Scotland's Plant Health Conference - 28th May 2019
DoubleTree by Hilton Hotel, Edinburgh Airport, EH28 8LL

Xylella Biosecurity Briefing and Discussion

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Risk mapping of the likelihood and impact of a Xylella fastidiosa outbreak in Scotland

- Samantha Broadmeadow
- Kevin Watts
- Chris Quine

Forest Research

- Ruth Mitchell

The James Hutton Institute

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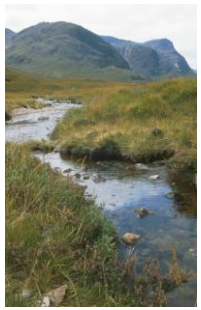
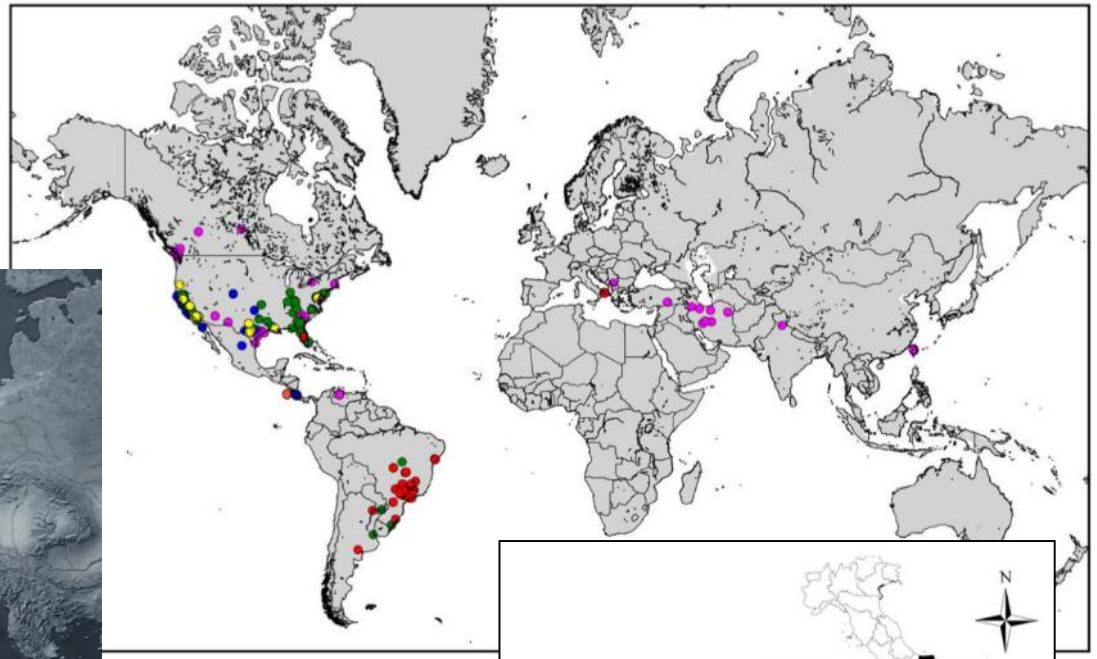
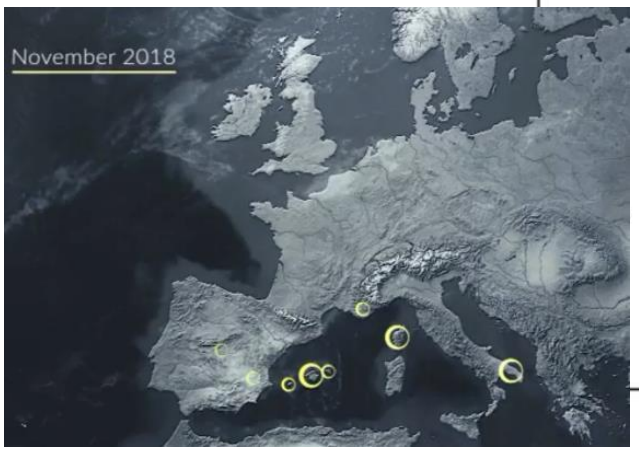
Global distribution of disease

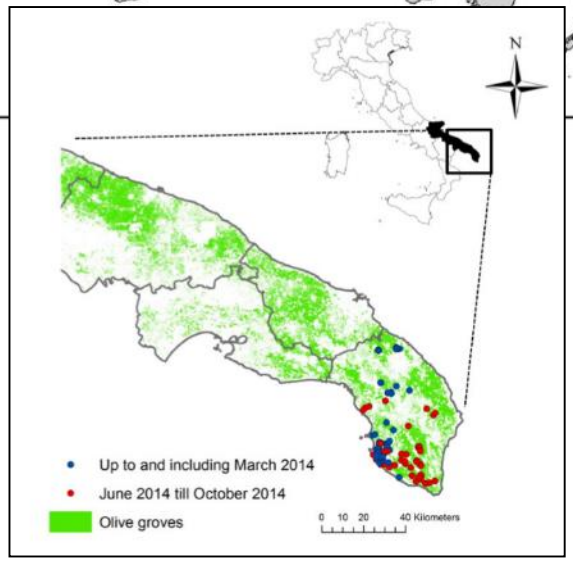


EFSA Scientific Opinion (2015)

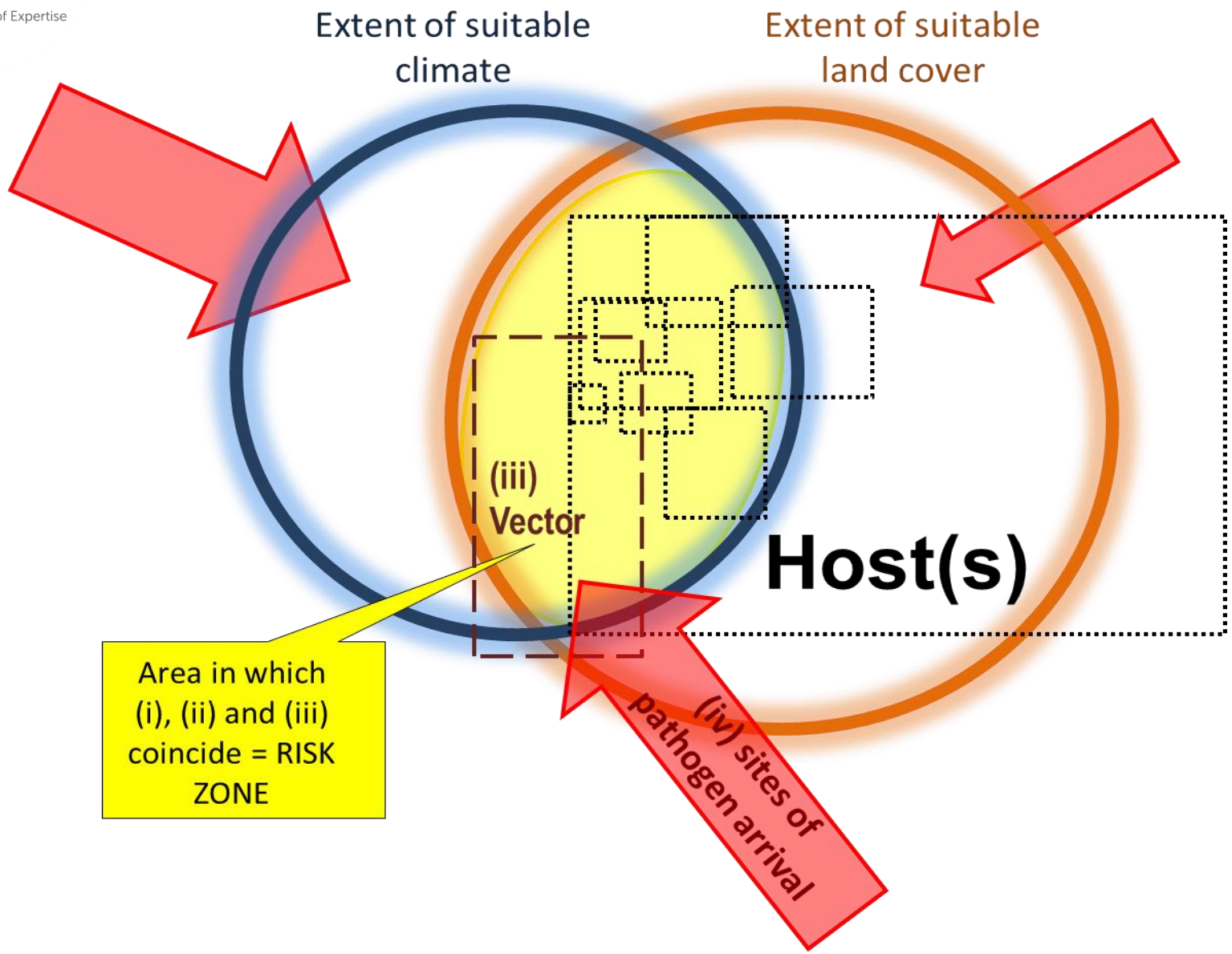
World distribution of Xylella fastidiosa subspecies







Mapping Approach



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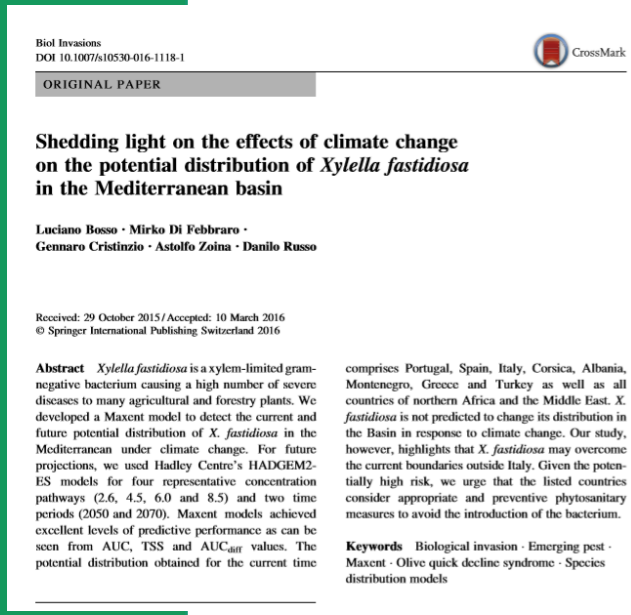
Information sources for *Xf* in Europe

The risk in Europe is continually assessed by the European Food Safety Authority

In the UK DEFRA and the FC have produced lots of advice and guidance documents

Some published research into Xylella in Europe



Biol Invasions
DOI 10.1007/s10530-016-1118-1

ORIGINAL PAPER

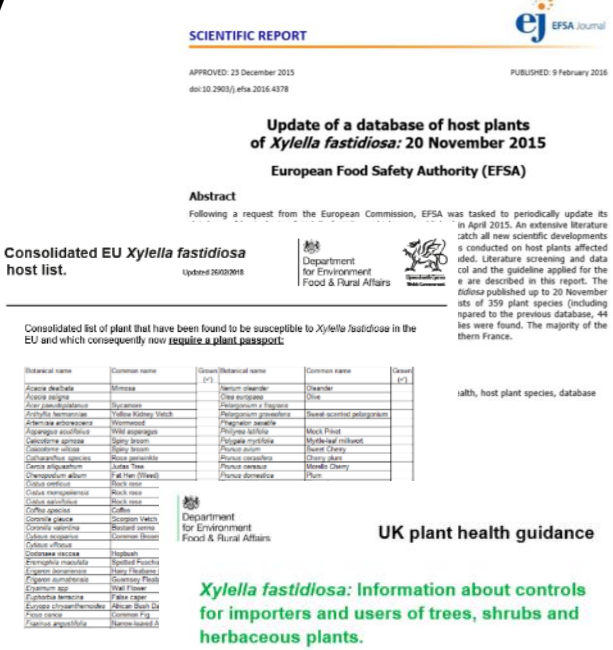
Shedding light on the effects of climate change on the potential distribution of *Xylella fastidiosa* in the Mediterranean basin

Luciano Bosso · Mirko Di Febbraro · Gennaro Cristinzio · Astolfo Zoina · Danilo Russo

Received: 29 October 2015 / Accepted: 10 March 2016

Abstract *Xylella fastidiosa* is a xylem-limited gram-negative bacterium causing a high number of severe diseases to many agricultural and forestry plants. We developed a Maxent model to detect the current and future potential distribution of *X. fastidiosa* in the Mediterranean under climate change. For future projections, we used Hadley Centre's HADGEM2-ES models for four representative concentration pathways (2.6, 4.5, 6.0 and 8.5) and two time periods (2050 and 2070). Maxent models achieved excellent levels of predictive performance as can be seen from AUC, TSS and AUC_{diff} values. The potential distribution obtained for the current time comprises Portugal, Spain, Italy, Corsica, Albania, Montenegro, Greece and Turkey as well as all countries of northern Africa and the Middle East. *X. fastidiosa* is not predicted to change its distribution in the Basin in response to climate change. Our study, however, highlights that *X. fastidiosa* may overcome the current boundaries outside Italy. Given the potentially high risk, we urge that the listed countries consider appropriate and preventive phytosanitary measures to avoid the introduction of the bacterium.

Keywords Biological invasion · Emerging pest · Maxent · Olive quick decline syndrome · Species distribution models



SCIENTIFIC REPORT

EFSA Journal

APPROVED: 23 December 2015
PUBLISHED: 9 February 2016
doi:10.2903/j.efsa.2016.4378

Update of a database of host plants of *Xylella fastidiosa:* 20 November 2015

European Food Safety Authority (EFSA)

Abstract

Following a request from the European Commission, EFSA was tasked to periodically update its
in April 2015. An extensive literature
atch all new scientific developments
s conducted on host plants affected
ided. Literature screening and data
col and the guideline applied for the
e are described in this report. The
fidiosa published up to 20 November
ists of 359 plant species (including
npared to the previous database, 44
ies were found. The majority of the
thern France.

Consolidated EU *Xylella fastidiosa* host list.

Updated 26/02/2018

Department for Environment Food & Rural Affairs

Consolidated list of plant that have been found to be susceptible to *Xylella fastidiosa* in the EU and which consequently now require a plant passport:

Botanical name	Common name	Grown (*)	Botanical name	Common name	Grown (*)
Acacia dealbata	Mimosa		Nerium oleander	Oleander	
Acacia saligna			Olea europaea	Olive	
Acer pseudoplatanus	Sycamore		Pelargonium x hispanic		
Anthyllis hermanniae	Yellow Kidney Vetch		Pelargonium graveolens	Sweet-scented pelargonium	
Artemisia arborescens	Wormwood		Phagnalon saxatile		
Asparagus acutifolius	Wild asparagus		Polygala myrtifolia	Mock Privet	
Calicotome spinosa	Spiny broom		Polygala myrtifolia	Myrtle-leaf milkwort	
Calicotome villosa	Spiny broom		Prunus avium	Sweet Cherry	
Catharanthus species	Rose periwinkle		Prunus cerasifera	Cherry plum	
Cercis siliquastrum	Judas Tree		Prunus cerasus	Morello Cherry	
Chenopodium album	Fat Hen (Weed)		Prunus domestica	Plum	
Cistus creticus	Rock rose				
Cistus monspeliensis	Rock rose				
Cistus salviifolius	Rock rose				
Coffea species	Coffea				
Coronilla glauca	Scorpion Vetch				
Coronilla valentina	Bastard senna				
Cytisus scoparius	Common Broom				
Cytisus villosus					
Dodonaea viscosa	Hopbush				
Eremophila maculata	Spotted Poochs				
Erigeron karvinskianus	Many Fleabane				
Filgeron sumatrensis	Guernsey Fleab				
Erysimum spp	Wall Flower				
Euphorbia terracina	False caper				
Eurypia chrysanthemoides	African Bush Da				
Ficus carica	Common Fig				
Fraxinus angustifolia	Narrow-leaved A				

Department for Environment Food & Rural Affairs

UK plant health guidance

***Xylella fastidiosa:* Information about controls for importers and users of trees, shrubs and herbaceous plants.**

Updated September 2018

Leaf scorch of Polygala myrtifolia (Milkwort) infected by Xylella fastidiosa subsp. multiplex in Corsica. Photo: Bruno Legendre, Anses Plant Health Laboratory,

This guide is intended for all plant: growers, retailers, landscapers, garden designers, traders, importers whether outside of the European Union (EU) or from within the EU and within the UK.

Summary of key points:

- This disease has the potential to have huge implications for the UK horticultural trade and the wider environment. It is, therefore, imperative that all parties are aware of the importance of following the measures put in place. These are initiated at EU level and are non - negotiable.
- There are outbreaks of *Xylella fastidiosa* in Italy, France (Corsica and mainland France), Spain (islands of Mallorca, Menorca and Ibiza and mainland Spain). In March 2018 Germany declared it had eradicated the disease.

Updating the UK Rapid Pest Risk Analysis for *Xylella fastidiosa*

Defra Risk and Horizon Scanning Team
14th September 2017

Background

PRAs are kept under review to ensure they are still fit for purpose taking into account new findings and scientific developments. *Xylella fastidiosa* is no exception. Since Version 1 was produced in 2014 (Parkinson & Malumphy, 2014), there have been many new developments and the risks throughout Europe have been extensively assessed by EFSA (2015) in a 262 page scientific opinion. However, because the risks to the UK were considered not to have changed significantly, the focus has been on providing key information to the industry and the public with a Plant Pest Factsheet (Parkinson & Malumphy, 2015), a web-based resource (Forestry Commission, 2017), an information note on high risk hosts (Defra 2017) and guidance for importers (Defra & APHA, 2017) all accessed through the UK Plant Health Portal[1]. This has been supported with webpages provided by the industry[2] and the European Commission that provides a list of susceptible hosts in the EU (European Commission, 2015-2017). Two EU Horizon 2020 research projects (POnTE[3], end date October 2019, and XF-ACTORS[4], end date October 2020) are currently underway and their wide ranging *X. fastidiosa* objectives include a re-evaluation of the risks posed by this species throughout the EU.

This document, provided as a new appendix to the UK PRA (Parkinson & Malumphy, 2014), has been written to determine whether the recent literature has substantially altered the risk ratings given in the PRA and their level of confidence. It provides a detailed evaluation of the evidence that the different *X. fastidiosa* subspecies and strains pose a risk to plant health in temperate climates such as those in the UK.

Current European distribution

Biol Invasions
DOI 10.1007/s10530-016-1118-1

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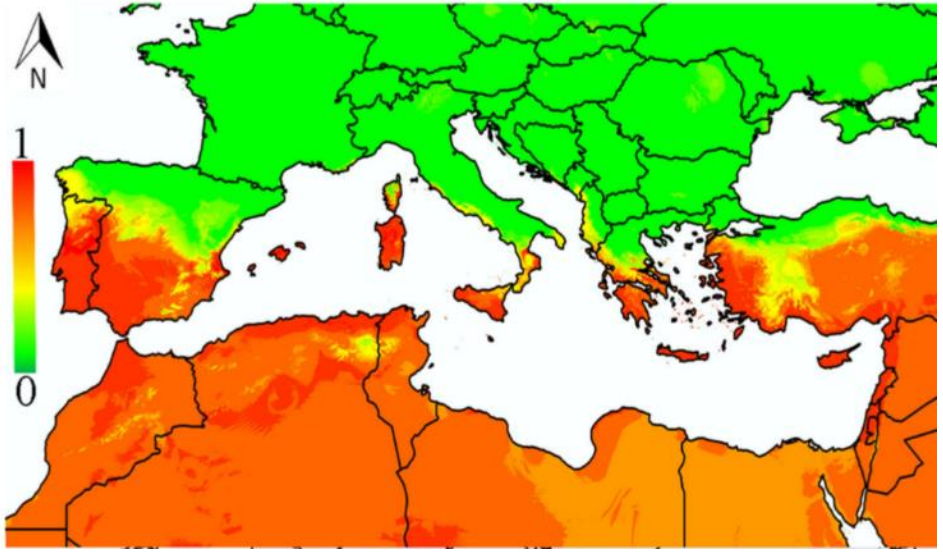
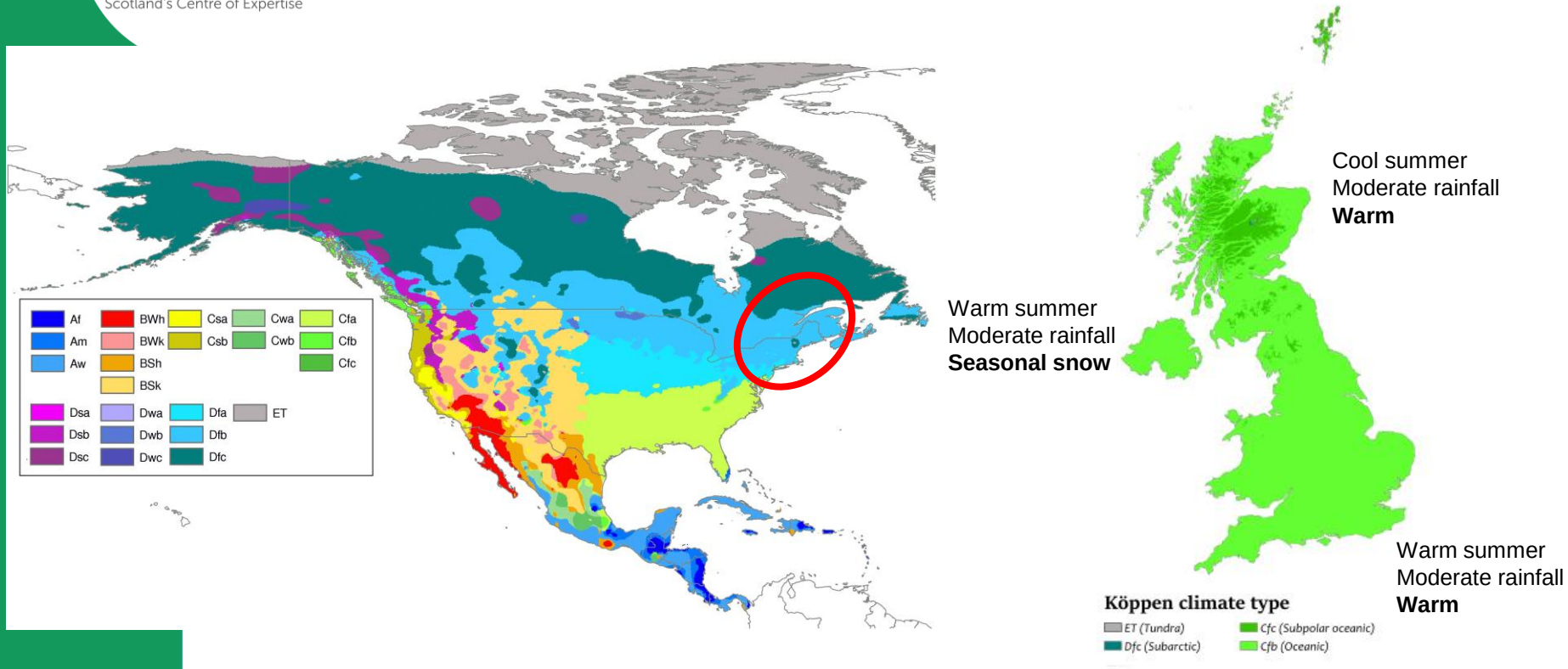


Köppen-Geiger global climate classification



- *Xylella fastidiosa* subspecies *multiplex* infects street trees in USA - American species of oak, elm and sycamore
- Pathogen survives through severe winters - resistant to cold - protected from penetrating frost by seasonal snow cover
- UK much milder winters and cooler summers than the northmost limit of the North American distribution

UK rapid pest risk assessment (DEFRA 2017)

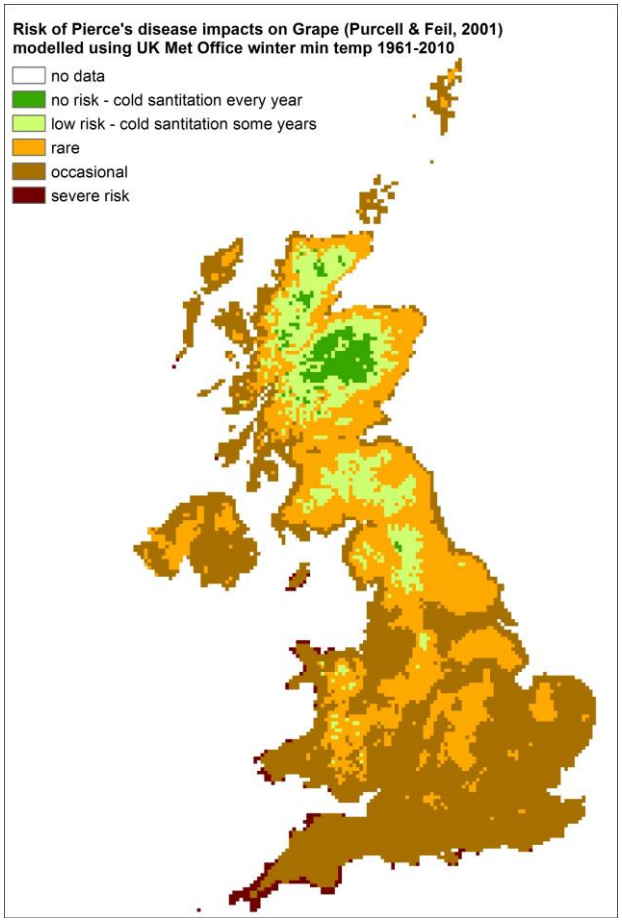
Modelled climate control of pathogen

Xylella fastidiosa subsp. *fastidiosa* causes Pierce's disease in grape vines

Seasonal sanitation of grape vines with Pierce's Disease - apparent symptom remission following a hard winter.

Purcell and Feil (2001) devised a climatic risk map for Pierce's Disease in American vine yards based on winter minimum temperature:

>4.5 ºC	severe risk
1.7 - 4.5 ºC	high risk
-1.1 - 1.7 ºC	low risk
< -1.1 ºC	no risk



UK Met Office long term climate data: Mean minimum temperature

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Disease vector - xylem feeding insects

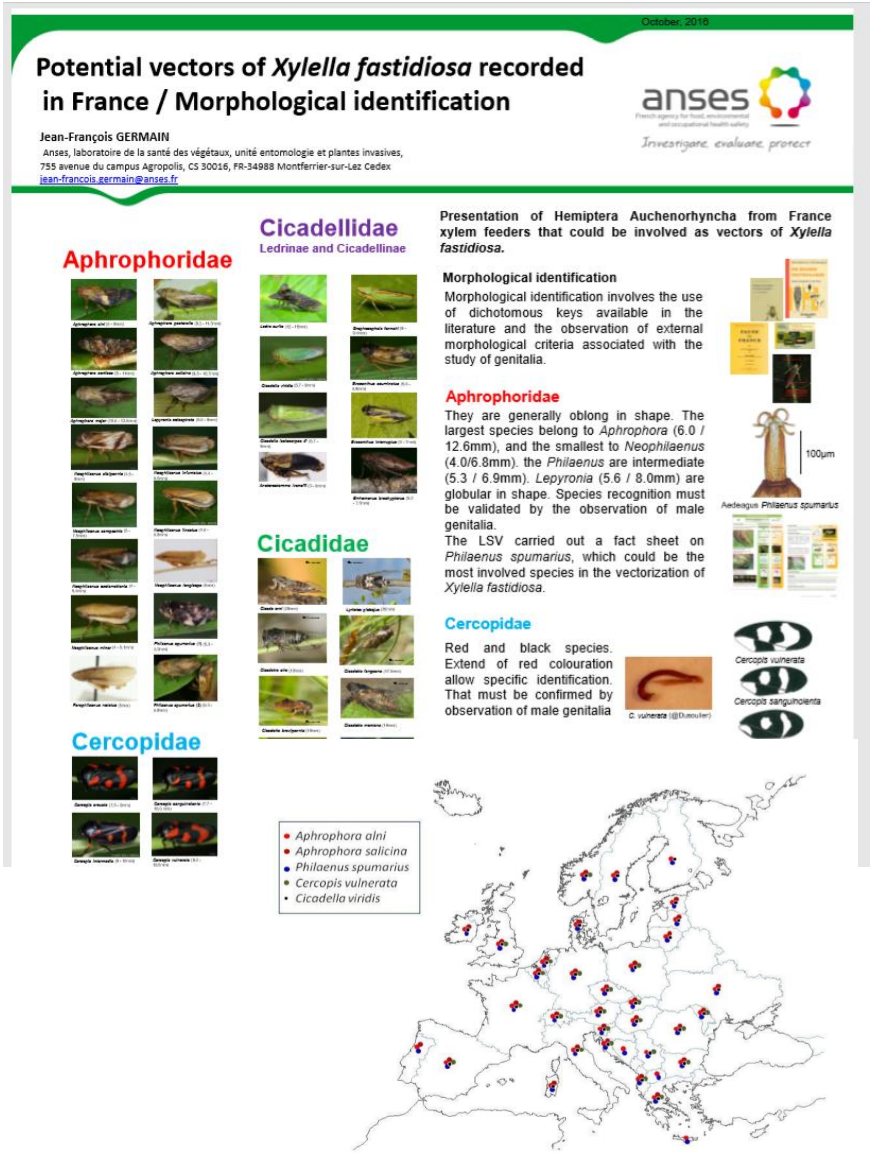
EFSA consider all xylem feeding insects as potential vectors.

Philaenus spumarius identified as key vector in Apulia, Italy

Several other species known to occur in the UK

Most have preference for grasses and soft herbaceous species but some are known to feed on shrubs particularly willows

Considerable uncertainty: *Philaenus spumarius* was used as model insect vector species



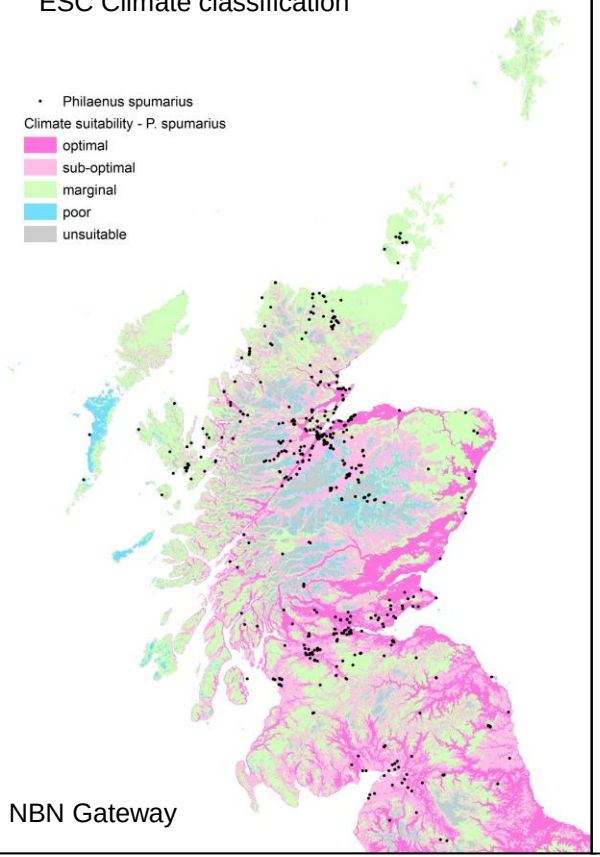
Philaenus spumarius

The risk map was devised from the model vector species environmental envelope

Optimal: warm, dry / moist and sheltered

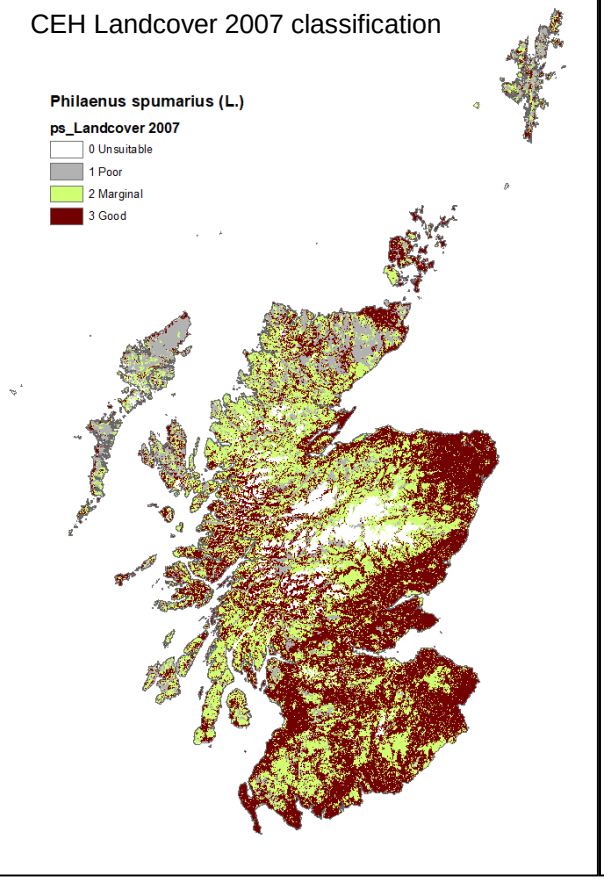
Good: urban, deciduous woodland, improved grassland & arable

ESC Climate classification

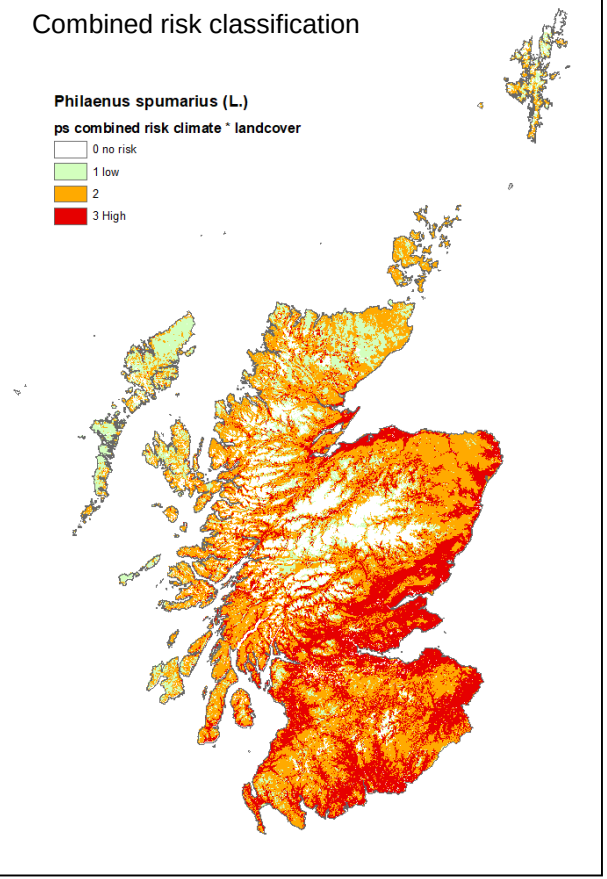


NBN Gateway

CEH Landcover 2007 classification



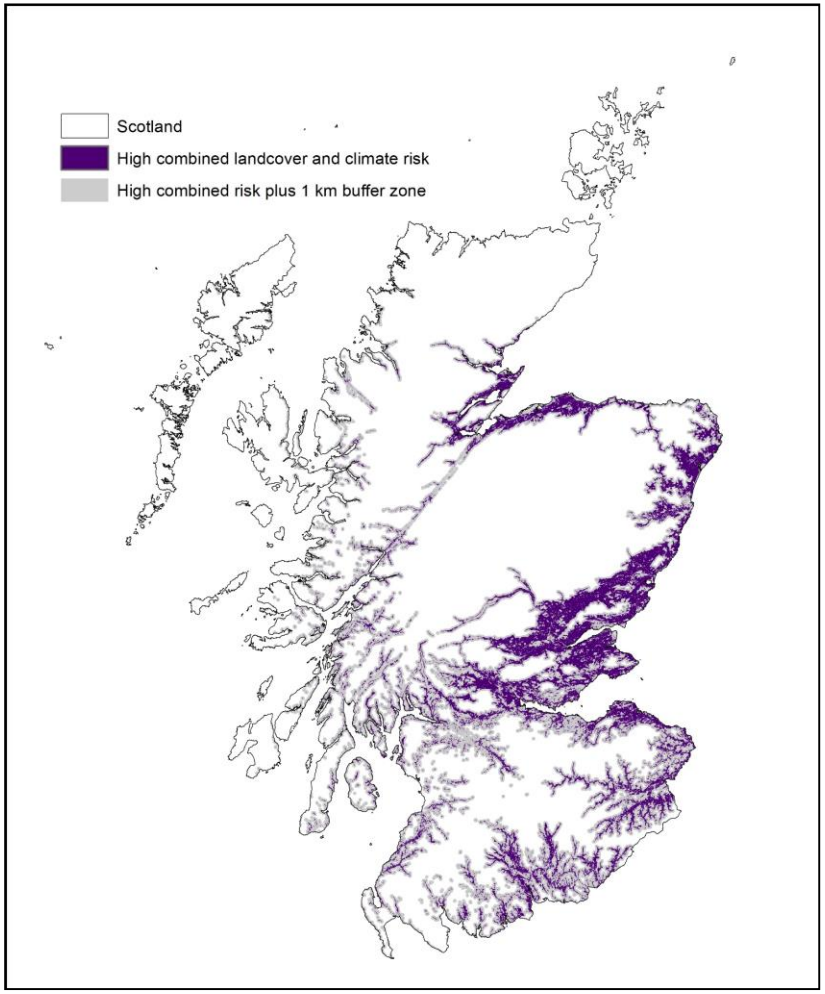
Combined risk classification

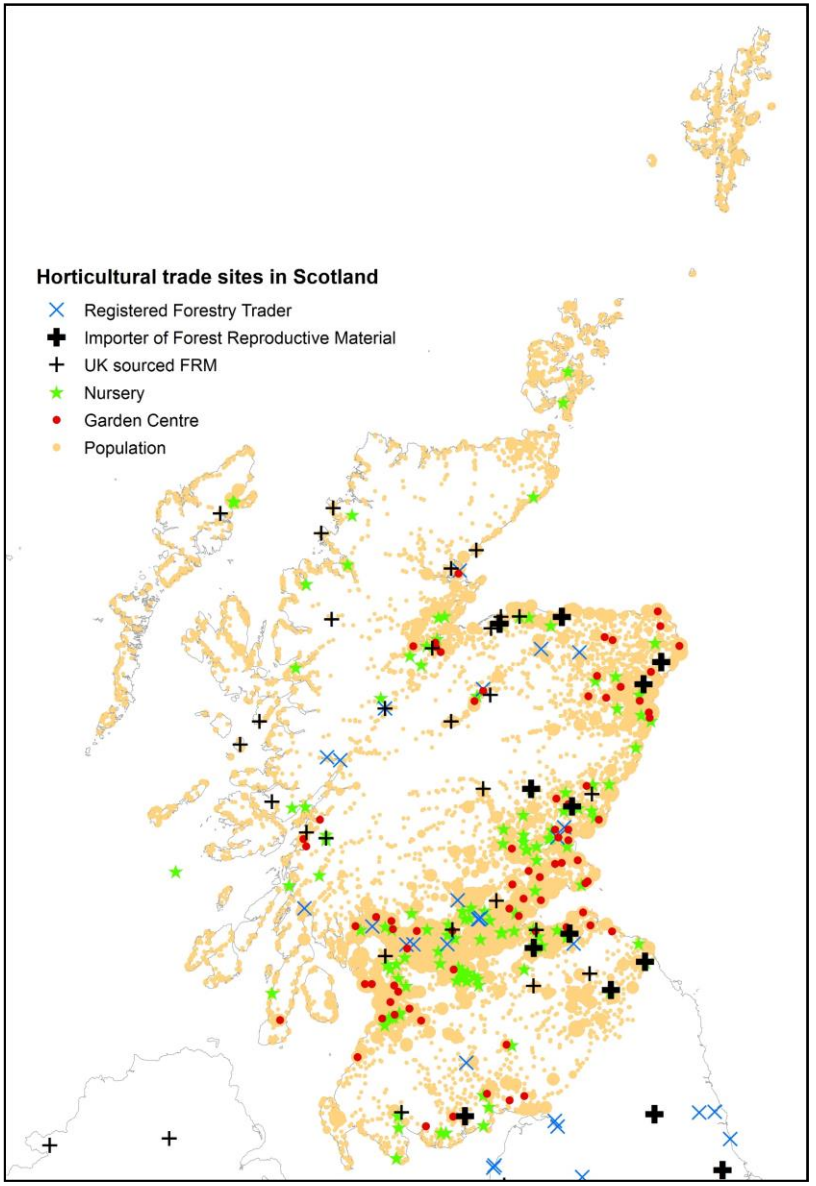


Likelihood map

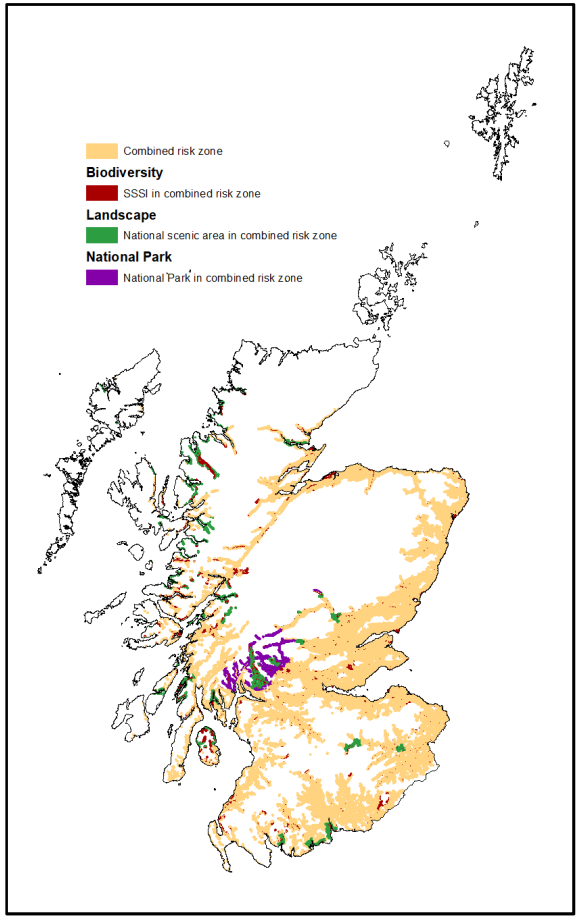
The high risk zone covers 25,035 km^2 (32%) of Scotland.

It includes 81% population
86% garden centres
79% plant nurseries
76% suppliers of FRM

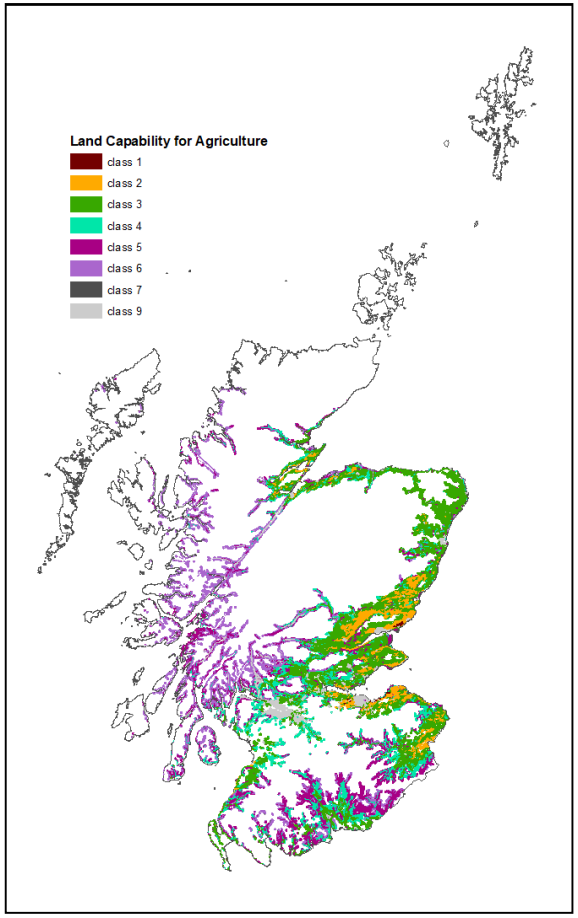




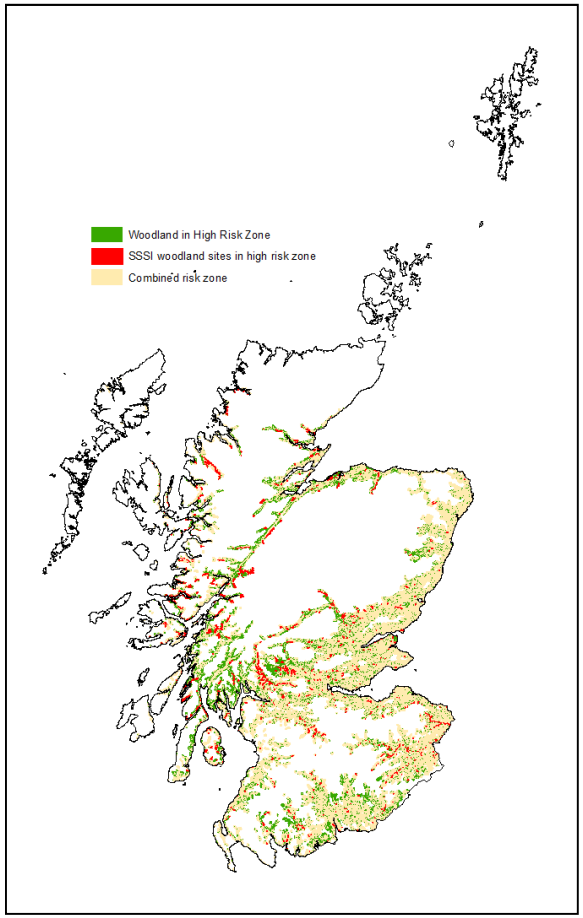
Impact maps



National Parks 16%
National Scenic Areas 15%
SSSIs 12%



Grade 1 100%
Grade 2 96%
Grade 3 32%



National Forest Estate 41%
Native woodland 33%

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Next steps

Factor	Suitable spatial data	Knowledge and Information sources	Certainty
Pathogens	▪ UK Met Office climate and projected climate data ▪ NBN data ▪ NVC – priority habitat mapping ▪ Agricultural census data	Results from the Horizon 2020 projects **POnTE** and **XF actors** will better characterise the hosts and environmental range of X.f subspecies in Europe	?
Hosts			???
Vectors		**POnTE** and **XF actors**; BRIGIT; Wren Project	?
Infection point	Citizen science reports	Surveillance by plant health inspectors + volunteers	?
Internal translocation		Trade and transport of horticultural material to be modelled as part of BRIGIT	??

POnTE Pest Organisms Threatening Europe

XF ACTORS

BRIGIT

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Using modelling to investigate the effectiveness of national surveillance monitoring aimed at detecting a *Xylella fastidiosa* outbreak in Scotland

Steven White (CEH), James Bullock (CEH), Stephen Cavers (CEH) & Dan Chapman (University of Stirling)

Centre for Ecology & Hydrology
NATURAL ENVIRONMENT RESEARCH COUNCIL

BRIGIT

UNIVERSITY of STIRLING

XF ACTORS
Xylella Fastidiosa Active Containment Through a multidisciplinary-Oriented Research Strategy

Funded by the European Union
H2020-MSCA-RISE-2016
CURE-XF - 734353

efsa
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Background

- *Xylella fastidiosa* is bacterial pathogen with over 500 known host plant species
- Once it was restricted to the Americas but was discovered in Puglia, Italy in 2013
- Since then it has spread to and killed millions of olive trees
- New outbreaks in Italy, Spain, France and Portugal, plus other discoveries
- What does this mean for Scotland?

Questions

- If Xylella is introduced to Scotland how might it spread?
- How should one conduct surveillance for Xylella in Scotland
  - National surveillance?
  - Risk-based surveillance?
- How important is the underlying epidemiology?

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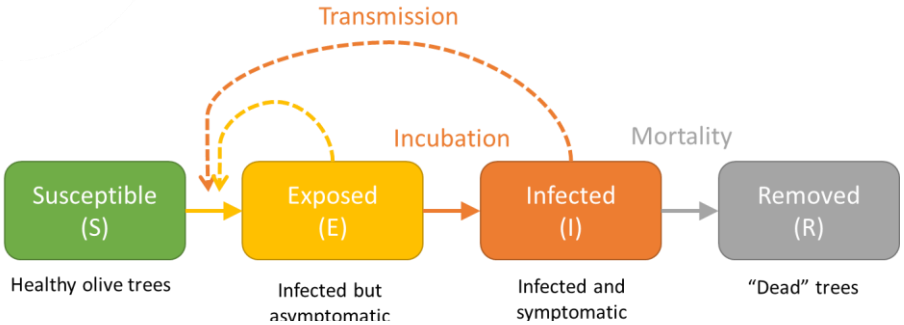
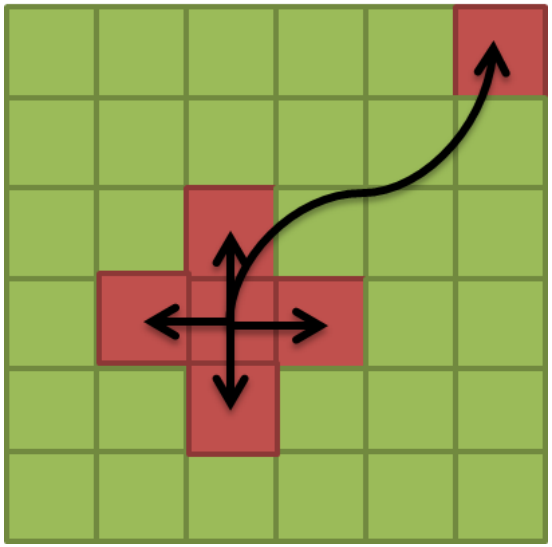
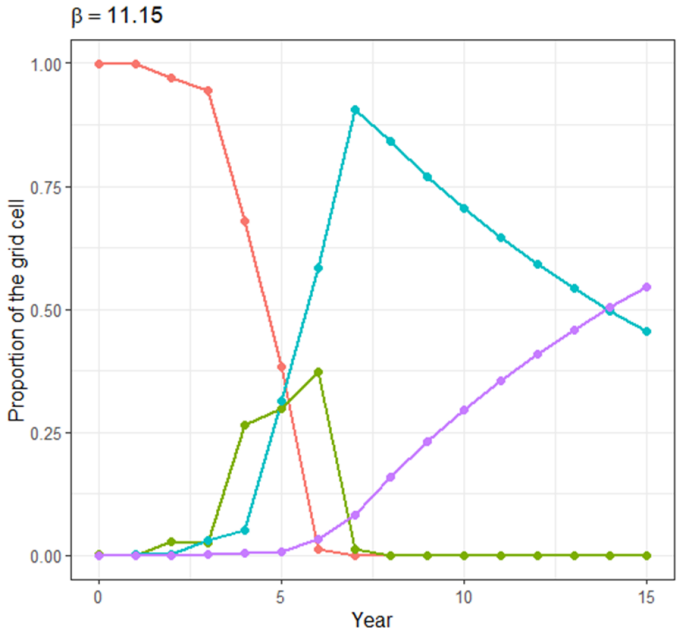
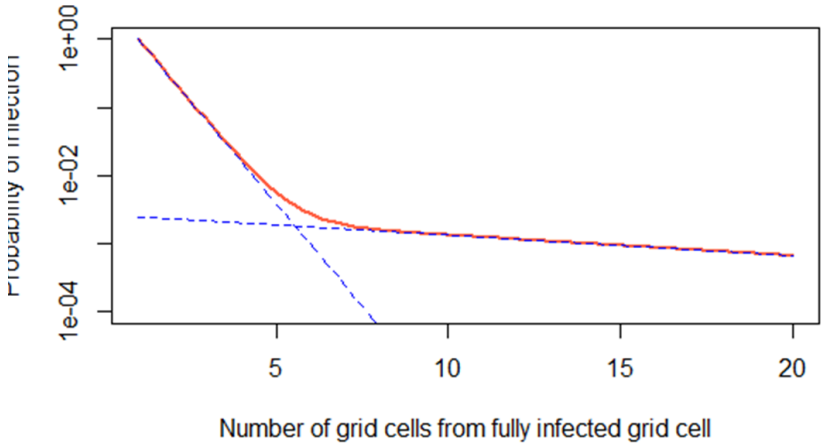
Method









Growth + Dispersal

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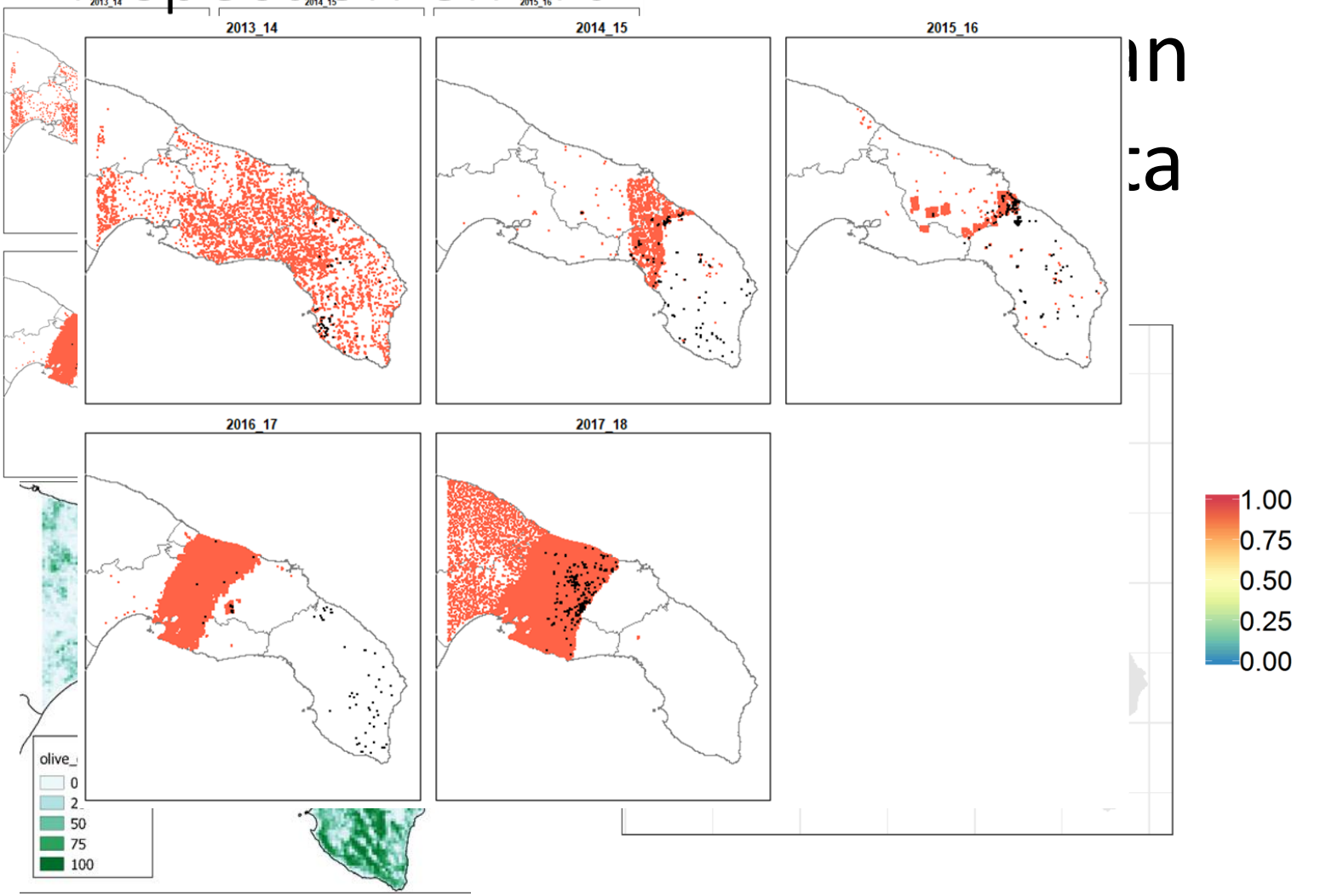
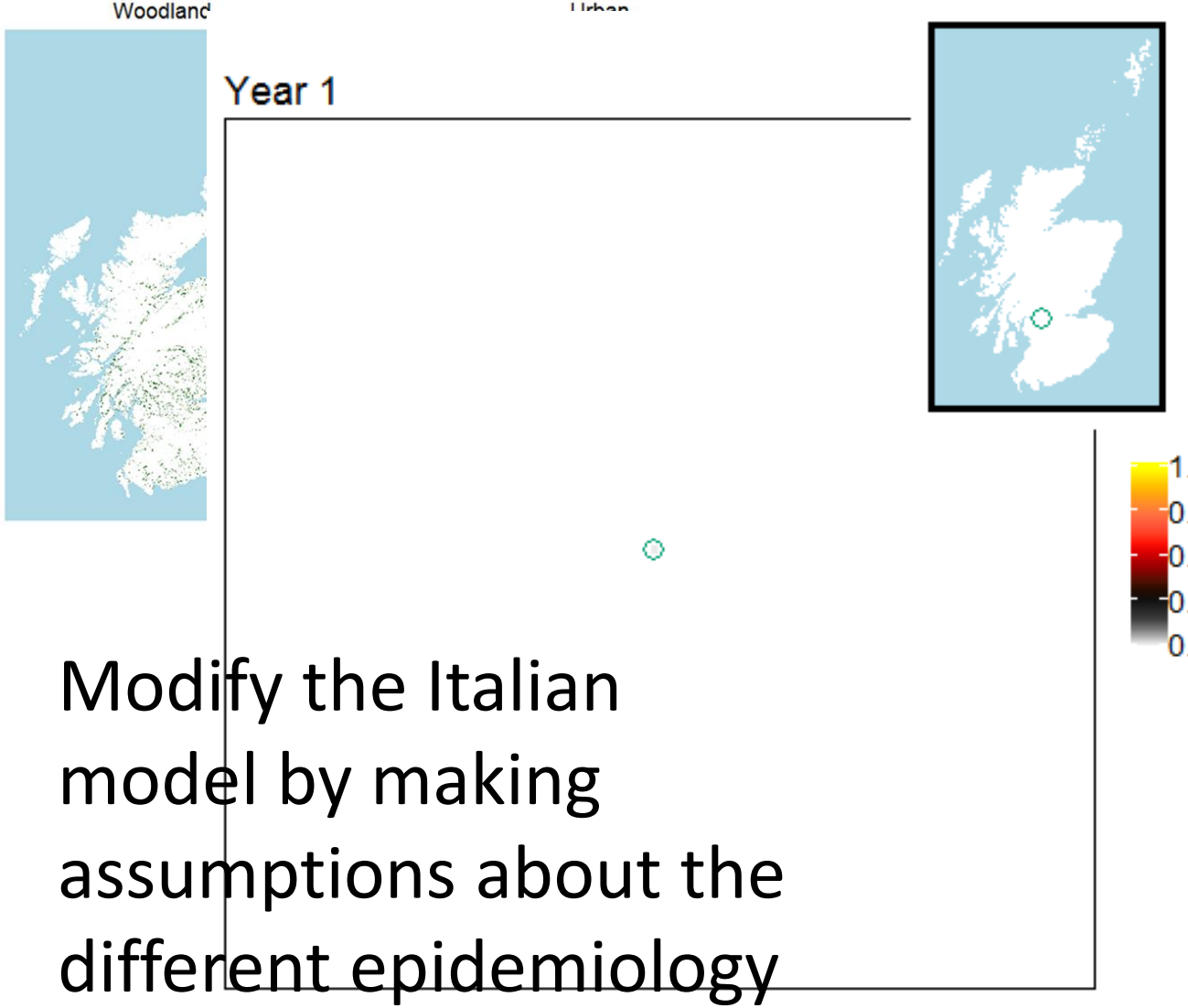
Method

Inspection effort



Scottish Scenario



Modify the Italian model by making assumptions about the different epidemiology

Scottish Surveillance

- New Xf introduction either at random location or within 10km of a nursery (locations provided by PHC)
- Surveillance is either:
  - National –100x100m grid cell is randomly tested at given intensity
  - Risk-based - surveillance is concentrated around nurseries at varying intensities and radii
- Simulated testing
  - Inspect 90-100% of host plants within 100x100m
  - Simulate lab ELISA/PCR lab testing (as done in Puglia)
  - Xf detected or not

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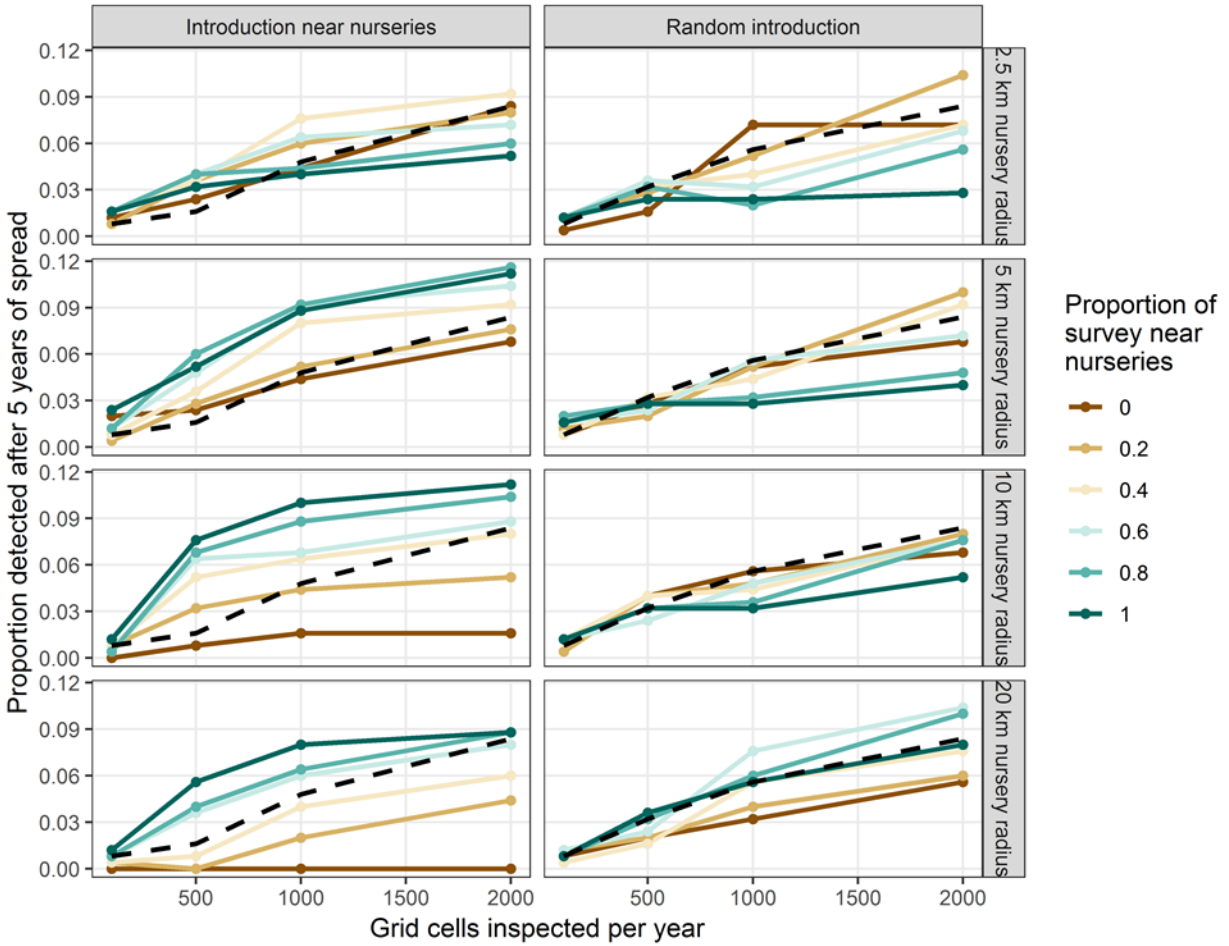
Results

Puglia-like epidemiology



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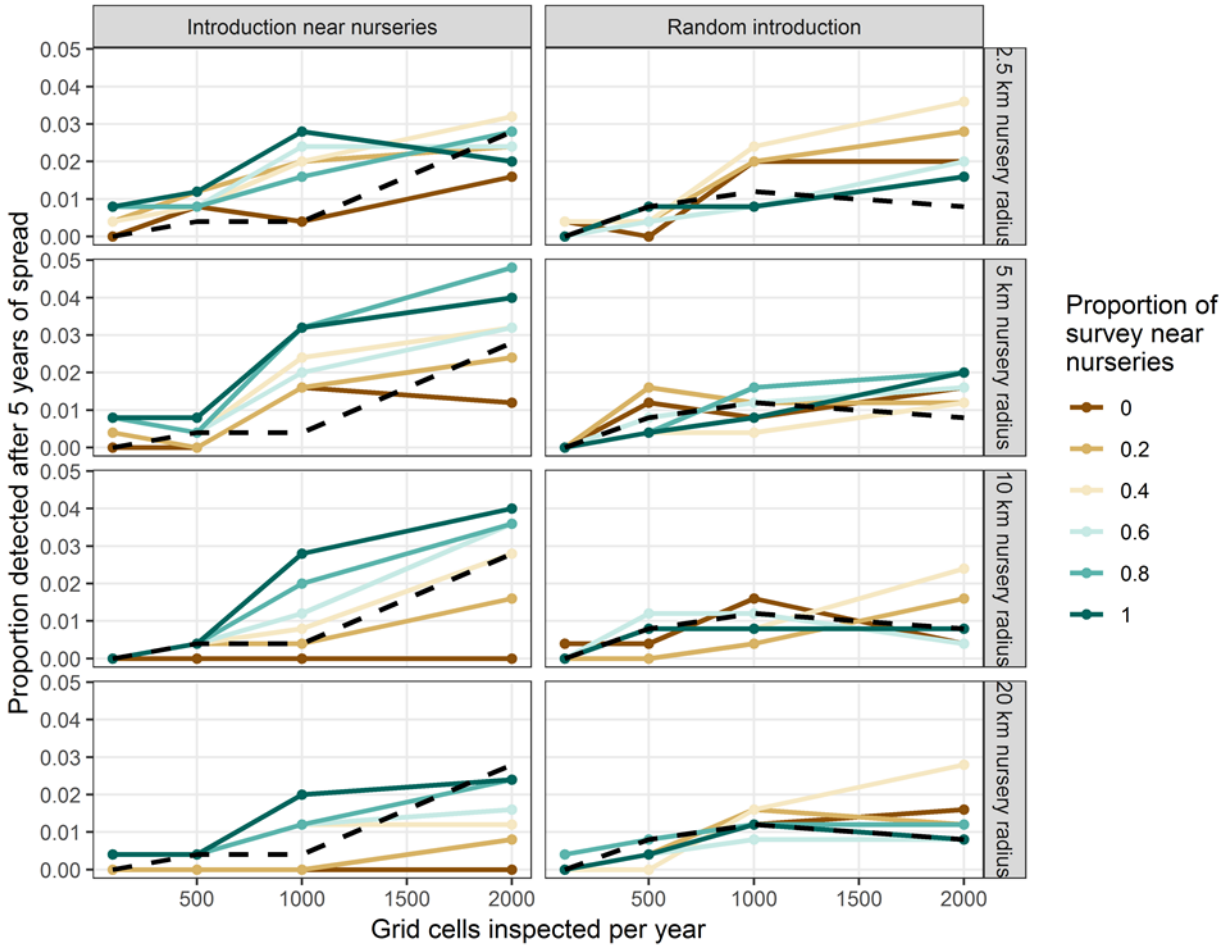
Results

Scottish-like epidemiology



Take Home Message

Best surveillance strategy is a mixture of national and risk-based surveillance

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Utilising samples collected in an existing biodiversity network to identify the presence of potential insect vectors of *Xylella fastidiosa* in the UK

Elisa Fuentes-Montemayor, Kirsty Park, Matthew Guy, Katherine Lester, Stuart A'Hara, Joan Cottrell

UNIVERSITY of STIRLING

Forest Research

SASA
Helping Scotland Grow

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Xylella fastidiosa

- Bacterial disease affecting plants (e.g. olive, oak)
- Transmitted by xylem-feeding invertebrates, e.g.
- Cercopoidea (froghoppers/spittlebugs)
- *Philaenus spumarius*
- Not known to occur in the UK, but outbreaks in mainland Europe – **important to identify factors associated with vector presence**

Main objectives

1. Examine patterns of *Xylella* vector abundance in woodland patches within agricultural landscapes, & evaluate the importance of site- and landscape-level attributes on vector abundance

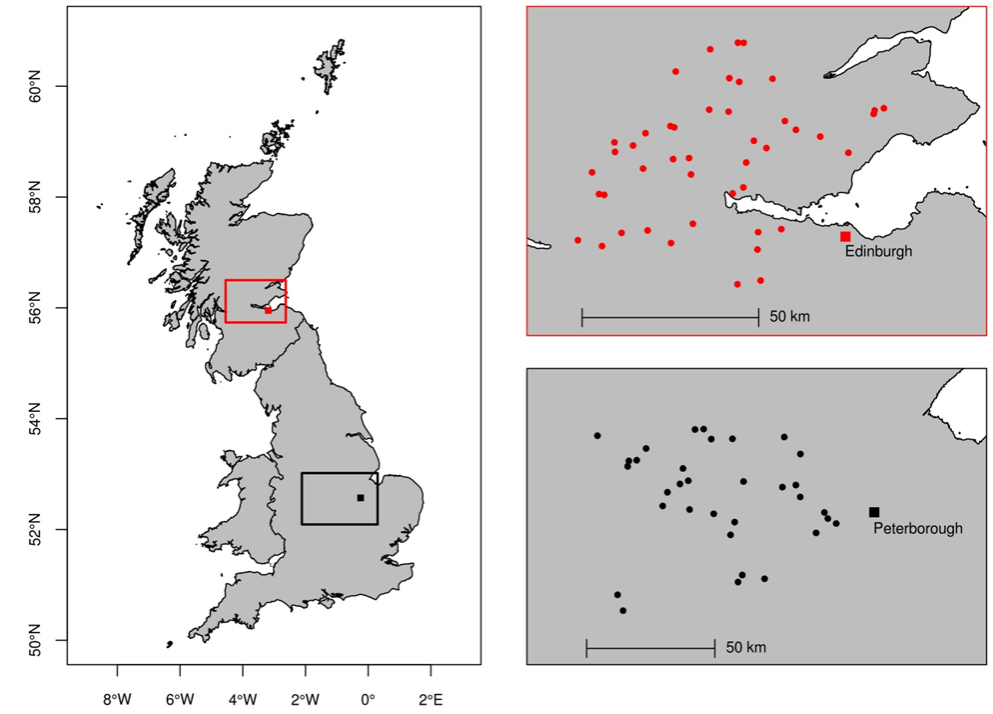
2. Conduct a meta-barcoding proof-of-concept study on a subset of samples (to test the potential of this approach as a fast and efficient way to monitor presence of vector species)

Watts *et al.* (2016) *Ecol Evol* 6: 3012–3025

Web: www.wren-project.com Email: wren@stir.ac.uk Twitter: @WrENproject

Methods (1)

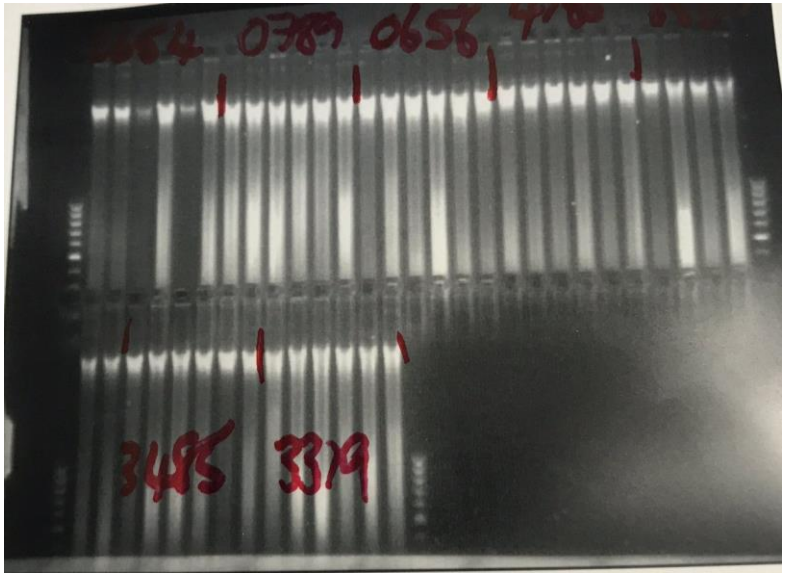
- 78 secondary woodlands, 2 study areas
- Malaise traps used to collect flying invertebrates
- Auchenorrhyncha id using morphological methods



Fuller *et al.* (2018) *J Appl Ecol* 55: 1173–1184

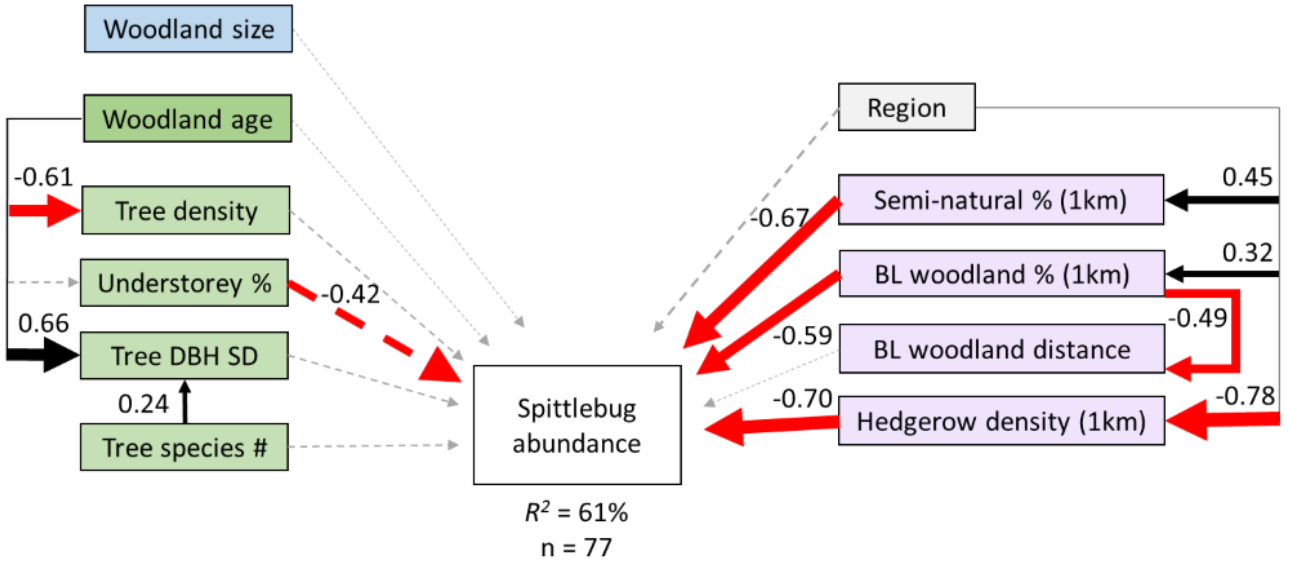
Methods (2)

- Samples from 34 secondary woodlands in Scotland subjected to meta-barcoding analysis
- Samples of 2 ‘mock communities’ (to compare primer efficiency in mixed arthropod samples of known composition)
- Species lists checked against previous records of species occurrence in Britain



Results (1)

- 10,322 Auchenorrhyncha specimens, 68 species
- 3 spittlebug species: *Philaenus spumarius* (159 specimens), *Aphrophora alni* (139) & *Neophilaenus lineatus* (57)
- Mean spittlebug abundance per site = 4.6 specimens (range 0 – 48)



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Results (2) – preliminary

- All samples produced a high number of reads (range 218,848 – 786,687 per sample)
- Sequences of some of the vector species have been identified in some of the samples (by matching them to vector DNA sequences in BOLD database)
- Complete list of species detected expected by June (bioinformatics ongoing)

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
1	OTU-ID	Size	Kingdom	Kingdom-confi	Phylum	Phylum-confi	Class	Class-conf	Order	Order-conf	Family	Family-confi	Genus	Genus-confi	Species	11649AS0(	11649AS0(	11649AS0(
2	OTU_801	1237	Animalia	1	Arthropoda	0.9997	Insecta	0.9987	Diptera	0.9937	Muscidae	0.9672	Spilogona	0.8657	Spilogona_trianguligera		1663	0
3	OTU_14	93528	Animalia	1	Arthropoda	0.9996	Insecta	0.9993	Diptera	0.9969	Psychodidae	0.9902	Psychoda	0.9566	Psychoda_phalaenoides		3221	2453
4	OTU_191	7388	Animalia	1	Arthropoda	1	Insecta	0.9994	Lepidoptera	0.9969	Noctuidae	0.9838	Apamea	0.9114	Apamea_monoglypha		823	1698
5	OTU_76	18795	Animalia	1	Arthropoda	0.9996	Insecta	0.9994	Diptera	0.9971	Muscidae	0.9909	Phaonia	0.9607	Phaonia_tuguriorum		1113	0
6	OTU_19	62388	Animalia	0.9999	Arthropoda	0.9993	Insecta	0.998	Diptera	0.9223	Muscidae	0.5713	Phaonia	0.3068	Phaonia_aberrans		4449	1
7	OTU_500	2551	Animalia	1	Arthropoda	0.9997	Insecta	0.9996	Hymenoptera	0.9979	Ichneumonidae	0.9938	Mastrus	0.9771	Mastrus_ridibundus		806	0
8	OTU_23	62779	Animalia	1	Arthropoda	0.9992	Insecta	0.9987	Diptera	0.9862	Muscidae	0.95	Coenosia	0.7959	Coenosia_means		52906	6252
9	OTU_45	27004	Animalia	1	Arthropoda	0.9995	Insecta	0.9991	Diptera	0.996	Anthomyiidae	0.9838	Mycophaga	0.9196	Mycophaga_testacea		1165	944
10	OTU_2527	335	Animalia	1	Arthropoda	0.9992	Insecta	0.9988	Diptera	0.9952	Ceratopogonidae	0.9802	Forcipomyia	0.8991	Forcipomyia_bipunctata		208	3
11	OTU_301	4606	Animalia	1	Arthropoda	0.9992	Insecta	0.9987	Diptera	0.9912	Rhagionidae	0.9781	Symphoromyia	0.8868	Symphoromyia_crassicornis		5601	0
12	OTU_29	54926	Animalia	1	Arthropoda	0.9992	Insecta	0.9987	Diptera	0.9837	Muscidae	0.9328	Coenosia	0.7959	Coenosia_means		46129	5131
13	OTU_1545	402	Animalia	0.9999	Arthropoda	0.9993	Insecta	0.9985	Diptera	0.9587	Dolichopodidae	0.7951	Dolichopus	0.5397	Dolichopus_shelfordi		574	0
14	OTU_21	61048	Animalia	1	Arthropoda	0.9995	Insecta	0.9992	Lepidoptera	0.9961	Noctuidae	0.9809	Apamea	0.8991	Apamea_crenata		19481	1
15	OTU_2773	105	Animalia	0.9999	Arthropoda	0.9992	Insecta	0.9987	Diptera	0.9787	Muscidae	0.8983	Coenosia	0.726	Coenosia_means		130	17
16	OTU_1148	894	Animalia	0.9999	Arthropoda	0.9994	Arachnida	0.9992	Opiliones	0.9969	Phalangiidae	0.9902	Mitopus	0.9566	Mitopus_morio		167	0
17	OTU_24	55441	Animalia	1	Arthropoda	0.9995	Insecta	0.9992	Lepidoptera	0.9961	Noctuidae	0.9809	Apamea	0.8991	Apamea_crenata		17758	0
18	OTU_67	21013	Animalia	1	Arthropoda	0.9992	Insecta	0.9989	Diptera	0.9944	Fanniidae	0.9773	Fannia	0.8827	Fannia_aff._subsimilis		635	1588
19	OTU_15	77459	Animalia	1	Arthropoda	0.9996	Insecta	0.9993	Diptera	0.9969	Muscidae	0.9874	Helina	0.9361	Helina_evecta		7636	3702
20	OTU_26	53897	Animalia	1	Arthropoda	0.9995	Insecta	0.9993	Diptera	0.9965	Chironomidae	0.9888	Metriocnemus	0.9402	Metriocnemus_albolineatus		3279	1200

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Key messages

- *Xylella* vectors (spittlebugs) more abundant in landscapes with high proportion of agricultural land
- Site-level characteristics of little importance
- Metabarcoding is an efficient way to monitor presence of the main *Xylella* vector species
- Potentially applicable to screen for other invertebrate pests (but further work needed)

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