Rapid Pest Risk Analysis for Elm Yellows

Disclaimer: This document provides a rapid assessment of the risks posed by the pest to the UK in order to assist decisions on a response to a new or revised pest threat. It does not constitute a detailed Pest Risk Analysis (PRA) but includes advice on whether it would be helpful to develop such a PRA and, if so, whether the PRA area should be the UK or the EU and whether to use the UK or the EPPO PRA scheme.

STAGE 1: INITIATION

1. What is the name of the pest?

Elm yellows phytoplasma: novel taxon, '*Candidatus* Phytoplasma ulmi'

Common name of the pest:
Elm yellows
Elm phloem necrosis
Nécrose du liber de l'orme (French)
Phloemnekrose der Ulme (German)

Taxonomic position:
Kingdom - Bacteria; Phylum - Tenericutes; Class - Mollicutes; Order - Acholeplasmatales; Family - Acholeplasmataceae; Genus – Phytoplasma

Special notes on nomenclature or taxonomy:
The Elm Yellows (EY) pathogen belongs to a wider grouping of phytoplasmas that occur on a number of tree species such as alder (*Alnus*), hornbeam (*Carpinus*) and olive (*Olea*), as well as woody plants such as grapevine (*Vitis*) and *Rubus.* Only with the advent of DNA sequencing and the use of molecular markers has it proved possible to differentiate the EY phytoplasma within this group that affects elms (Sinclair, 2000) and *Candidatus* Phytoplasma ulmi is classified on the basis of analysis of the ribosomal protein gene operon 16SrV-A (Lee *et al.*, 2004).

The EPPO datasheet for Elm Phloem Necrosis notes that Sinclair (1981) gives the name 'elm yellows phytoplasma' to this organism on the basis that the phloem necrosis symptom occurs in the highly susceptible *Ulmus americana* but 'yellows' (chlorotic foliage) is the more characteristic symptom in several elm species. The European Elm Yellows phytoplasma has been considered to be distinct from the North American Elm Yellows phytoplasma. However, more recent genetic analyses comparing the phytoplasma from elm samples with symptoms of elm yellows collected from the USA, Italy, France, Germany suggests they are the same or closely similar based on the 16S rRNA gene, ribosomal protein and *secY* gene sequences (eg Jović *et al.*, 2011; Lee *et al*., 1993, 1995, 2004; Maürer *et al*., 1993; Marcone *et al.*, 1997).

2. What is the pest's status in the EC Plant Health Directive (Council Directive 2000/29/EC) and in the lists of EPPO?

The North American Elm Yellows phytoplasma has EU Annex designation **I/AI**. It is also the subject of an EPPO datasheet (EPPO, 1997).

3. What is the reason for the rapid assessment?

Under Annex IVA1 14 of the EC Plant Health Directive living elm material from North America into EU Member States can be imported only if no symptoms of Elm Phloem Necrosis (Elm Yellows) have been observed at the place of production of its immediate vicinity since the beginning of the last complete cycle of vegetation. These measures are designed to prevent the introduction of Elm Yellows (EY). However, this is based on the assumption that the phytoplasma that causes EY and is present in North America is distinct from the EY recognised in some European countries. This position has not been reviewed in the light of findings of EY in a number of EU Member States and recent studies evaluating the relatedness of the EY phytoplasma from North America and Europe. Additionally, Mittempergher (2000) suggested that the occurrence of EY in Europe could result in the risk of the pest spreading with trade exchanges of cuttings of clonal material, either of indigenous elms or of hybrids between European and Asian elm species.

Most recently, the use of resistant elm material from elm breeding programmes in Europe has raised the possibility that EY could be introduced into the UK via planting stock potentially exposed to this disease in the original place of production (Webber, 2013, unpublished report. Since that report, the presence of the EY phytoplasma has been confirmed in some planting/propagative stock of Morfeo imported from Italy (Fera 2014, unpublished record). Morfeo is a Dutch elm disease (DED) resistant elm clone derived from a cross between *Ulmus chenmoui* x Dutch hybrid clone 405 (Santini *et al*., 2011), and EY is known to be present in Italy where the material came from. In the light of these findings, this Rapid Pest Risk Analysis is required to determine the status of the pathogen in the UK and whether or not a full PRA is required, and to indentify future actions which might be taken to prevent ingress of the pest or mitigate its effects.

<u>STAGE 2: RISK ASSESSMENT</u>

4. What is the pest's present geographical distribution?

Following the initial descriptions in the mid-western United states in the 1930s (Swingle 1938), EY was recognised as the cause of mortality in *Ulmus americana.* By the late 1990s/early 2000s, EY had spread further east and north (including southern Canada) and had been reported from 25 States with occasional records (usually single trees) in States beyond the main geographical area of distribution (Sinclair, 2000) (see Table 1).

Until the 1980s, EY was believed to be absent from Europe and present only in North America. The first formal report of the pest came from Italy (Pisi *et al*., 1981). Following this, sporadic EY symptoms were seen on *Ulmus minor* throughout all areas of Italy including Sardinia and Sicily and very occasionally on *U. pumila* (Mittempergher, 2000). *Ulmus chenmoui* is also known to suffer from a decline in Italy that is associated with the presence of the EY phytoplasma (Sfalanga *et al.*, 2002). The pest has also been confirmed as present in France (Boudon-Padieu *et al*., 2004), Germany (Maürer *et al*., 1993) and Serbia (Jović *et al.*, 2011) (Table 1) and there are unconfirmed reports from Austria and the Czech Republic.

Table 1. Distribution of Elm Yellows based on confirmed reports.

North America	Eastern United States (including Alabama, Arkansas, Connecticut, Georgia, Illinois, Indiana, Iowa, Kansas, Kentucky, Maryland, Massachusetts, Minnesota, Mississippi, Missouri, Nebraska, New, Jersey, Ne York, Ohio, Oklahoma, Pennsylvania, Tennessee, West Virginia, plus occasional records outside the main distribution range), southern Ontario, Canada
Central America	No record
South America	No record
Caribbean	No record
Europe	Italy, France, Germany, Serbia
Africa	No record
Asia	No record
Oceania	No record

5. Is the pest established or transient, or suspected to be established/transient in the UK?
Asian and European elm species are considered to be moderately or highly resistant to EY. For this reason it has been suggested that the EY phytoplasma is an elm pathogen that is native to and unimportant in Europe or Asia, but was accidentally introduced into the USA during the late 1800s (EPPO, 1997). The pest is considered absent from the UK.

However, recently some elm cultivars characterised as highly resistant to DED and planted in southern England, have included the Italian clone Morfeo and the Dutch/French clone Lutèce. In 2013, some 2 year-old Morfeo trees propagated from scion material imported from Italy in 2012 started to show symptoms that were suggestive of EY infection (Figure 1). The presence of the EY phytoplasma in a sample of the symptomatic material has since been confirmed (Fera, 2014, unpublished records). Apart from being produced in Italy where EY is now considered widespread, Morfeo is a clone derived from a cross with *Ulmus chenmoui*, an elm species that is often affected by a decline syndrome that is associated with the presence of the EY phytoplasma in Italy (Sfalanga *et al.*, 2002).

Figure 1: Unusual appearance of 2-year old UK propagated examples of elm clone Morfeo. Left, unusual blanched leaf appearance; right, plant with red autumn colouration with stunted dwarf-leaf growth and small shoots similar to those found on EY affected trees in Italy.

6. What are the pest's natural and experimental host plants; of these, which are of economic and/or environmental importance in the UK?

On the basis of unique DNA and biological properties, the elm yellows phytoplasma associated with *Ulmus* species represents a novel taxon '*Candidatus* Phytoplasma ulmi'. EY1^T is the reference strain for this taxon and originates from an elm yellows symptomatic *U. americana* (Lee *et al.*, 2004). All strains occur within the 16SrV-A subgroup induce a range of symptoms depending on the elm species affected, which can include epinasty, yellowing, dwarfing and premature casting of leaves, witches'-brooms at the tips of twigs and branches and precocious opening of vegetative buds. There is a possibility that EY which affects *Ulmus* could infect in other hosts, but even if this is the case it would depend on available vectors feeding and thereby transmitting *Ca.* Phytoplasma ulmi between different host groups. Carraro *et al.* (2004) report that alder yellows and EY are closely related and on an experimental basis they succeeded in transmitting alder yellows to elm (*U. minor*). However, given that currently recognised vectors have not been found to naturally transfer this phytoplasma to any other hosts apart from *Ulmus*, the likelihood of this occurring is low.

In the context of the EY subgroup 16SrV-A, known hosts include a number of elm species.

- Species most affected in North American include native species *U. americana, U. rubra, U. alata, U. serotina, U. crassifolia*, and the natural hybrid *U. pumila* x *rubra.* The Asiatic species *U. parvifolia* has also been confirmed as a host in North America.

- In Europe, known hosts have been reported to include the native species *U. minor* and the introduced Asiatic species *U. japonica*, *U. parvifolia*, *U. pumila* and *U. chenmoui*.

- No information has been obtained to confirm if any Asiatic elms have been found to be affected by EY in their natural geographic range.

Findings of confirmed natural hosts of EY and associated symptoms are shown in Table 2.

Mittempergher (2000) compiled a susceptibility rating of elm species to EY, based on the symptoms observed in elms species and their hybrids being used in the Dutch elm disease elm resistance breeding programme in Italy. He ranked *U. americana* as highly susceptible, species such as *U. chenmoui*, *U. villosa*, *U. japonica* and *U. parvifolia* had some susceptibility, whilst *U. minor*, *U. laevis and U. glabra* and *U. pumila* were usually the least affected with only light symptoms or even asymptomatic infection occurring. However, even with less susceptible species, symptom expression is related to size and small trees can develop severe symptoms and may suffer mortality (Mittempergher, 2000). In addition, certain elm species or clones can have a high frequency of infection but a low level of symptom expression because they are able to tolerate EY infection; this applies particularly to species such as *U. pumila*.

Economically and / or environmentally important elms species that show some susceptibility to EY are present in the UK. Some, including Asiatic and North American elm species, are used occasionally as ornamental species, as are some of the Dutch elm disease resistant selections (see Dunn, 2000), but *U. minor* (field elm) is widespread in the UK. *Ulmus minor* is a highly polymorphic European species, although its taxonomy remains a matter of contention (Collin *et al.*, 2000). A number of species, sub-species or varieties have been grouped into this taxon including smooth-leaved elm, Cornish elm, Plot's elm, Wheatley elm and English elm. For the purposes of this document, the distribution of two elm species within the species aggregate *U. minor* known to have or likely to have some susceptibility to EY are shown (Fig. 2); they comprise *Ulmus procera* (English elm – see Fig. 2A) and *Ulmus minor* (smooth-leaved elm, also known as *U. carpinifolia* – see Fig. 2B). The only true UK native elm species, *U. glabra* (wych elm), has not been confirmed as a host of EY; Mittempergher (2000) reports that no symptoms of EY have been observed on this species in Europe and it is considered to be resistant to EY in the USA (Sinclair, 2000).

Table 2. Natural *Ulmus* hosts of Elm Yellows

Host		Family	Symptom/ location for detection	Location	Reference
Scientific name	Common name				
U. americana	America elm	Ulmaceae	Phloem necrosis, associate-ed with foliar epinasty, yellowing, leaf fall and mortality Infected phloem smells of wintergreen	USA	Sinclair *et al.*, 1972; Sinclair,1981; 2000; Martin, 2012
U. alata	Winged elm	Ulmaceae	Phloem necrosis, associate-ed with foliar epinasty, yellowing, leaf fall and mortality Infected phloem smells of wintergreen	USA	Sinclair, 2000; Martin, 2012
U. crassifolia	Texas Cedar elm	Ulmaceae	Phloem necrosis, associate-ed with foliar epinasty, yellowing, leaf fall and mortality Infected phloem smells of wintergreen	USA	Sinclair, 2000; Martin, 2012
U. rubra	Slippery elm	Ulmaceae	Phloem necrosis, yellow-green leaves, witches brooms, mortality Infected phloem smells of maple syrup	USA	Sinclair, 2000; Martin, 2012
U. serotina	September elm	Ulmaceae	Phloem necrosis, associate-ed with foliar epinasty, yellowing, leaf fall and mortality Infected phloem smells of wintergreen	USA	Sinclair, 2000; Martin, 2012
U. rubra x *pumil*a	Hybrid red	Ulmaceae	Phloem necrosis, associate-ed with foliar epinasty, yellowing, leaf fall and mortality	USA	Sinclair, 2000
U. parvifolia	Lacebark elm	*Ulmaceae*	Witches brooms, declining growth, foliage with distinctively yellow or red leaves at the end of the season	USA, Italy	Sinclair, 2000 Mittempergher, 2000
U. pumila	Siberian elm	Ulmaceae	Witches brooms	Italy	Mittempergher, 2000
U. chenmoui	Chenmou elm	Ulmaceae	Paler leaves, generalised decline, red leaves	Italy	Sfalanga *et al.*, 2002
U. japonica	Japanese elm	Ulmaceae	Yellowing, arrested growth, epicormics	Italy	Mittempergher, 2000
U. villosa	Cherry-bark elm	Ulmaceae	Decline, severe symptoms in young trees	Italy	Mittempergher, 2000
U. minor	Field elm	Ulmaceae	Witches brooms, stunting	Italy, France	Conti et al., 1987 Mittempergher, 2000 Boudon-Padieu *et al.*, 2004

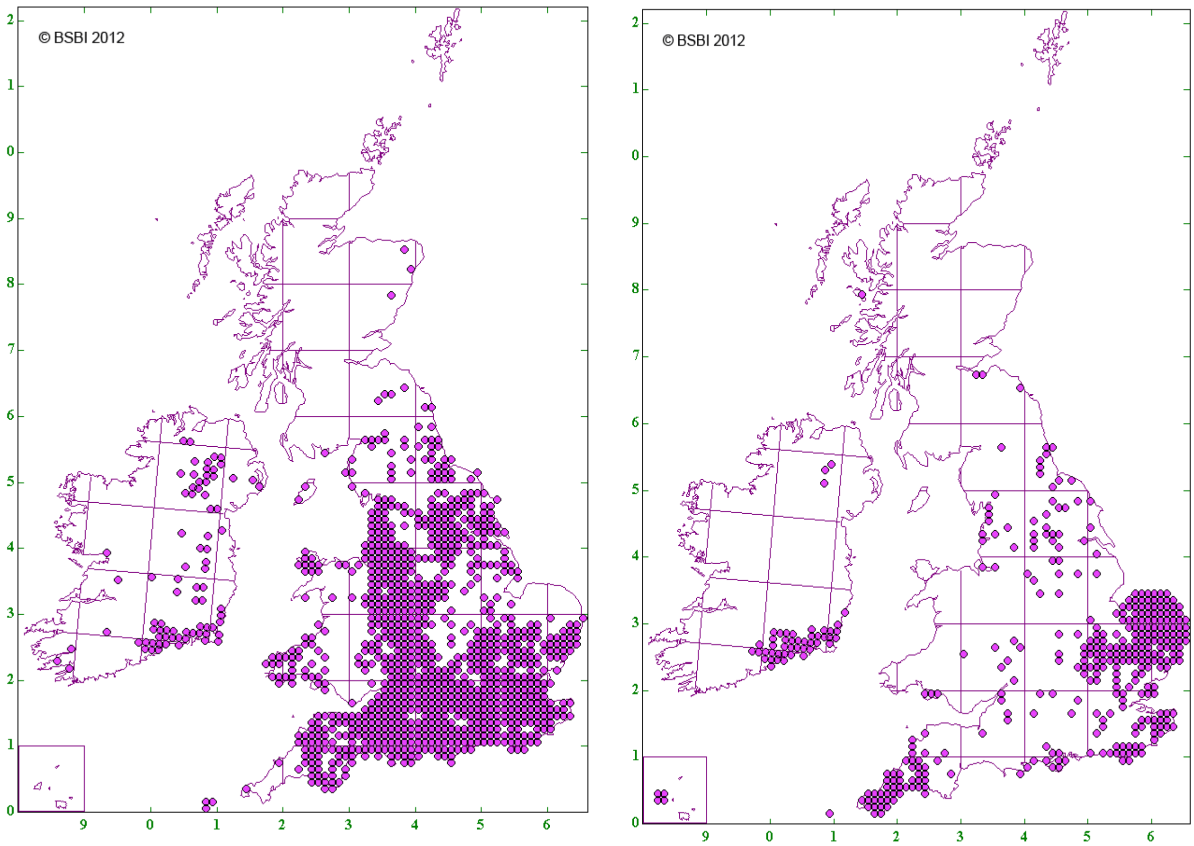

Figure 2: Shaded areas indicate presence of *Ulmus* spp in hectads (10 km square) over the British Isles; Fig 1A, *Ulmus procera*; Fig 1B, *Ulmus minor* (Figures taken from the Botanical Society of the British Isles Maps Scheme – http://www.bsbimaps.org.uk/atlas/main.php

7. If the pest needs a vector, is it present in the UK?

EY is transmitted by insect vectors (McCoy *et al*., 1989), and all known insect vectors of phytoplasmas are phloem-feeding hemiptera (leafhopper, planthopper and psyllid species). In North America, the main vector is the leafhopper *Scaphoideus luteolus* (Baker, 1949) but other leaf hopper species are also implicated (Matteoni and Sinclair, 1988), and Rosa *et al.* (2014) confirmed that the spittlebug *Lepyronia quadrangularis* and a species of *Latalus* leafhopper can act as vectors. The same species are not present in Europe and there is less certainty about the vectors that are most significant. Carraro *et al.* (2004) showed that the leafhopper *Macropsis mendax* could transfer the EY phytoplasma between infected and healthy trees of *U. minor* and *U. pumila.* Various leafhopper and planthopper species including *Philaenus spumarius*, *Iassus scutellaris*, *Cixius sp.* and *Allygidius furcatus* have also been found to carry an EY phytoplasma (Boudon-Padieu *et al.,* 2004; Mittempergher, 2000). Some of these species are known in Britain and could potentially act as vectors. They include:

- *Cixius* species (eg *C. nervosa*): widespread and common on deciduous trees and shrubs (http://www.britishbugs.org.uk/homoptera/Cixiidae/Cixius_nervosus.html),
- *Philaenus spumarius* – Common Froghopper: a common species across a wide range of plants (http://www.britishbugs.org.uk/homoptera/Aphrophoridae/Philaenus_spumarius.html),

- *Iassus scutellaris*: considered common in certain localities but confined to the south of England, particularly associated with elm and recorded in hedgerows of English elm (http://www.britishbugs.org.uk/homoptera/Cicadellidae/Iassus_scutellaris.html),
- *Alligidius* (*Allygus*) *commutatus*: common http://www.gbif.org/species/2030346
- *Macropsis mendax* (synonym *Macropsis glandacea*): uncommon, present in the eastern and south east England https://data.nbn.org.uk/Taxa/NHMSYS0020442424/Grid_Map

8. What are the pathways on which the pest is likely to move and how likely is the pest to enter the UK?

Based on the known infection biology of EY in elm and other host species, the pest can be propagated by vegetative multiplication of plant material already infected with EY (Caudwell *et al*., 1994; Mittempergher, 2000). If elms are infected, EY can persist in the roots and affect new growth in the spring. In international trade therefore, infected elm planting material is likely to be the pathway for the pest to enter the UK and this has apparently occurred on at least once occasion with clonal elm material brought in from Italy. There is also the possibly that infective vectors could be associated with plants originating from areas where the pest and vectors are present. However, the vector is most likely to be carried as eggs and transovarial transmission of the EY phytoplasma does not apparently occur with all vectors (Anon, 2002; EPPO, 1997).

As an obligate parasite that invades living phloem sieve cells, there is no available evidence to suggest that EY could move via timber or soil pathways.

Host plants for planting:	Very unlikely		Unlikely		Moderately likely		Likely	X	Very likely	
Timber / wood	Very unlikely	X	Unlikely		Moderately likely		Likely		Very likely	
Soil	Very unlikely	X	Unlikely		Moderately likely		Likely		Very likely	

9. How likely is the pest to establish outdoors or under protection in the UK?

Establishment under protection is possible, particularly if elm material is being used as scions for vegetative propagation and the process is being undertaken under controlled condition. The EY agent can be transmitted from plant to plant through bark patch graft inoculations (Braun and Sinclair, 1979). Protection might also favour any leaf or plant hopper associated with the plants that might act as a vector, but could also exclude any vector thereby making establishment and spread from such conditions unlikely.

In the wider environment in Europe, EY has been confirmed in elms located in southern France extending north to just south of Paris (Mäurer *et al*., 1993), and throughout all parts of Italy (Mittempergher, 2000). In the USA minimum winter temperatures of below -26°C are considered to be climatically limiting for EY, and the disease tends to persist at elevations below 400m, especially in lake and river basins (Matteoni and Sinclair, 1988; Sinclair, 2000). Mittempergher (2000) remarks that the disease is likely to be present in other Mediterranean countries with a climate similar to that of Italy, but there is no reason to suppose that EY could not establish throughout much of Britain, providing suitable vectors and susceptible elm species are available to the pest.

Outdoors:	Very Unlikely		Unlikely		Moderately likely		Likely	X	Very likely	
Under protection:	Very Unlikely		Unlikely	X	Moderately likely		Likely		Very likely	

10. How quickly could the pest spread in the UK?

Insect vectors acquire the phytoplasma when they feed on young shoots of infected elms. The same vectors then transmit EY to healthy trees during feeding, but the spread is mostly local. In addition, EY can spread among closely spaced trees of the same species via root grafts.

Over long distances spread is via infected plants but additionally it has been suggested that long-distance wind-borne transport of EY-carrying vectors can result in infections occurring beyond the main range of the disease in the USA (Hart, 1978; Sinclair, 2000). However Sinclair (2000) also reports that epidemics of elm yellows, although locally spectacular, do not spread rapidly. From 1975-85 Lanier *et al.* (1988) documented the rate of spread of EY in the Syracuse area of New York at 1 km per year in a westerly direction and less than 3 km over a decade in a northerly direction. Topography and available vectors appear to influence spread significantly. The disease can be endemic for many years between flare-ups in a given locale, and even subside in some cases. On that basis, natural spread is likely to be slow to moderate (with a high degree of uncertainty because of lack of information about effective vectors and the optimal climatic conditions required for spread). In the trade, long-distance movement of infected plants could result in rapid spread.

Natural spread:	Very slow		Slow	X	Moderate		Rapid		Very rapid	
In trade:	Very slow		Slow		Moderate		Rapid	X	Very rapid	

11. What is the area endangered by the pest?

The pest could potentially become established throughout the range of its known hosts (principally *U. minor*) which are found in woodlands, hedgerows and roadsides, parklands and gardens (see Figure 2). Although Dutch elm disease (pathogen *Ophiostoma novo-ulmi*) has killed much of the mature elm stock throughout the UK, particularly in the south of England, many millions of young, regenerated elms remain across the country despite being exposed to repeated waves of the disease at 15 to 20 year intervals (Harwood *et al*., 2011).

12. What is the pest's economic, environmental or social impact within its existing distribution?

In North America, EY is lethal to native elm species and has killed hundreds of thousands of elm trees from the Great Plains eastward to New York and south to Mississippi (Swingle, 1942; Sinclair, 2000), but its impact has been overshadowed by Dutch elm disease (DED). It has not proved possible to control EY on a practical scale and Sinclair (2000) comments that the impact of EY in undermining elm management for Dutch elm disease has been underestimated and it has significantly disrupted elm conservation programmes. In addition, the use of some DED resistant elm clones produced from long-term breeding programmes has had to been abandoned in some instances due to EY, notably, *Ulmus americana* 'Liberty' clones planted to replace trees lost to DED.

Economic:	Very small		Small		Medium	X	Large		Very large	
Environmental:	Very small		Small		Medium		Large	X	Very large	
Social:	Very small		Small		Medium	X	Large		Very large	

13. What is the pest's potential to cause economic, environmental or social impacts in the UK?

The major loss of elms in the UK since the late 1960s due to a second DED epidemic has largely reduced countryside elm to an understory species (Brasier, 1996; Webber, 2010). Despite this, pockets of mature elm and large individual trees exist around the countryside in areas such as Cambridgeshire and East Sussex. The population of over 50,000 elms conserved in the Elm Disease Control areas of Brighton, Hove and parts of East Sussex also includes many large veteran elms. The 17,000 elms within Brighton and Hove alone comprise the National Elm Collection, recognised as a national resource since 1998 http://www.brighton-hove.gov.uk/content/leisure-and-libraries/parks-and-green-spaces/national-elm-collection . Some of the elms within this National Collection are considered the largest and oldest surviving English elms in Europe. They are also home to a colony of elm-dependent White-letter Hairstreak butterflies, a species which is entirely reliant on elm for food and has been on the decline in areas that have suffered with DED.

In a more recent initiative, the Hampshire & Isle of Wight Branch of *Butterfly Conservation* (BC) has initiated trials of some elm cultivars considered highly resistant to DED in 2000, including the Italian clone Morfeo and the Dutch/French clone Lutèce. The trials are in fulfilment of Objective 5 for the White-letter Hairstreak (WLH) in BC's South Central Regional Action Plan: to evaluate their potential as host plants for the butterfly, now a DEFRA UK Biodiversity Action Plan 'Priority' species (no. 945) on account of its increasing scarcity as a consequence of the DED pandemic. Details of the trials are provided in the Butterfly Conservation Elm Trials report (2013).

On this basis, the economic impacts of EY are likely to be limited in the UK due to low levels of susceptibility in native and naturalised elm species (Mittempergher, 2000) and the competing effects of DED. In contrast, environmental and social effects are likely to be higher (medium to large) at least at a local level because of the potential for EY to undermine the National Elm Collection and DED control efforts, to affect ornamental elm species and clones that are DED resistant but have susceptibility to EY, and the impact on butterfly conservation efforts which have been making use of clones that may either be susceptible to EY or potentially act as carriers for EY to move into the wider environment.

Economic:	Very small		Small	X	Medium		Large		Very large	
Environmental:	Very small		Small		Medium	X	Large		Very large	
Social:	Very small		Small		Medium	X	Large		Very large	

14. What is the pest's potential as a vector of plant pathogens?

EY is a plant pathogen with no capacity to act as a vector of other pathogens.

STAGE 3: PEST RISK MANAGEMENT

15. What are the risk management options for the UK?

Genetic analyses comparing the EY phytoplasma from elm samples collected from the USA, Italy, France and Germany suggest they are the same or closely similar based on the 16S rRNA gene, ribosomal protein and *secY* gene sequences (eg Maürer *et al*., 1993; Lee *et al*., 1993, 1995, 2004). A study by Boudon-Padieu *et al.* (2004) based on the endonuclease *Tru*9I restriction pattern of FD9 DNA fragment indicated three 'types' of EY-group phytoplasma from elm sampled in Europe could be distinguished. One type resembled the American type EY1, another was the European type ULW, and a third pattern was slightly different from either EY1 or ULW. Another study by Jović *et al.* (2011), reported a high degree of genetic variability in strains of EY found infecting elms in Serbia. This suggests some diversity in the EY phytoplasma that affects elm, with overlap between strains from North America and Europe. Boudon-Padieu *et al.* (2004) also suggest that the frequency of EY in Europe is underestimated. Risk management options are therefore considered within this context.

Action for keeping the pest out of the UK

Current records suggest that EY is not known to occur in the UK, although it has now been detected in plants of the elm clone Morfeo being propagated under licence at a nursery in the UK (Fera, 2014 unpublished record). The pathway for entry into the UK is therefore directly associated with scion material introduced for propagation from Italy. EY is known to exist in the country that the scion/ planting stock has come from; it is accepted that the pest may even be native to Europe or possibly Asia and possibly more widespread in Europe than records suggest (EPPO, 1997; Sinclair, 2000; Boudon-Padieu *et al.,* 2004).

Currently EY is listed in Annex IAI of Directive 2000/29/EG as Elm Phloem Necrosis mycoplasma, with Annex IVAI requirements which demand that no symptoms of EY have been seen at the place of production or its immediate vicinity since the last complete cycle of vegetation. This applies only to elms from North America. These requirements, however, do not adequately mitigate the risk of entry of EY into the UK. As already described, the strain of EY found in Europe and North America cannot be considered to be distinct and current legislation is not addressing the risk of entry of EY into the UK from the EU.

The best way of preventing EY establishing in the UK would be to prevent entry which would require changes to current EU legislation. As this organism is present in some EU Member States listing in Annex IAI is not appropriate. Moving EY to Annex IAII would mean that it would be regulated throughout the whole EU; alternatively moving to Annex IIB would mean regulation in only certain protected zones was seen as being appropriate.

Current measures only require that elms from North America have come from a pest free place of production. It is questionable whether place of production freedom provides an adequate guarantee of freedom as there is a risk that (1) the vector can be spread long distances by wind and (2) the possibility of latent infection that could mean that symptoms may not be seen within one cycle of growth. Requiring that elms have originated in a pest free area (PFA) designated in accordance with ISPM4 would offer a greater level of protection. Requirements for PFA would be needed in Annex IVAI of the Directive 2000/29/EC to cover plants for planting of elm from North America and Annex IVAII (whole EU) or Annex IVB if only regulated in protected zones.

To manage the risk of introductions, proportionate actions would include:

- In view of the likelihood that the pest may be native to Europe but absent from the UK, any elm material, including Dutch elm disease resistant plants, should be imported only with a plant passport. There is also the option of treatments to address the risk associated with plants imported for propagation which could include:

- Caution in the use of foreign elm germ-plasm that may have a high level of resistance to DED but lower tolerance to EY than native/naturalised elm species that are widespread in the UK.
- Treatment with insecticide, to destroy eggs and any other stages of the vector.

- A quarantine/monitoring period to allow symptom development in any elm material infected with EY, particularly any scion material introduced for propagation. Symptoms are most likely to visible at the end of summer when the shoots are fully developed. Testing of any symptomatic material would be required to confirm EY infection.
- Surveys of recently planted elm selections, particularly those that have parentage that includes more susceptible species as defined by Mittempergher (2000) such as *U. japonica*, *U. villosa* and *U. wallichiana*. Surveys would also need to be extended to all elm species if the option of a protected zone was to be pursued, as there would then need to be evidence demonstrating that EY was absent from the UK.

Options for control if the pest became established
In the USA, treatment of EY affected trees with antibiotics in the tetracycline group delivered via direct tree injection is available for high value trees and provides remission from symptoms (Arbor Systems, 2013). However, use of antibiotics to treat plants is not an option in the UK.

As options for control are limited and the native/naturalised elm species common throughout the UK are considered to have low susceptibility or tolerance, the following can be considered:

- No intervention for trees in the wider environment, especially if symptoms are relatively mild.
- Avoid planting of elm clones and species known to have moderate-to-high levels of susceptibility to EY. Mittempergher (2000) has concluded that although EY appears to be "*a fairly harmless disease in European elm species*" that situation could change if there is an emphasis on planting DED resistant elm clones which tend to be more susceptible to EY. He also notes that elm breeding programmes in Europe "*are contending with difficulties of controlling a possible [EY] epidemic among [elm] clones and the danger of infection resulting from planned germ-plasm exchange between partners*".

16. Summary and conclusions

This PRA shows:

Potential for entry is: <u>Moderately likely to Likely</u> when associated with plants for planting or scion material of elm produced in areas where the pest is already established in Europe. Regulation of elm plant imports from North America closes the pathway from this region. There is no risk of entry via the movement of soil and timber.

Potential for establishment is: <u>Moderately likely to Likely</u> but with a high degree of uncertainty because of the lack of information in relation to vectors, climatic constraints and levels of tolerance/resistance in common elm species.

Economic, environmental and social impacts are expected to be: <u>Small to medium</u>, possibly high at local level.

Endangered area: Throughout the UK but again with a high degree of uncertainty because of the lack of information in relation to vectors, climatic constraints and levels of tolerance/resistance in common elm species

Risk management:

Practices are available to manage the risk (see 15) but require further evaluation to measure their effectiveness in relation to EY.

17. Is there a need for a more detailed PRA?

Yes [ ] No [X]

If yes, select the PRA area (UK or EU) and the PRA scheme (UK or EPPO) to be used.

PRA area: UK or EU? UK PRA scheme: UK or EPPO? UK

18. Given the information assembled within the timescale required, is statutory action considered appropriate/justified?

As the pest is currently not established in the UK statutory action can be considered justified.

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