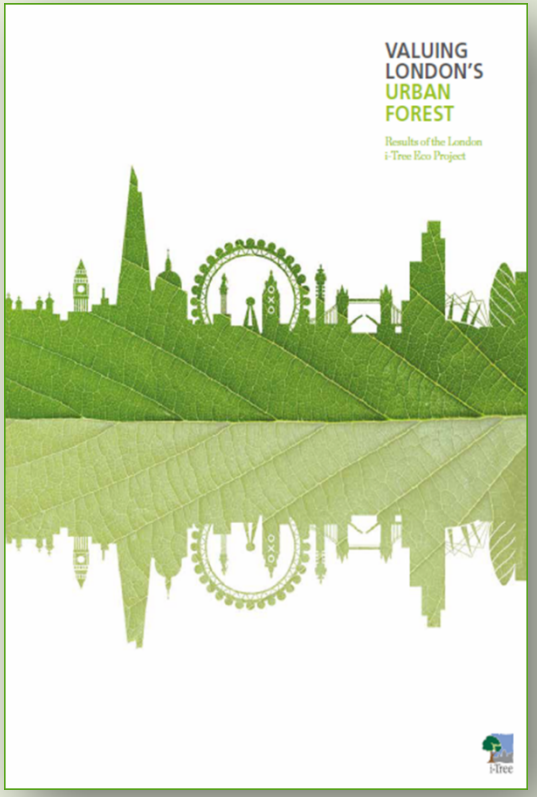
Replacement cost: £447,345,251.00



London Plane:

Plane Wilt

Ceratocystis fimbriata f platani



London Plane:

121,000 trees

40,224 km² leaf area

1756 mt leaf biomass

8.9% of the canopy cover in inner London

2.5% of the canopy cover in outer London

Replacement cost: £351,623,660.00

Some of the others on mainland Europe

Pinewood Nematode (Bursaphelenchus xylophilus)
Oriental Gall Wasp (Dryocosmus kuriphilus)
Red Necked Longhorn (Aromia bungii)
Plane Canker (Ceratocystis fimbriata f. sp. platani)
Sweet Chestnut Canker (*Cryphonectria parasitica*)
Pine Processionary Moth (Thaumetopoea pityocampa)
Elm Yellows (Elm Yellows phytoplasma)
Apple Root Knot Nematode (*Meloidogyne mali)*
Ambosia Beetle (*Megaplatypus mutatus)*
Emerald Ash Borer (Agrilus planipennis)

Problems for the tree nursery:

There is a constant demand for as wider species range as possible.

It is also recognised that resilience is achieved through species diversity

Celtis australis

Lagerstroemia indica

Broussonetia papyrifera

Aesculus turbinata

Alnus hirsuta var Siberica

Chionanthus retusus

***Carya ovata*:**

Halesia carolina

Idesia polycarpa

Tree Population Resilience

We need a diversity of trees in our urban forests to guard against disasters like Dutch Elm disease but also to put the right tree in the right place as the evolution of our cities and suburbs creates new settings for tree planting

Frank Santamour 1990

So there is a conflict:

The need for bio-security.
The need for tree nurseries to supply a wide range of species and cultivars which inevitably involves imports from across the world.

The need to use the widest range of species and cultivars in our cities to provide resilience against pest and disease.

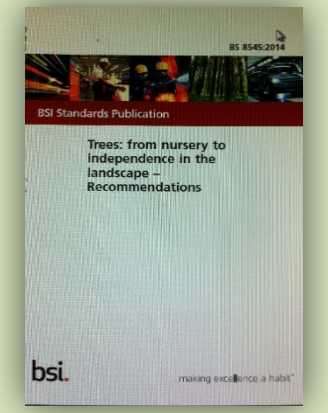
A total uncertainty as to annual demand for trees.

Current system not working effectively
historically slow response to threat
lots more pests and diseases could arrive

Big changes to come both at UK and EC level
DEFRA committed to implement actions

Looking to implement all before 2018

BS 8545 Trees from Nursery to Independence In the Landscape: Published February 2014.



The clause which didn't get in.

8.6.1 Bio-security is an important consideration. To minimize the risk of pests and or diseases being imported directly into the UK, all young trees produced abroad but purchased for transplanting should spend at least one full growing season on a UK nursery and be subjected to a full pest and disease control programme.

8.6.2 Evidence of this control programme, together with a comprehensive audit trail of when imported trees were received and how long they have been on the nursery, should be obtained from the supplying nursery. The audit trail should extend beyond the nursery after dispatch, allowing for full recall in the event that any pest and/or disease problems manifest themselves in the landscape.

Not much help there then……..

But each of us either buys or produces trees so

why look elsewhere for someone else to take responsibility ?

A personal view:

It is an illusion that UK nurseries are going to be able to be self sufficient in supplying the requirements of a modern urban forest agenda, in the foreseeable future, without imports.

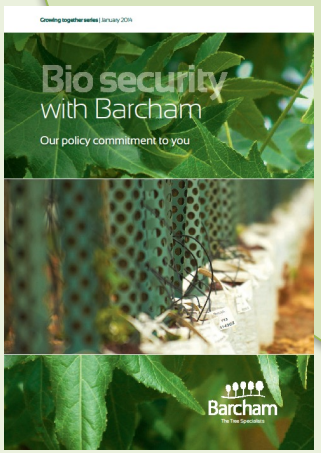
What is needed is a honest approach from all those involved in the production, procurement, planting and management of young trees.

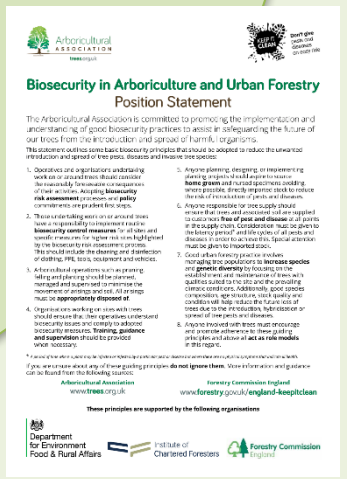
A move away from 'lip service' towards changed working practices.

The current discourse needs to change which means a fundamental change of behaviour

Do NOT supply, purchase or plant imported trees directly into the UK environment.

QUARANTINE.





And so what can you contribute towards increased biosecurity ?

Thanks for listening