

The environmental risk assessment of plant pests

The Unit for Risk Assessment of Plant Pests  
Swedish University of Agricultural Sciences  
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# The assessment of risk to ecosystem services from introduced tree pests and pathogens and mitigation actions – the UK experience.

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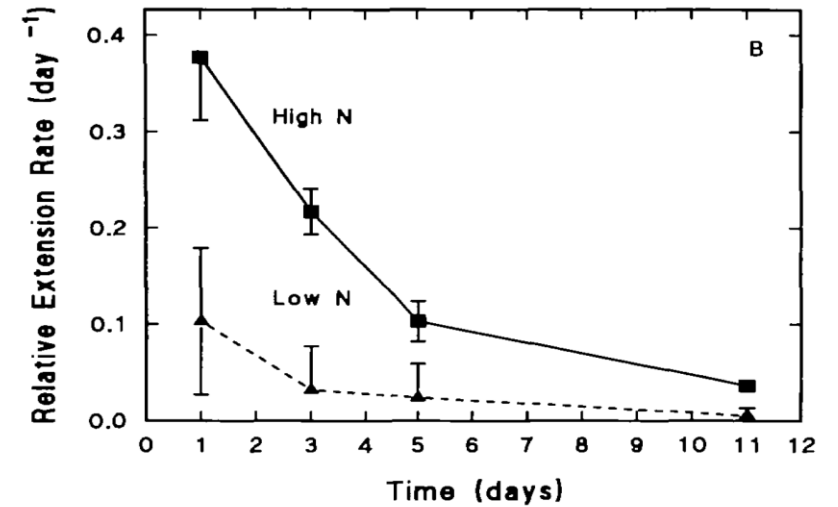
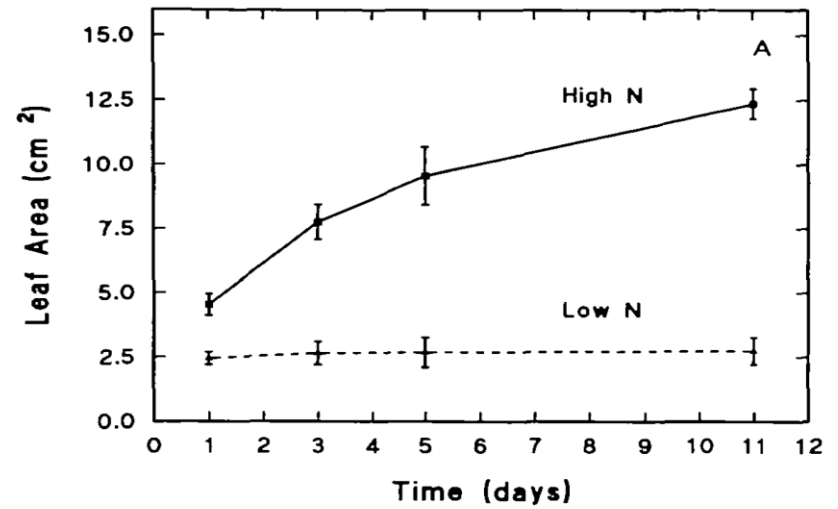
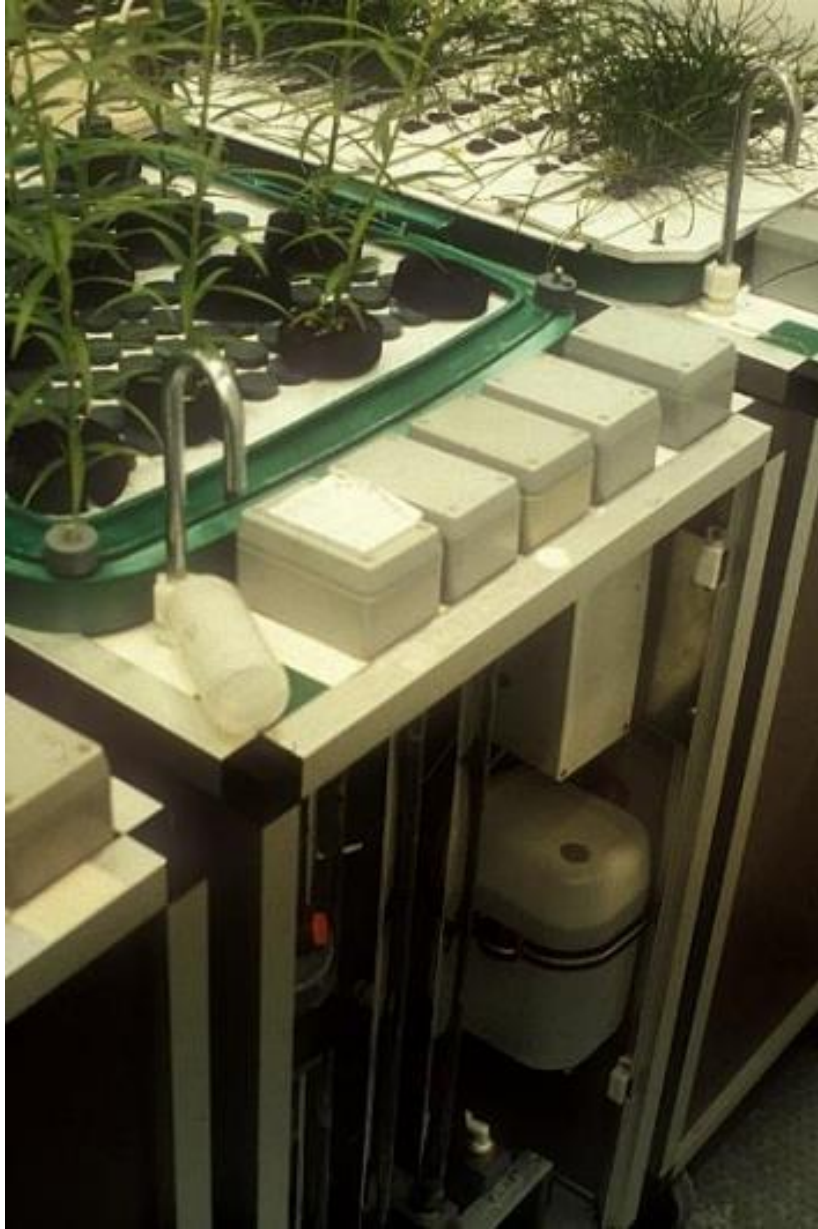


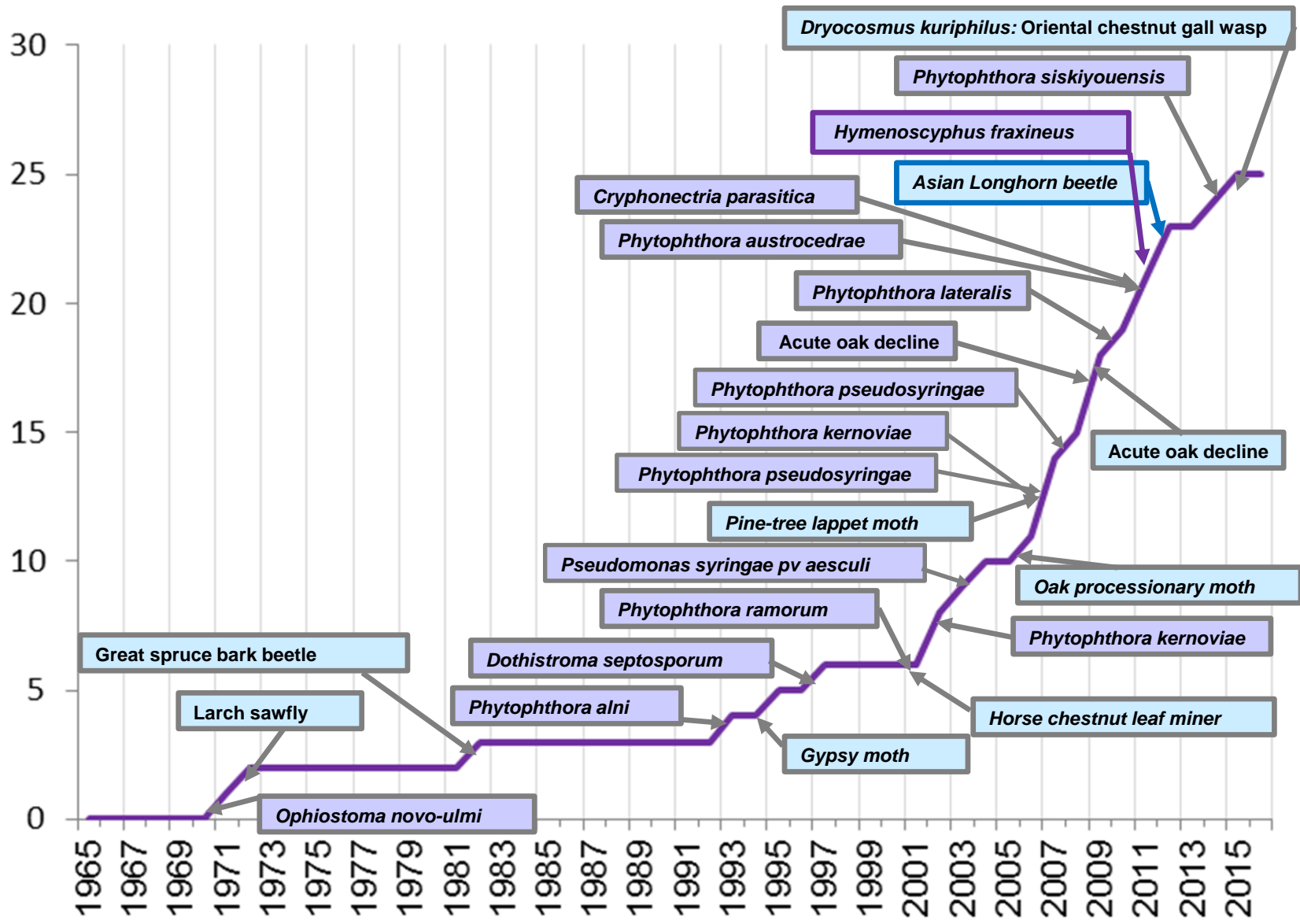
FIG. 1. Leaf area development (A) and relative rate of leaf extension (B) for plants grown in optimum (*High N*) or sub-optimum (*Low N*) nitrogen treatments. Four plants were harvested from each treatment

Taylor, McDonald, Stadenburg & Freer-Smith 1992 J of Experimental Botany 44 155-165

# The assessment of risk to ecosystem services from introduced tree pests and pathogens and mitigation actions – the UK experience.

- Evidence on the increasing risk from plant pests & diseases - trees and agriculture
- A short update on “top 5” current UK tree pests and diseases
- The impacts of tree pests and diseases on the ecosystem services provided by forests, woodlands and urban trees
- Ongoing actions and achieving more equitable cost sharing
- Future research objectives.

Cumulative no of new pathogens & pests in UK – modified from Freer-Smith & Webber 2015



Increasing numbers of forest pests & pathogens

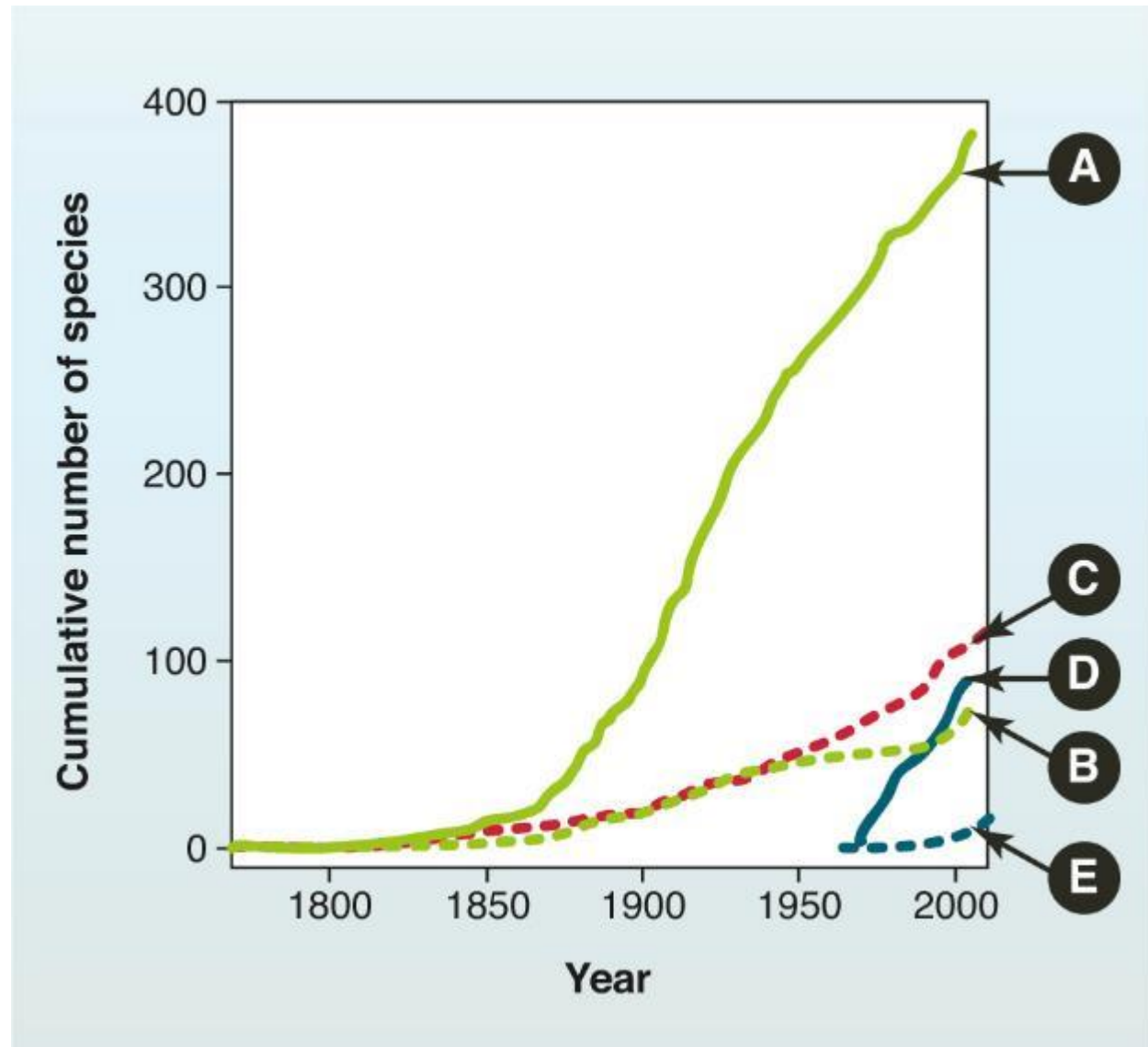
**A** – non-native insects in USA

**B** – 'high impact' non native pests & pathogens in USA (Aukema et al 2010 Bioscience 60, 886-897)

**C** – non-native pathogens in Europe

**D** – non-native invertebrates plant pests in UK

**E** – non-native pests & pathogens in UK.



**Boyd, Freer-Smith, Gilligan & Godfray 2013 'The Consequence of tree pests and diseases for Ecosystem Services' Science 342, 1235773**

# UK Plant Health Risk register

<https://secure.fera.defra.gov.uk/phiw/riskRegister/>

Has over 700 entries each with a risk assessment.

Risk ratings are allocated by assigning a value for **likelihood** of a risk arising, the **impacts** on hosts if it does and the **value** of the hosts in the UK

The above factors are rated 1 to 5 (informed expert opinion) and multiplied together to give a **risk rating** ranging from 1 to 125. Overall UK risk rating = likelihood x impact x value.

Likelihood and impact are both rated with and without mitigation measures which are – co-ordinated action by Government, industry & stakeholders to lessen likelihood and impact or both.

which are – co-ordinated action by Government, industry & stakeholders to lessen likelihood and impact or both:

**Regulation (EU regulated and UK protected zone)**

**Surveillance**

**Industry Scheme**

**Contingency Plan**

**Awareness**

**Research**

## Five current main concerns

- Ramorum disease – *Phytophthora ramorum*
- Dothistroma needle blight – *Dothistroma septosporum*
- Chalara dieback of ash – *Hymenoscyphus fraxineus*
- Acute oak decline – *Agrilus*, *Gibbsiella quercinecans* and *Brenneria goodwinii*
- Oak processionary moth – *Thaumetopoea processionea*

Mitigated Risk rating	Mitigated Risk rating
125/125	80/125
75/125	50/125
100/125	80/125
100/125	75/125
100/125	45/125

*Cryphonectria parasitica*

60/125

30/125





**Death of tan oak in California**



**A close up view of a tree trunk naturally infected with *P. ramorum***

**Bleeding (resinous exudates) cankers (dead inner bark) are a typical symptom on oaks**



**Needle blight and shoot die-back of a Douglas-fir sapling naturally infected with *P. ramorum***



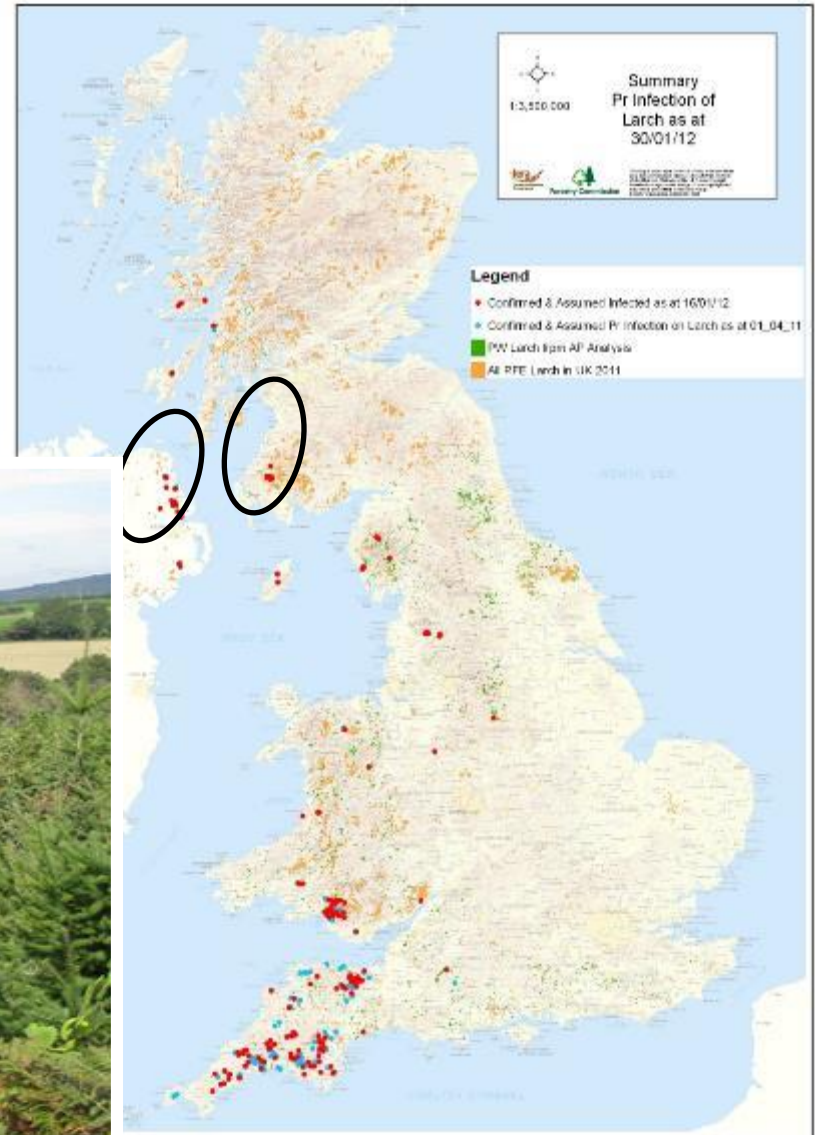
**An eradication site in USA as part of disease management to prevent further spread**

# *P. ramorum* on Japanese larch in 2009



# *P. ramorum* in the UK

*P. ramorum* initially on beech in 2002 inoculum from rhododendron; in 2009 “jumped” to larch & by 2013 infected larch covered 11,000 ha and new lineages were present.



# *P. ramorum* 2014

## EU Quarantine pathogen

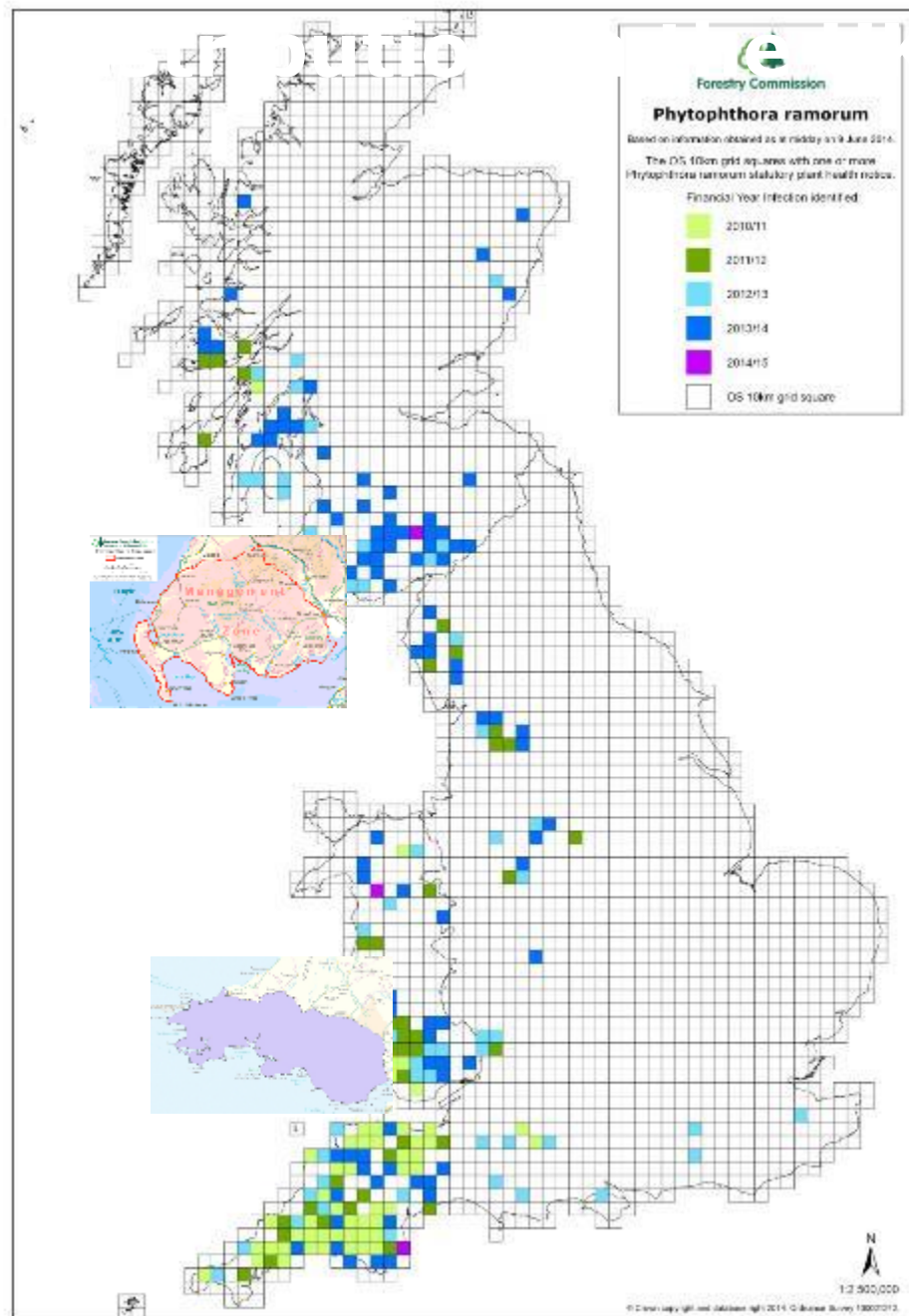
Requirement to remove sporulating hosts

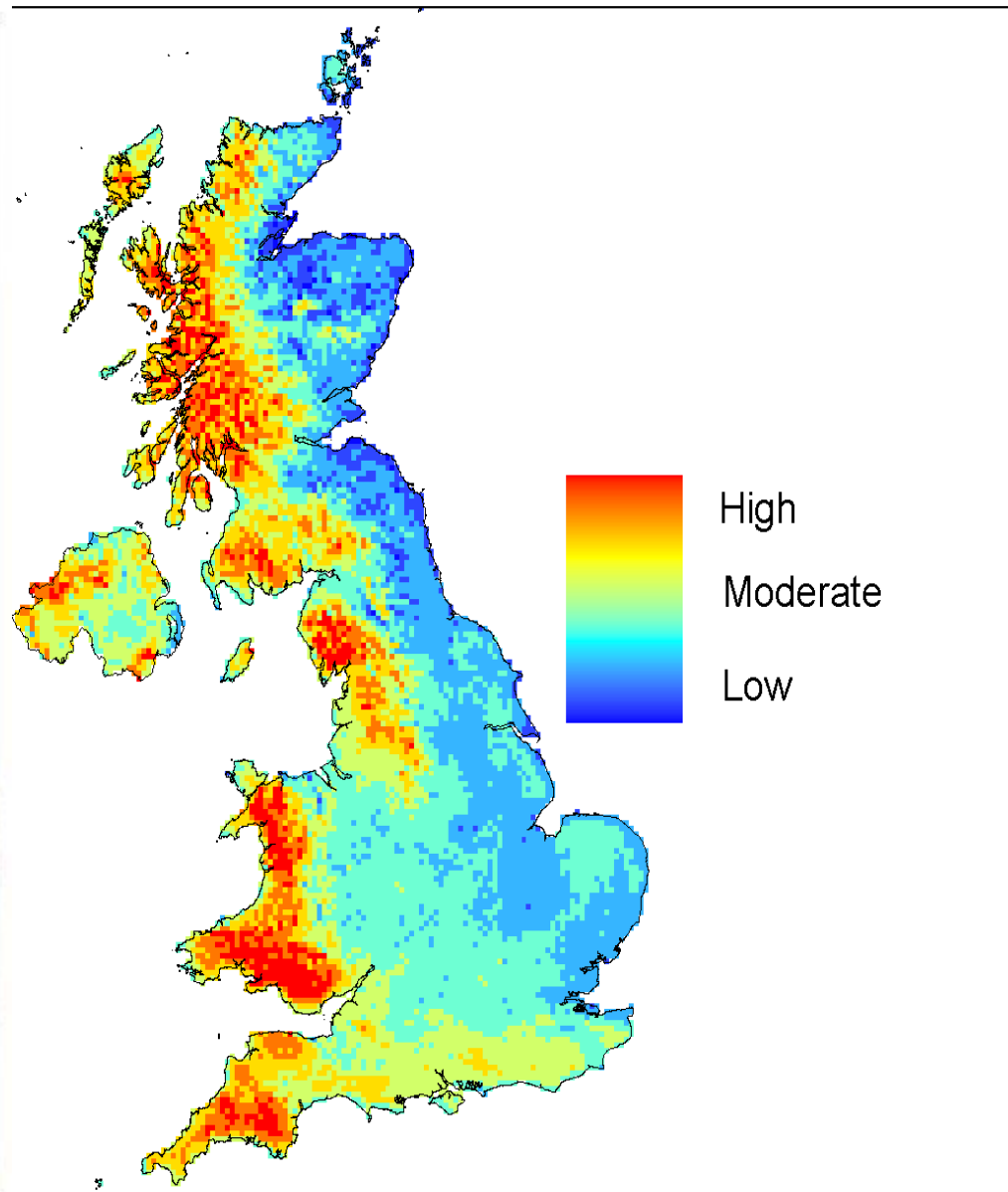
Control strategies (England, Scotland and Wales) based on zoning

- heavily infected areas (sw Scotland, s Wales) managed as single zone
- control targeted on areas outside these zones with felling enforced by SPHNs

Monitoring focuses on climatic high risk areas

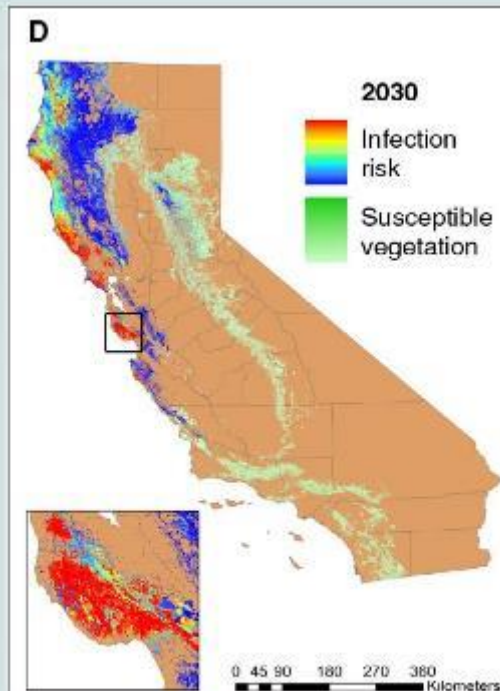
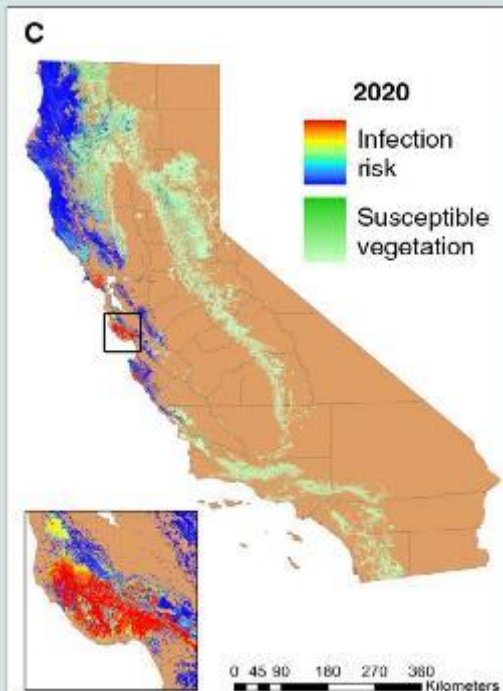
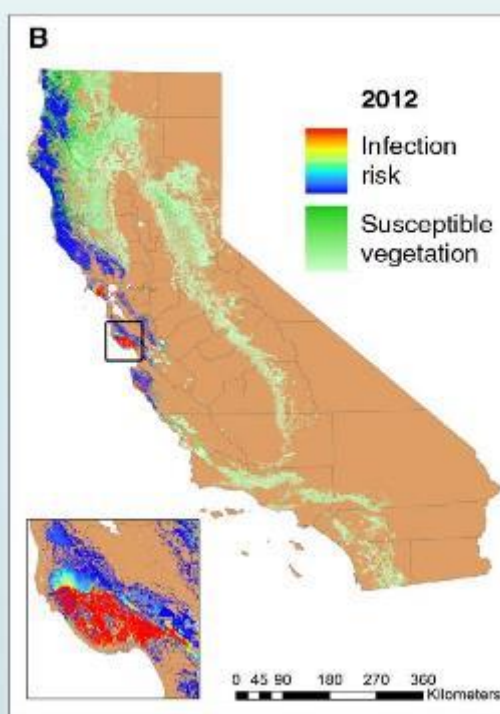
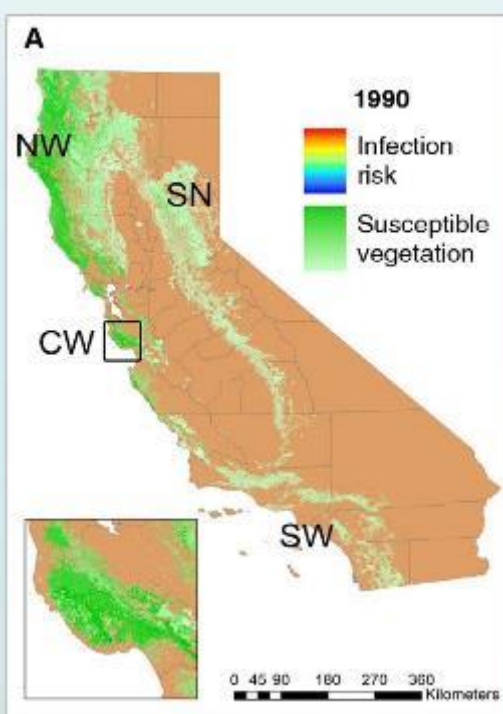
Replanting with different species







Meentemeyer *et al* 2011  
Epidemiological modeling  
of invasion in heterogeneous  
landscapes: Spread of  
sudden oak death in  
California *Ecosphere* 2



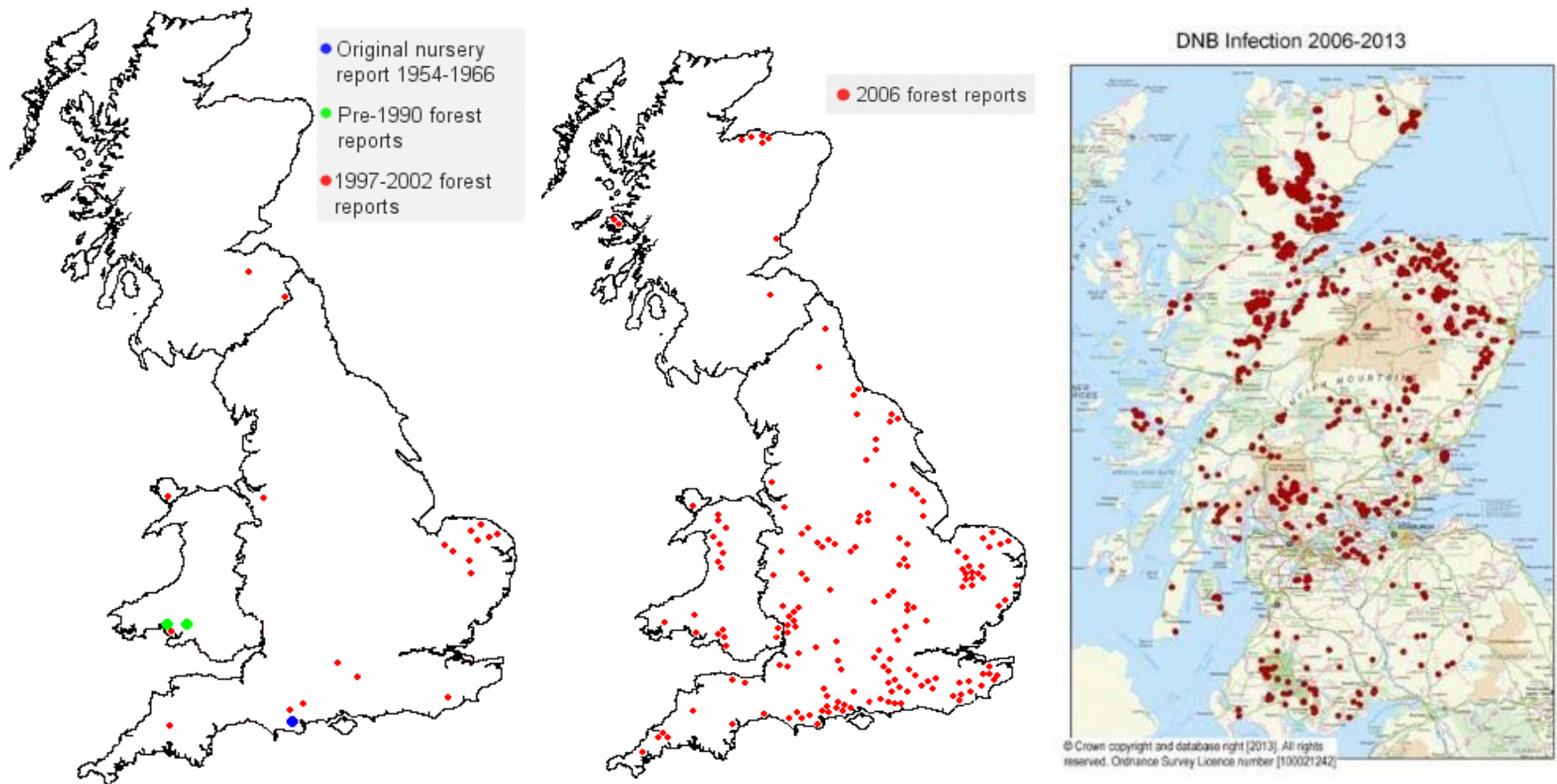
# Dothistroma needle blight



Highly damaging pathogen of conifers, first reported in the UK in the 1950s in a nursery in Dorset and one stand in South Wales.

# History in Britain

Increased across the south of England during the 1990s and by 2006 was widespread in this country on *Pinus nigra* var. *laricio*. Further disease detection across Scotland between 2006-2013, mainly on *P. contorta* and *P. sylvestris*, including native Caledonian pine areas.



Management e.g. thinning, clearfell, use of alternative spp. and chemical



Five hectare experimental site to assess the environmental impacts and efficacy of copper fungicide under Scottish conditions.

- First finding Feb/March 2012 in a nursery – trees imported from Netherlands
- Next finding in May – saplings planted winter 2011/12 in a car park near Lincoln
- Rapid survey conducted in November 2012; finds as at 12 noon 21 Nov 2012

121 in wider environment

84 recently planted sites

17 nurseries (not shown)

**222 total**



July 2014

281 wider environment

355 recent plantings

26 nurseries

**649 total**

September 2014

437 wider environment

377 recent plantings

26 nurseries

**840 total**



By April 2017 1184 grid squares.

## Chalara control strategy

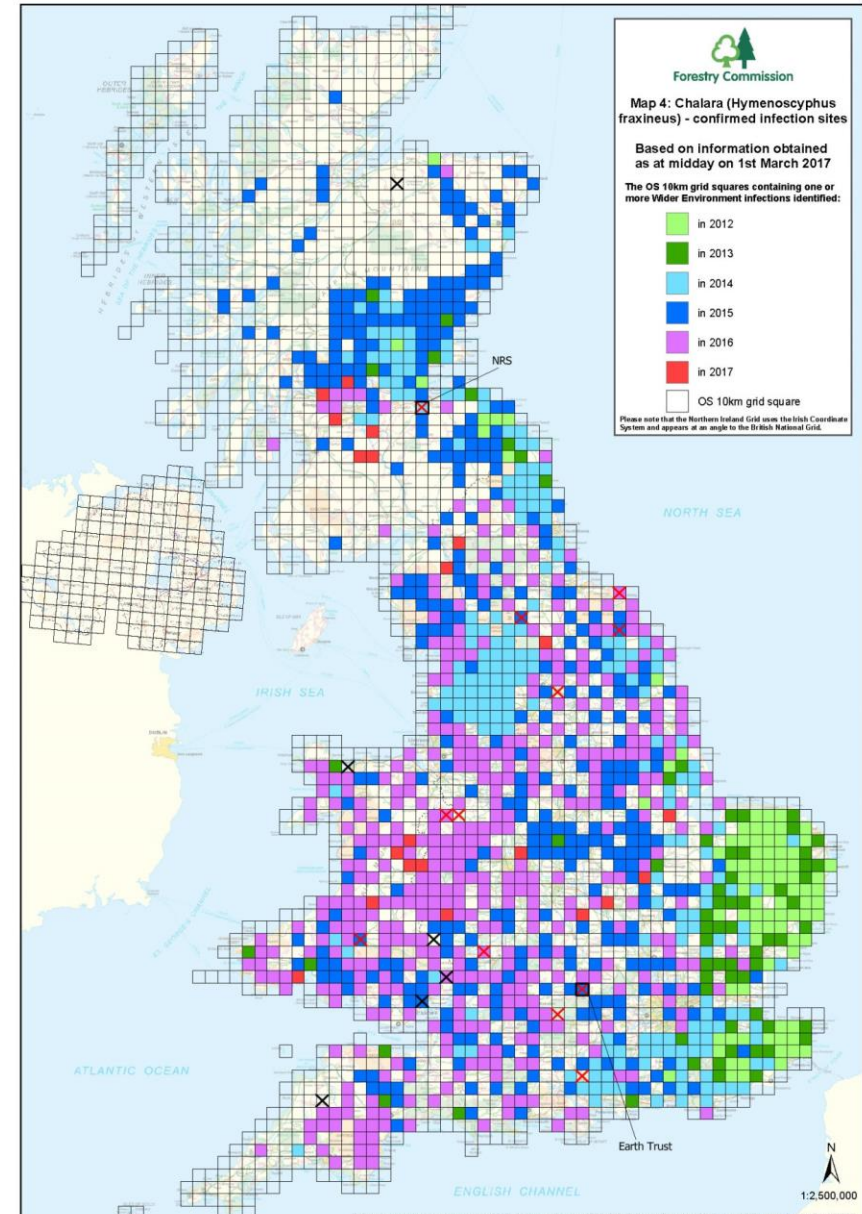
Management of infected wider environment sites; recommend that plants are removed from recently planted sites but not obligatory

See Mitchell *et al* 2014 Biological Conservation 175, 95-109

Assess ecological function and use of *F. excelsior* by other organisms (953 associated species)

Concludes that:

- Management which does not remove infected trees is best for obligate and highly associated trees
- Gives guidance on alternative tree species – *Q. robur/petraea* can host 69% of associated spp.





Oak, ash and beech – 9.4 5.4 & 3.5 % of GB  
woodland area – 2.66 M ha  
(Nat. Inventory of woodland & Trees, FC 2003)



## Acute oak decline is not a quarantine disease

- Recommendations are precautionary and voluntary
  - If felling is preferred option then immediate disposal of bark and sapwood on site is recommended
  - Caution on moving infested firewood
- Remission can occur so leaving trees *in situ* and alleviating stress is advised in some cases

## Research into potential control includes

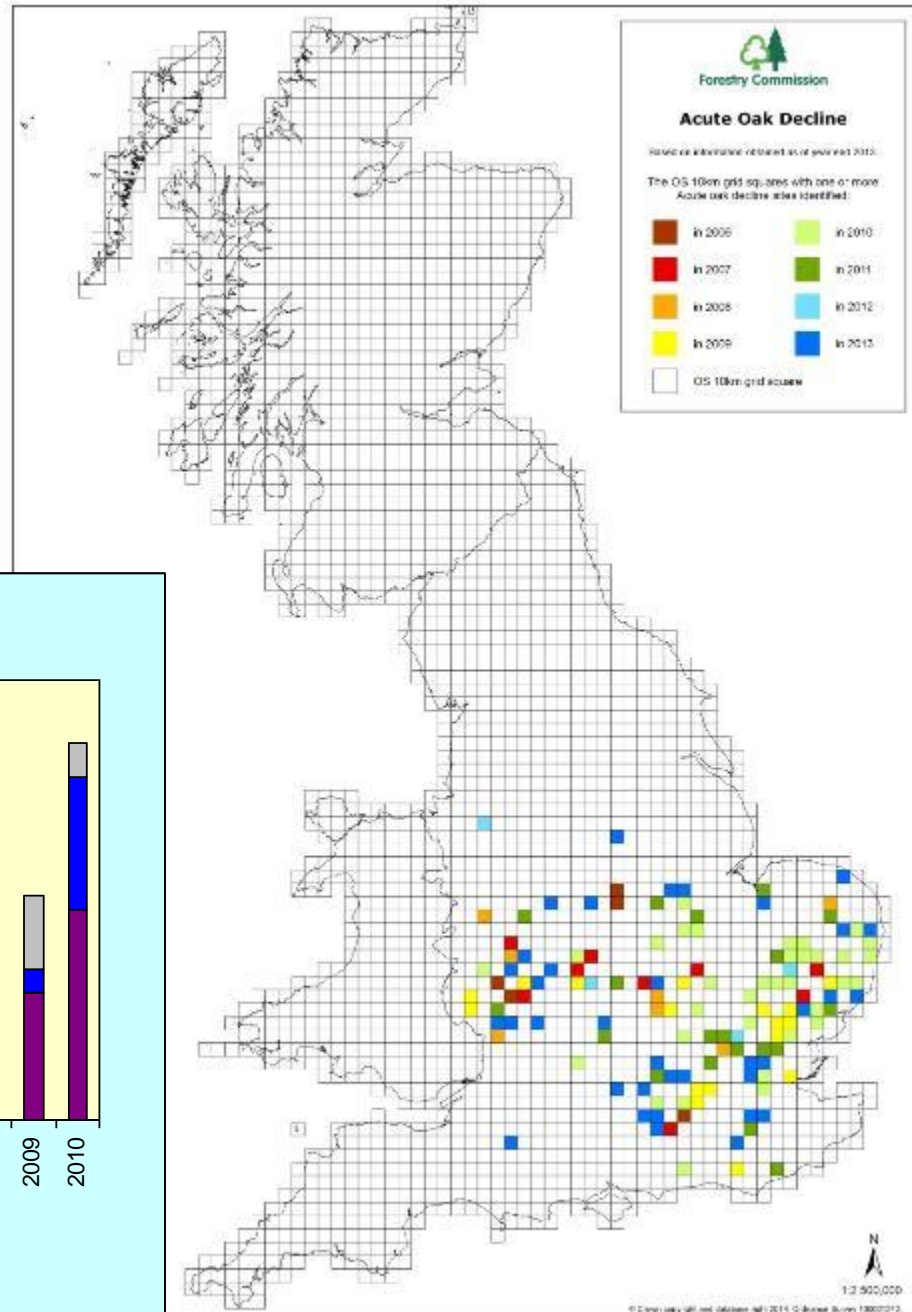
- Establishing the nature of the link between *Agrilus* and AOD
- Understanding what attracts *Agrilus* to susceptible oak trees
- Pheromones for potential trapping
- Attitudes to control of this native beetle so that responses to control can be managed



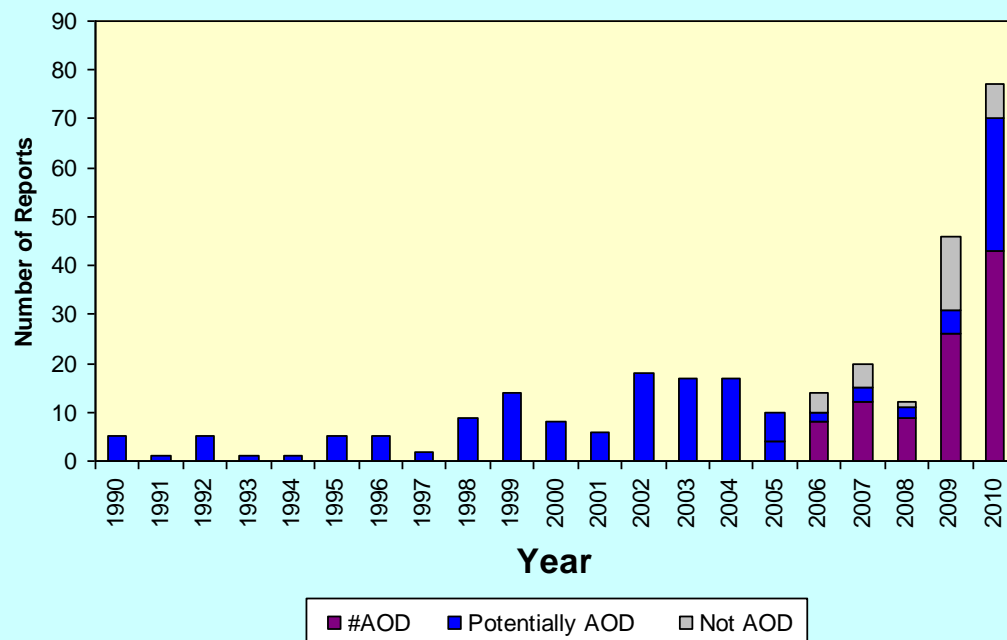
### Acute Oak Decline

Source: Information released as of 29/04/2013

The OS 10km grid squares with one or more Acute oak decline areas identified:



### Summary of oak enquiries 1990 - 2010 FR



# Oak Processionary Moth *Thaumetopoea processionea*



- Found in London in 2006 at several locations. Arrived on 4-8 m tall imported oak for street landscape plantings
- It is a major defoliator of oak
- Caterpillars carry thousands of tiny irritating hairs which pose a considerable hazard to public health

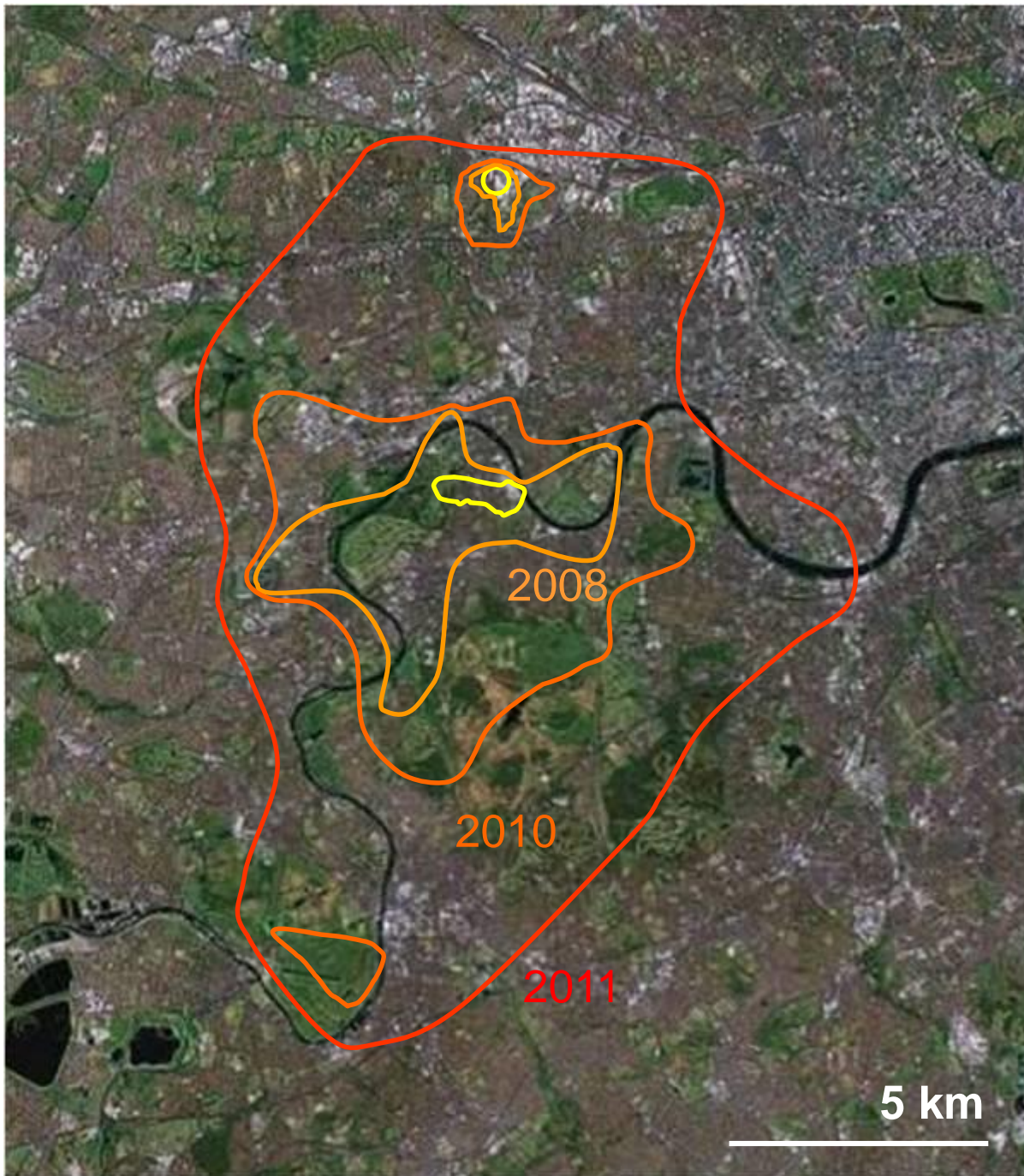


0.1 mm

# Controlling OPM is difficult and costly



# OPM outbreak area in London, 2006–2011



- on average, the population has spread at a rate of 0.9 km per year
- the outbreak in London now covers an area of 99 km<sup>2</sup>

# Oak Processionary Moth

Aerial application  
of the biological  
insecticide

*Bacillus*

*thuringiensis*

(BT) was carried  
out at Pangbourne  
in 2013 (14 ha)  
and 2014 (2.5 ha)

No OPM larval  
nests have been  
found at

Pangbourne in  
2013 and 2014.





## Recent new examples which have been eradicated or are currently being contained/eradicated:

<i>Ips typographus</i> – occasional interceptions at ports (last time was 1997)	40/125
<i>Anoplophora gabripennis</i> - Asian Longhorn beetle – eradicated from Kent in 2012 and 13 (2133 trees felled in an 11.5 ha area).	40/125
<i>Cryphonectria parasitica</i> , sweet chestnut blight, 3 finds in 2012 now eradicated but recurred in 2016 and “spread” further in 2017	30/125
<i>P. austrocedrae</i> , Phytophthora of Juniper arrived 2011	45/125
<i>P. lateralis</i> , Phytophthora of Lawson cypress arrived 2010	24/125
<i>Dendrolimus pini</i> , Pine lappet moth – located near Inverness in 2009/10 currently contained.	40/125

**Plus a number of significant threats not yet present – details and PRAs on UK Plant Risk Register Some e.g. Emerald ash borer (*Agrilus planipennis*) and the bacteria *Xylella* are considered as high risks**



# Planted Forests on the Globe

## *Renewable Resources for the Future*

Ecosystem services were formally defined in the UN Millennium Ecosystem Assessment 2005 as the ‘benefits people obtain from ecosystem’ with four categories

- 1. Supporting services** are the basis for the other three  
e.g. nutrient dispersal and cycling, seed dispersal, primary production
- 2. Provisioning services** – products  
e.g. wood, crops, water, minerals, pharmaceuticals, energy
- 3. Regulating services** – benefits obtained from the regulation of ecosystem processes  
e.g. carbon sequestration, climate regulation, conservation of biodiversity  
waste decomposition, purification of air and water, pest & disease control
- 4. Cultural services** – non material benefits  
e.g. cultural and spiritual inspiration, recreation, tourism.

# Planted Forests on the Globe

## *Renewable Resources for the Future*



- The full value of planted forests are rarely quantified and so may not be realised or delivered.
- Planted forests may be characterised by their original objective, e.g. timber production or slope protection and not by the breadth of current and potential ecosystem services.
- Has the concept of ecosystem services contributed by moving forest policy and the delivery of ecosystem services forward?

# Planted Forests on the Globe

## *Renewable Resources for the Future*



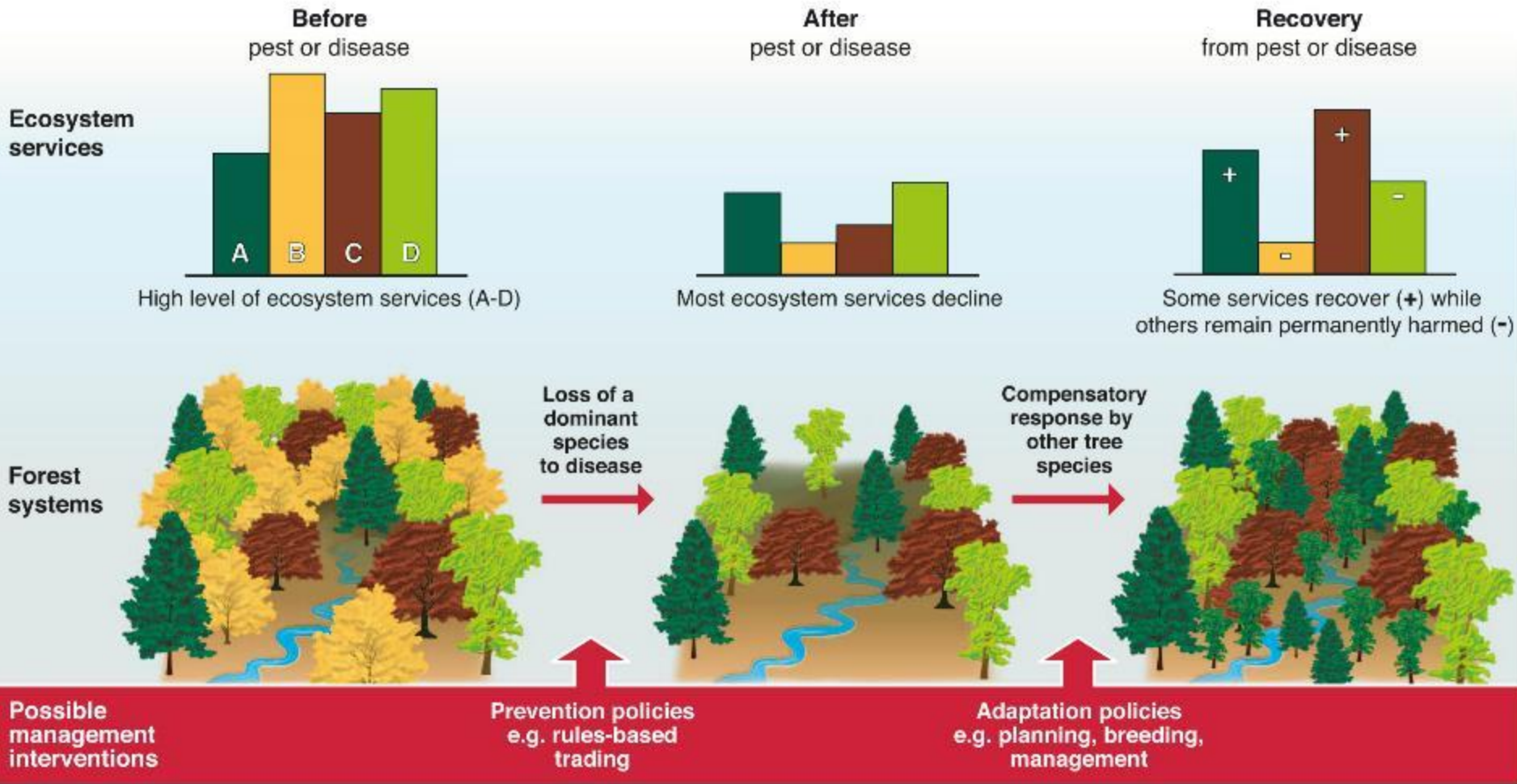
- What is the relationship between natural capital and the sustainable flow of ecosystem services?
- Are we valuing ecosystem services effectively? Is there a mismatch between those ESs where value is delivered locally to owners (e.g. timber) and those delivered on a larger scale (e.g. climate regulation).
- Payment for ecosystem services – is it happening. Does it move the agenda forward, what has been/will be the impact of carbon trading?

# Planted Forests on the Globe

## *Renewable Resources for the Future*



- What can we learn from the progress and implementation of REDD programmes – control of GHG exchange is a major forestry regulating service
- Has the concept of ecosystem services moved the urban tree agenda forward e.g. trees to improve air quality, for temp. regulation and urban water management?
- Are forests contributing adequately to poverty alleviation?



Boyd, Freer-Smith, Gilligan & Godfray 2013 'The Consequence of tree pests and diseases for Ecosystem Services' Science 342, 1235773

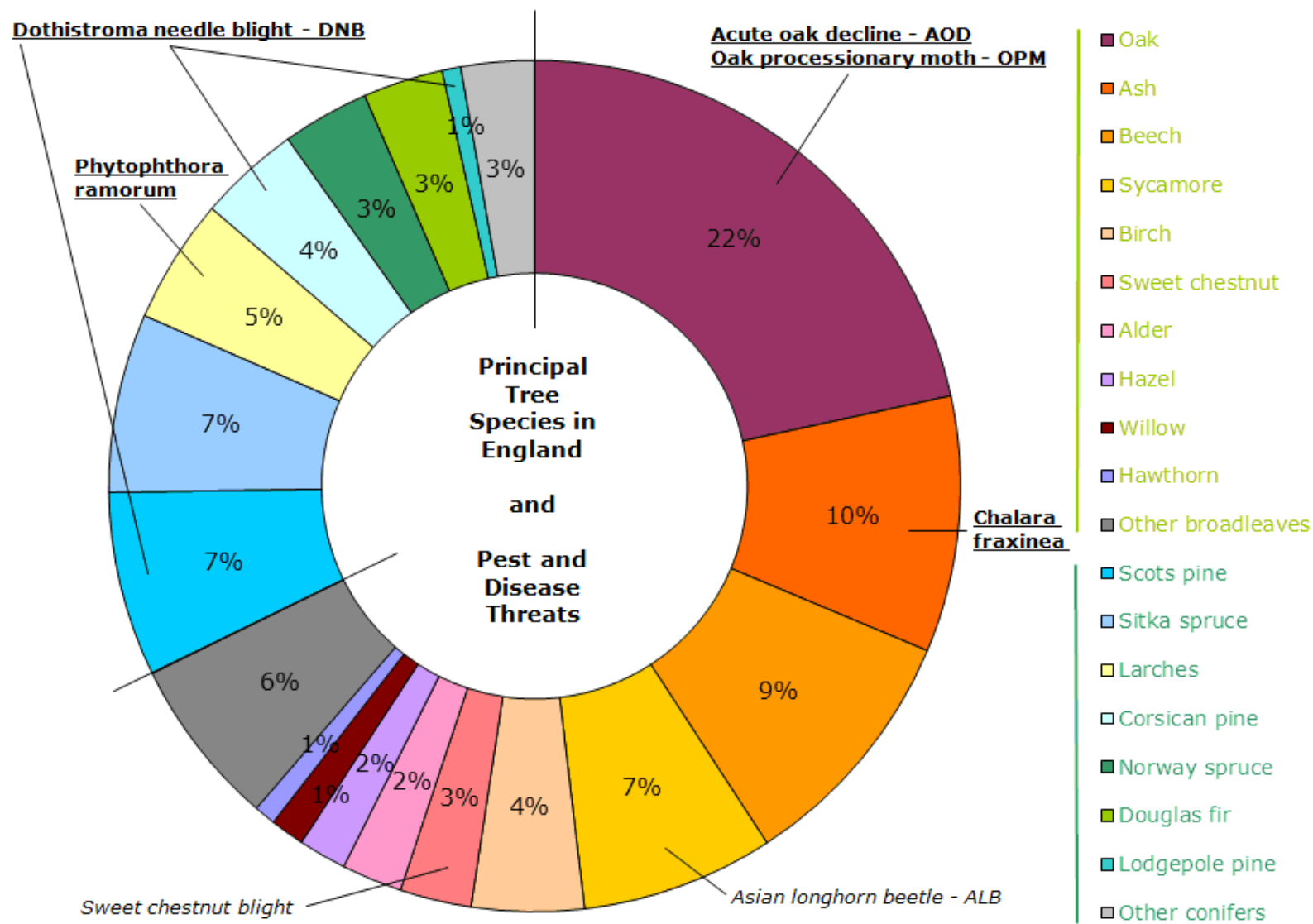
- Many of the benefits from woodlands remain uncosted and are enjoyed by a range of stakeholders
- In UK agriculture farmers bear the cost of treatment of established pests and disease, with the state focusing on risk assessment, border controls and outbreak management.
- Responsibilities are less clear for semi-natural ecosystems delivering a range of ecosystem services
- but recent focus in UK forestry has been on risk assessment & management and outbreak management – is now time to move to contingency planning.

# Current emerging threats in the UK

We have placed emphasis on early detection –  
OBSERVATREE project used volunteers,  
published guidance and an online reporting system  
TREEALERT.

2017 most reported - Chalara on ash, then  
*Sirococcus* on cedar, oak decline and *Neonecrista*  
*neomacrospora* on firs (*Abies* spp) and a concern  
over reemergence and spread of *Cryphonectria*  
*parasitica*

# The proportion of standing volume in English woodlands by species and associated pest and disease threats



Produced by: Forestry Commission England

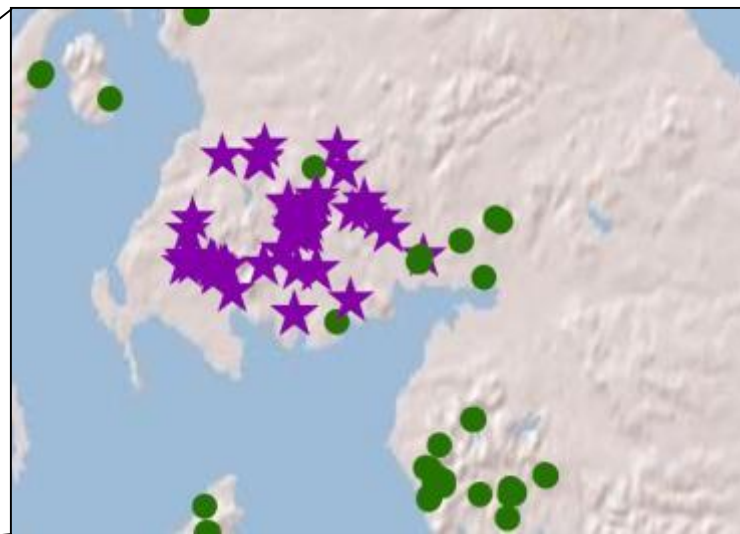
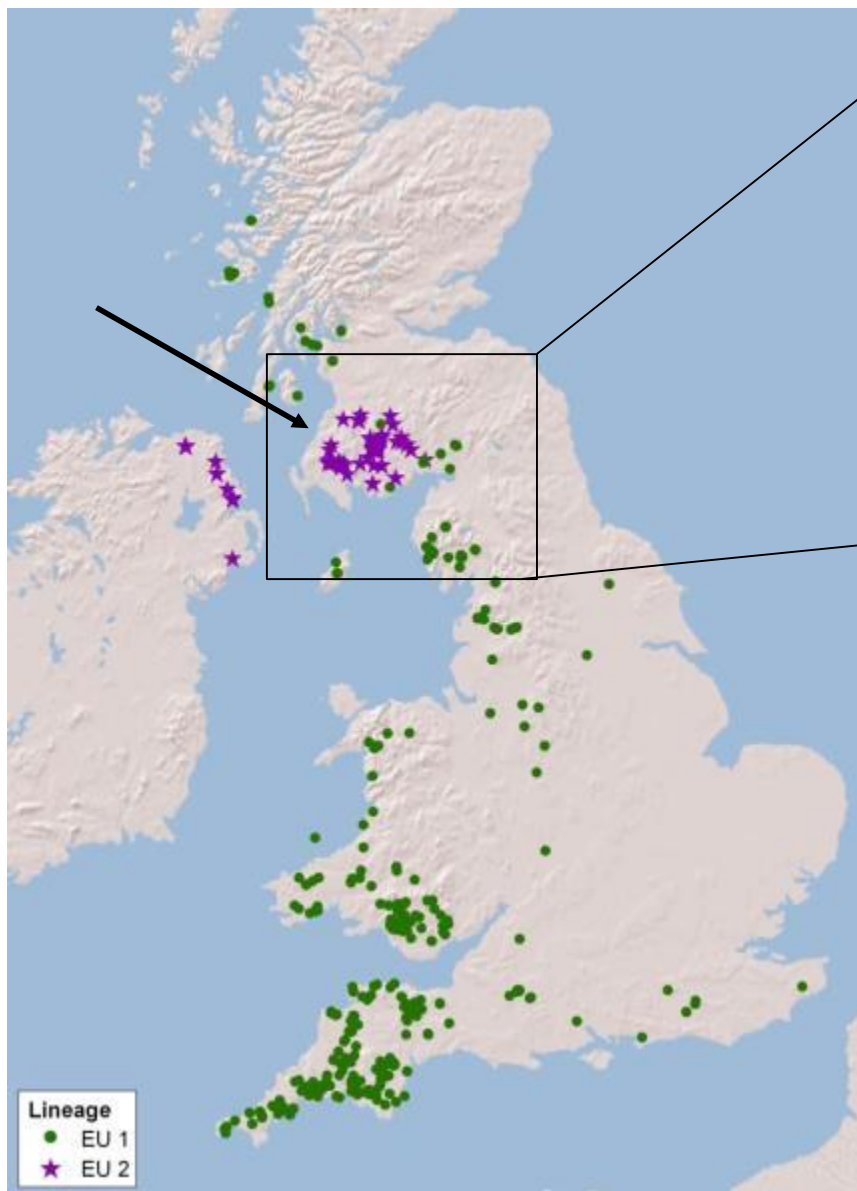
Measure: Standing Volume in Millions of Cubic Metres Overbark Standing. Source: Forestry Statistics 2013

Broadleaves: National Forest Inventory: Preliminary estimates of quantities of broadleaved species in British woodlands, with special focus on ash (2012)

Conifers: National Forest Inventory: Standing timber volume for coniferous trees in Britain (2012)

*Italicised pests and disease are thought to have been eradicated*





## EU2 has been found on:

*Abies grandis*  
*Abies procera*  
*Fagus sylvatica*  
*Larix decidua*  
*Larix kaempferi*  
*Larix x eurolepis*  
*Quercus rubra*  
*Rhododendron ponticum*  
*Tsuga heterophylla*  
*Vaccinium myrtillus*

Legislation – EPPO, EU Standing Committee on Plant Health and UK Plant Health Strategy Board.

### **Actions since COBRA meeting Nov 2012:**

Gov. Chief Scientist's Science Advice to Government in an Emergency committee

May 13 Final Rpt Tree Health & Plant Biosecurity Expert Taskforce.

April 14 Defra, SG, WG & FC Plant Biosecurity Strategy for GB

Appointment of Chief Plant Health Officer

Development of UK Plant Health Risk register

Oct 14 Creation of Animal & Plant Health Agency

Tree Health & Plant Biosecurity research initiative c. £7 M over three years, 7 projects

Dec 14 Walport Boyd report "Animal & Plant Health in the UK: Building our science capability.

New EU Plant Health Regime – registration, plant pass porting, trade pathways.

- Cost ecosystem services and natural capital
- Evaluation of the pest and disease susceptibility of new species being recommended in climate change adaptation.
- Research to support risk assessment:-
  - The molecular basis for pathogenicity – why some pest species reach epidemic prevalence and abundance
  - Which species, if transported will recombine to enhance pathogenicity
- Breeding for resistance and integrated forest management represent effective options for forestry and these must not be overlooked as a consequence of immediate priority sensibly given to current outbreaks.

## **Forest research is investigating the disease and assessing the risks for forest trees from *P ramorum***

- **Foliage susceptibility**
- **Wounded & unWou log tests**
- **Sapling susceptibility**
- **Sporulation potential on leaves**
- **Studies on mating and breeding systems**
- **Comparative behaviour of EU and US isolates**
- **Outbreak management; DCZs**

**Promoting resilience of UK tree species to novel pests and pathogens: ecological and evolutionary solutions**

**Modelling economic impact and strategies to increase resilience against tree disease outbreaks**

**New approaches for the early detection of tree health pests and pathogens**

**Understanding public risk concerns: an investigation into the social perception, interpretation and communication of tree health risks**

**Population structure and natural selection in the Chalara ash dieback fungus, *Hymenoscyphus pseudoalbidus***

**Identifying genomic resources against pests and pathogens in tree genera: a case study in *Fraxinus***

**Biological pest control of insect pests that threaten tree health**

# 2008 UK Climate Change Act

- Climate Change Committee chaired by Lord Krebs
- Every 5 years the Secretary of State for the Environment presents a CC Risk Assessment to Parliament- 2012 and 2017

# Climate Change Risk Assessment methodology:

- **11 Sectors gathered evidence** -700 risks – 100 which were prioritized by **expert peer review**  
– **Sector workshops** to identify the most important risks – 10% of risks selected for **detailed analysis of impacts** each assessed using a single climate factor e.g. temp. 30 impacts in forestry – **Evidence report** in forestry Tier 2 (higher) risks were:  
Pests & diseases, drought, productivity & wildfires

**Figure 1:** Top six areas of inter-related climate change risks for the United Kingdom



**More action needed** – new Government policies

**Research Priority**– research needed to assess the need for additional action.

**Sustain current action**    and    **Watching brief**





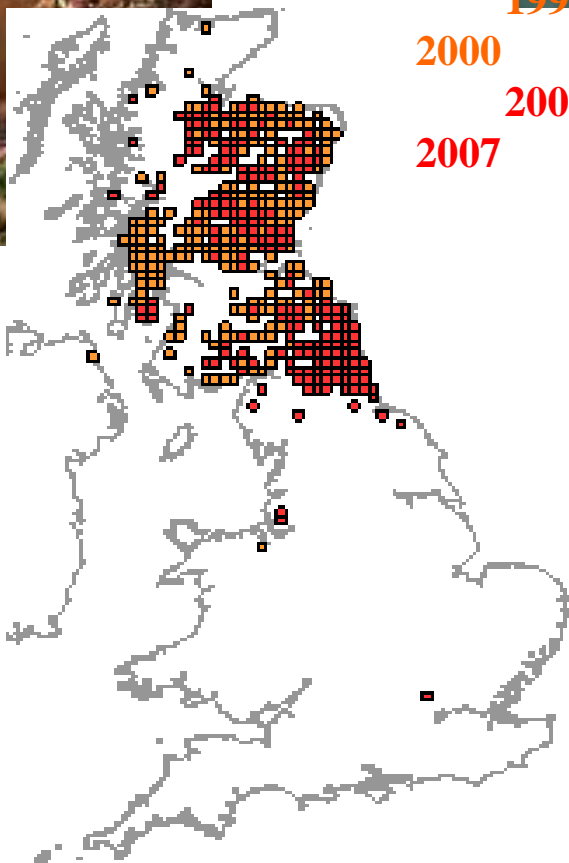
**Red Squirrel**

1995-

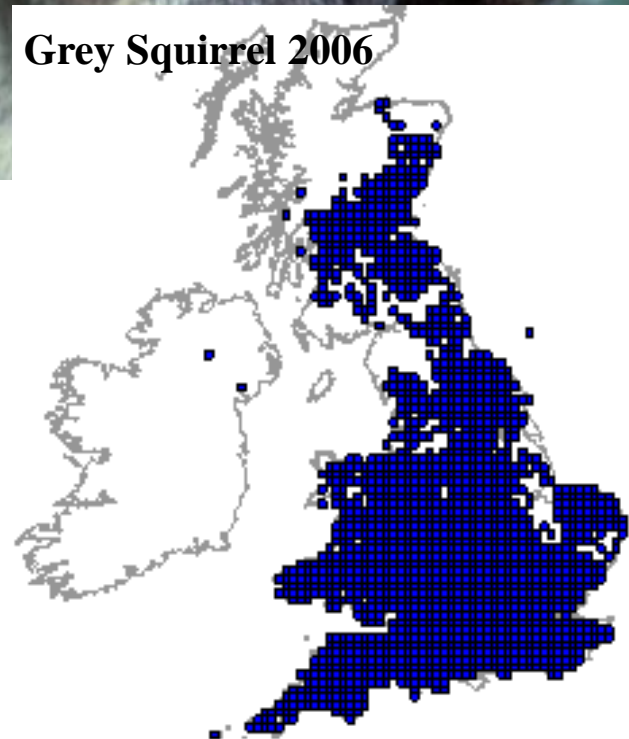
2000

2001-

2007



**Grey Squirrel 2006**



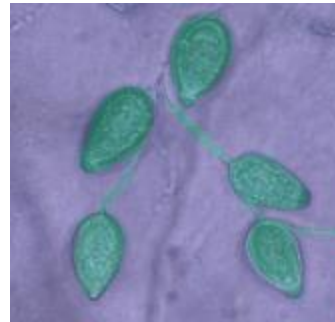
16/11/2017

NBN gateway 2006

# Challenges for Plant Health

The basic challenges for Plant Health are reflected in EPPO's Madeira declaration (2004) – “*State of Emergency in Plant Health*”:

- An increasing threat from exotic plant pests and pathogens
- Limited and decreasing resources and erosion of the scientific basis





# EUPHRESKO 2



## EUPHRESKO 1

23 partners and 6 observers



## EUPHRESKO 2

31 partners and 14 observers



# About UC Davis



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