Department for Environment Food & Rural Affairs

Rapid Pest Risk Analysis (PRA) for:

Neopulvinaria innumerabilis

Draft: December 2014

Stage 1: Initiation

1. What is the name of the pest?

Neopulvinaria innumerabilis (Rathvon) (Hemiptera, Coccidae) – Cottony maple scale

Synonyms: *Coccus innumerabilis* Rathvon; *Pulvinaria innumerabilis* (Rathvon); *Pulvinaria tinsleyi* King; *Neopulvinaria imertina* Hadzeibejli (in use in some literature at least until 2008).

2. What initiated this rapid PRA?

The UK Plant Health Risk Register identified the need to update the first UK PRA (MacLeod, 1997), taking into account recent information on hosts, the impact on grapevine (*Vitis vinifera*) and vectored pathogens. An assessment is required to help inform the decision on whether statutory action against future interceptions is justified.

3. What is the PRA area?

The PRA area is the United Kingdom of Great Britain and Northern Ireland.

Stage 2: Risk Assessment

4. What is the pest's status in the EC Plant Health Directive (Council Directive 2000/29/EC[1]) and in the lists of EPPO[2]?

Neopulvinaria innumerabilis is not listed in the EC Plant Health Directive, not recommended for regulation as a quarantine pest by EPPO and it is not on the EPPO Alert List.

5. What is the pest's current geographical distribution?

Neopulvinaria innumerabilis is native to North America. In the USA, it is present in most coastal states and around the Great Lakes region, but absent from inland states. In Canada, it occurs north of the Great Lakes and throughout most of British Colombia (Ben–Dov *et al*., 2014; Table 1).

Table 1: Distribution of *Neopulvinaria innumerabilis*

North America:	**USA** – Arkansas, Arizona, California, Colorado, Florida, Georgia, Illinois, Indiana, Louisiana, Mississippi, New Jersey, New York, New Mexico, Ohio, Oregon, Pennsylvania, Rhode Island, Vermont, Tennessee, Texas, Utah, Virginia, Washington, Wisconsin. **Canada** – British Columbia, Ontario & Quebec.
Central America:	Absent
South America:	Absent
Europe:	Croatia, France, Italy, Slovenia.
Africa:	Absent
Asia:	Armenia, Azerbaijan, Georgia, Russia, Turkey.
Oceania:	Absent

N. innumerabilis has been introduced to Europe and the Caucasus region of western Asia (Ben–Dov *et al*., 2014; Table 1). In Europe, it occurs along the northern coast of the Adriatic Sea: in north-east Italy (Friuli-Venezia Giulia region - Pavan *et al*., 1996), south-west Slovenia (Obalno-kraška region, Istria - Seljak, 2008) and coastal Croatia (Istria

[1] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CONSLEG:2000L0029:20100113:EN:PDF

[2] https://www.eppo.int/QUARANTINE/quarantine.htm

county, plus Šibensko-kninska & Lika-Senj counties in Dalmatia - Masten-Milek *et al.*, 2008).

N. innumerabilis is reported from the Aquitaine, Languedoc-Roussillon and Rhône-Alpes regions of southern France, reaching its northern limit in the Saône-et-Loire department of Burgundy. However, it is likely to occur more widely than this in France in the gaps in its recorded distribution (pers. comm. J-F Germain, ANSES). In Turkey, *N. innumerabilis* is only recorded from the urban districts of Ankara (Ülgentürk & Ayhan, 2011).

6. Is the pest established or transient, or suspected to be established / transient in the UK / PRA Area?

N. innumerabilis is neither present nor transient in the UK and it has never been intercepted in trade.

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

Neopulvinaria innumerabilis is highly polyphagous, feeding mainly on woody, deciduous hosts in 29 plant families (Appendix 1). It has an annual life cycle throughout its geographic range, with females overwintering on twigs and branches. They mature in spring and produce white, waxy egg masses by early summer (Sanders, 1905). The first instar 'crawler' nymphs are very mobile and disperse to the undersides of leaves, where they feed along the leaf veins. Male and female nymphs pass through four and two instars, respectively. At the end of the summer, winged males mate with adult females; the females then migrate to woody parts of the host to overwinter.

N. innumerabilis has been recorded on a wider range of hosts in its native distribution compared to Europe, where grapevine, *Vitis vinifera,* is the principal host with reported damage. Other ornamental members of the Vitaceae, *Parthenocissus quinquefolium* and *P. tricuspidata,* are also frequently colonised in Europe. Nevertheless, *N. innumerabilis* has been found on novel host genera and families in its introduced range: *Acacia* and *Phaseolus* (Leguminosae), Punicaceae and Rutaceae in Georgia (Hadzibejli, 1983); Bignoniaceae, Moraceae and Platanaceae in Turkey (Ülgentürk & Ayhan, 2011); and Actinidiaceae (kiwifruit) in Slovenia (Štrukelj pers. comm.).

N. innumerabilis has been recorded on 11 hosts in France (Canard, 1966), 14 in Turkey (Ülgentürk & Ayhan, 2011) and 18 in Georgia (Hadzibejli, 1983). *N. innumerabilis* has been reported from fewer hosts in certain countries (Slovenia 4 – Štrukelj pers. comm.; Italy 3 - Pellizzari Scaltriti, 1977; and Croatia 3 - Masten-Milek & Simala, 2008), which may reflect the length of time it has been detected and /or lower survey effort in particular environments, e.g. the high number of hosts in Turkey resulted from surveys of urban parks and gardens in Ankara.

Many hosts, of both economic and / or environmental importance, occur in the UK (Appendix 1). These include trees of ornamental and environmental value (e.g. *Acer, Ilex, Quercus, Juglans*) as well as fruit crops (e.g. *Malus, Prunus, Ribes* and *Vitis*).

8. What pathways provide opportunities for the pest to enter and transfer to a suitable host and what is the likelihood of entering the UK / PRA area?

Plants for planting: *Neopulvinaria innumerabilis* is moderately likely to enter on ornamental or crop plants moved in trade. This is assessed with medium confidence because the volume of trade from infested areas is uncertain. Plants carried in personal baggage are also a possible method of entry.

N. innumerabilis is only likely to be noticed between early summer and autumn, when the mature females produce white egg masses (ovisacs) and are conspicuous on twigs and branches (likened to strings of popcorn). Larvae develop on the undersides of leaves and are less noticeable, while adult males are winged and unlikely to be recognised as scale insects. The greatest risk comes from moving plants in winter, when immature females, without ovisacs, would be difficult to detect on twigs or bark.

Plants for planting (amenity lime and maple trees) were responsible for *N. innumerabilis'* introduction into urban Ankara (Turkey; Ülgentürk & Ayhan, 2011). As those trees originated in Italy, it is likely that *N. innumerabilis* could be dispersed in trade throughout Europe, depending on the location of infested hosts. *N. innumerabilis* is only reported from NE Italy at present, but it could be more widespread if it has gone undetected, or been mistaken for other, polyphagous scale species. Every year, the UK receives hundreds of tonnes of plants for planting, including shrubs and trees, from Italy and tens of tonnes from France; it does not receive any from Croatia, Georgia, Russia, Slovenia or Turkey (Eurostat data).

Although the main hosts in Europe, *Vitis spp.* may not be imported from outside the EU as plants, other than fruit (Annex III of Council Directive 2000/29, section 3.1.3), there have been about 10 interceptions per year, 1994-2013 (EFSA, 2014). Thus third country movements continue to pose a small risk of entry.

Trade of vine plants for planting within the EU is very large, with 17 exporting and 25 importing states of vine cuttings and canes (EFSA 2014). These young plants could carry overwintering female *N. innumerabilis* on dormant, lignified material and first instar crawlers on non-dormant material. Such vines are typically traded in quantities of tens to hundreds of tonnes between states.

Vines for planting can only be moved with a plant passport within the EU. This should help ensure that stock entering the UK is relatively pest free. However, other non-native insect pests have recently been intercepted on grapevine in nurseries (Grape leaf rust mite, *Calepitrimerus vitis*) and field outbreaks have occurred on imported stock (Grape

phylloxera, *Daktulosphaira vitifoliae*) (Malumphy, 2011). The UK has imported vines from seven EU states within the last 5 years (France, Germany, Italy, Netherlands, Poland, Portugal & Spain), with quantities ranging from hundreds of kilos to tens of tonnes (Eurostat, 2014).

N. innumerabilis is a member of the most successful taxon of soft scales (tribe Pulvinariini) to have established in the UK. Four related species are likely to have established in the UK as a result of the plant trade: *Pulvinaria regalis* (horse-chestnut scale), *Pulvinaria floccifera* (camellia scale), *Pulvinaria hydrangeae* (hydrangea scale) and *Pulvinariella mesembryanthemi* (mesembryanthemum scale) (pers. comm. C. Malumphy, Fera).

Plants for planting	Very unlikely	☐	Unlikely	☐	**Moderately likely**	✓	Likely	☐	Very likely ☐
Confidence	High Confidence	☐	Medium Confidence	✓	Low Confidence	☐			

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

9.1 Outdoors: *Neopulvinaria innumerabilis* is unlikely to establish outdoors because UK summers will probably not be hot enough for it to complete its life cycle. The main host, *Vitis vinifera*, is grown widely throughout England, particularly the south east and south west. Alternative woody hosts are also abundant in ornamental / amenity situations (e.g. *Parthenocissus*, *Acer*, Leguminosae) and the wider environment (*Acer*, *Tilia*, Rosaceae). This is assessed with medium confidence because there is uncertainty over *N. innumerabilis'* climatic limits.

N. innumerabilis has been present in France for about 50 years, but has not extended its distribution, beyond southern Burgundy, into the northern half of the country (the wine producing regions of Champagne and the Loire valley). It is unlikely that *N. innumerabilis* is limited by low winter temperatures, because it occurs in climates with colder winters in its native distribution, around the Great Lakes region in North America (Dfb – snow, fully humid, warm summer; Kottek *et al*., 2006). Rather, *N. innumerabilis* may be absent from northern France because summer temperatures are not high enough to sustain populations. Populations are low in the wine-producing, Finger Lakes region of New York State, USA (Fuchs *et al*., 2009). Here, summer temperatures are similar to those at *N. innumerabils*' range limit in the Burgundy region of France. In comparison, June to September temperatures are significantly lower on the south coast of the UK (Appendix 2).

9.2 Under protection: *N. innumerabilis* is unlikely to establish under protection because there are no reports of it having done so in either its native or introduced ranges.

9.1 Outdoors	Very unlikely	☐	**Unlikely**	✓	Moderately likely	☐	Likely	☐	Very likely ☐

Confidence	High Confidence	☐	Medium Confidence	☑	Low Confidence	☐		

9.2 Under Protection	Very unlikely	☐	**Unlikely**	☑	Moderately likely	☐	Likely	☐	Very likely	☐
Confidence	High Confidence	☐	Medium Confidence	☑	Low Confidence	☐				

10. If the pest needs a vector, is it present in the UK/PRA area?

Neopulvinaria innumerabilis is a free-living organism.

11. How quickly could the pest spread in the UK / PRA area?

11.1 Natural spread: *N. innumerabilis* would spread very slowly, perhaps less than 10m per year, because it is a sedentary organism and only the 1st instar 'crawler' stage actively disperses on the plant. This is assessed with low confidence, however, because there is evidence that *Pulvinaria* scales can also be dispersed passively in the wind at low altitude (e.g. in 'urban canyons' and along railway lines), which would result in faster local spread, perhaps tens to hundreds of metres per year. Such local spread may be more likely within infected vineyards because females have a very high fecundity (up to 7-8,000 eggs per ovisac; Canard, 1966).

11.2 With trade: *N. innumerabilis* is likely to spread quickly on plants moved in trade. Although mature females would be conspicuous in summer, larvae and overwintering females would be difficult to detect. *N. innumerabilis* could spread between suitable hosts in nurseries and be transferred from infested vineyards to new sites. This could occur over tens to hundreds of kilometres in a year, depending on the source and destination of stock. This is judged with medium confidence because the volume of any plant movements between vineyards in the UK is uncertain.

11.1 Natural Spread	**Very slowly**	☑	Slowly	☐	Moderate pace	☐	Quickly	☐	Very quickly	☐
Confidence	High Confidence	☐	Medium Confidence	☐	Low Confidence	☑				

11.2 With trade	Very slowly	☐	Slowly	☐	Moderate pace	☐	**Quickly**	☑	Very quickly	☐
Confidence	High Confidence	☐	Medium Confidence	☑	Low Confidence	☐				

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

12.1 Direct impacts from feeding: There are no reports of *N. innumerabilis* causing an impact under protection, therefore only impacts outdoors are considered further. *N. innumerabilis* weakens its hosts by feeding on phloem and by producing honey dew, which leads to the development of sooty moulds. These reduce photosynthesis in leaves and slow the ripening of fruit. The type of damage varies by host.

In North America, the main hosts are maples (especially *Acer saccharina* and *A. negundo*), on which only severe infestations of stressed trees cause die-back and mortality. Normally *N. innumerabilis* is controlled by natural enemies and only rarely reaches problem levels (Sanders, 1905; Philips, 1962; Shetlar, 1995). Although large infestations of *N. innumerabilis* have been reported from ornamental trees in Turkey, the level of damage was not described (Ülgentürk & Ayhan, 2011).

Since its initial discovery in France*, N. innumerabilis* has been considered a minor pest of grapevine (*Vitis vinifera*), only attaining high numbers in neglected vineyards (Canard, 1966). Between 1997 and 2014 (17 years) only five samples from outbreaks were submitted to plant health specialists (pers. comm. J-F Germain, ANSES). Similarly, in North America (New York state) *N. innumerabilis* feeding does not cause economic loss on grapevine because population density is low (Fuchs *et al*., 2009).

However, *N. innumerabilis* is a significant pest on grapevine in the hotter and drier vineyards of eastern Georgia (Yasnosh *et al*., 2001), as well as around the Adriatic Sea - in NE Italy, Slovenia and Croatia. Here, it reduces the quality and quantity of the grape crop and progressively weakens plants if infestations remain untreated between years (Pavan *et al*., 1996; Strujkel *et al*., 2012). *N. innumerabilis* caused consistently high levels of infestation (more than 250 larvae per leaf) at three localities in Croatia, where it had been detected for less than five years (Masten-Milek *et al*., 2008).

In one vineyard (with Chardonnay grapes) in Italy, *N. innumerabilis* heavily infested 58% of vine plants (defined as >50 female scales per 10cm of shoot). About two-thirds of these plants had only one or two healthy shoots (well-lignified with ten internodes) while one third had none (where three healthy shoots was normal). It was estimated that production from the vineyard was reduced by 70% (Pavan *et al*., 1996).

In summary, *N. innumerabilis'* direct impact is assessed, with high confidence, as large on grapevine based on the regular need for control measures in the southern part of its European range.

12.2 Indirect impact as a virus vector: *N. innumerabilis* has been shown: to transmit Grapevine leafroll-associated virus (GLRaV, strains 1 and 3) and Grapevine virus A (GVA) under laboratory conditions (Fortusini *et al*., 1997); to be a vector of GLRaV-1 and GLRaV-3 in vineyards in New York state (Fuchs *et al*., 2009); and - alongside other

scale insects and mealybugs - to be linked to the spread of GLRaV-1 and -3 within vineyards in Italy (Fortusini *et al*., 1996).

Both GVA and GLRaV are widespread throughout wine growing regions of the world, where they cause 5-22% and 20-30% yield losses in grapevines, respectively (CABI 2012, 2013). GLRaV-vector relationships in vineyards are not specific and numerous vectors often co-occur (Naidu *et al.*, 2014). So, while the explicit role of *N. innumerabilis* in virus-mediated impacts has not yet been demonstrated, it can be expected to contribute to such impacts. Therefore, it is likely that *N. innumerabilis* could have a small impact wherever GVA or GLRaV occur. This is assessed with low confidence because any impact would be contingent upon the primary mode of virus introduction - planting infected vines (Naidu *et al.*, 2014). In addition, whenever mealybugs (Pseudococcidae) are also present in vineyards, they are likely to be more efficient vectors due to higher mobility and shorter generation times.

12.1 Direct Impact - feeding	Very small	☐	Small	☐	Medium	☐	**Large**	☑	Very large	☐
Confidence	High Confidence	☑	Medium Confidence	☐	Low Confidence	☐				
12.2 Indirect Impact – virus vector	Very small	☐	**Small**	☑	Medium	☐	Large	☐	Very large	☐
Confidence	High Confidence	☐	Medium Confidence	☐	Low Confidence	☑				

13. What is the pest's potential to cause economic, environmental and social impacts in the UK / PRA area?

13.1 Direct economic impact from feeding: is judged to be small in commercial vineyards, based on evidence from southern and central France and North America (New York state), where the pest is of minor importance. This is assessed with medium confidence because, if central France represents the northern range limit of *N. innumerabilis* in Europe, it may only have a small impact during very hot summers in the UK. It is possible that ornamental or non-commercial grapevines, either under glass or in sheltered garden / urban situations, could suffer damage too.

Although *N. innumerabilis* can be a serious pest of ornamental *Acer* in North America, there is no evidence of this impact in Europe, except possibly in one urban area of Turkey. There remains a small risk that *N. innumerabilis* could impact *Acer* in sheltered garden / urban situations.

13.2 Indirect economic impacts as a virus vector: Grapevine leafroll-associated viruses 1 and 3 (GLRaV-1 and -3), and Grapevine virus A (GVA), do not appear on the UK Virus checklist (pers. comm. Adrian Fox, Fera). However, these viruses

are widespread throughout vine growing regions of the world and no systematic surveys to confirm their presence or absence have been conducted in the UK. GVA is reported as present in the UK (CABI, 2012) based solely on a report on an ornamental vine in a Scottish garden (where GLRaV-1 was also present; Saldarelli *et al*., 2005). More recently, GVA and GLRaV-1 were found at a botanical garden in grapevines bought from a domestic retailer (pers. comm. G. Clover, Royal Horticultural Society).

If *N. innumerabilis* was introduced as overwintering females on virus-infected stock, it could spread the virus locally following planting out. However, the European brown scale, *Parthenolecanium corni*, which is a confirmed GLRaV-1 and GVA vector (Hommay *et al*., 2008) is likely to be widespread in UK vineyards already (Malumphy, 2011) and thus a more effective vector. Therefore *N. innumerabilis* is unlikely to pose additional risk as a vector and its risk of impact is scored as small, with high confidence.

13.3 and 13.4 Environmental and Social impacts: These are judged to be small with high confidence, on the basis that no significant environmental or social impacts have been reported in Europe or elsewhere in the world.

13.1 Direct Economic Impact	Very small	☐	Small	☑	Medium	☐	Large	☐	Very large ☐
Confidence	High Confidence	☐	Medium Confidence	☑	Low Confidence	☐			
13.2 Indirect Economic Impact	Very small	☐	Small	☑	Medium	☐	Large	☐	Very large ☐
Confidence	High Confidence	☑	Medium Confidence	☐	Low Confidence	☐			
13.3 Environ - mental Impacts	Very small	☐	Small	☑	Medium	☐	Large	☐	Very large ☐
Confidence	High Confidence	☑	Medium Confidence	☐	Low Confidence	☐			
13.4 Social Impacts	Very small	☐	Small	☑	Medium	☐	Large	☐	Very large ☐
Confidence	High Confidence	☑	Medium Confidence	☐	Low Confidence	☐			

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

Neopulvinaria innumerabilis is able to transmit Grapevine leafroll-associated virus (GLRaV, strains 1 and 3) and Grapevine virus A under laboratory conditions (Fortusini *et al.*, 1999). Its impacts as a vector of these viruses are summarised under 12.2 and 13.2 above.

15. What is the area endangered by the pest?

The endangered area is the southern half of England, where most UK vineyards occur, and urban areas, where warm microclimates and susceptible ornamental plants exist.

Stage 3: Pest Risk Management

16. What are the risk management options for the UK / PRA area?

16.1 Exclusion: It is unlikely that *Neopulvinaria innumerabilis* could be excluded because the overwintering females are very difficult to detect on their woody deciduous hosts. Many of these hosts are imported from countries where the pest occurs. Despite an EU certification scheme for grapevine (EPPO, 2008), this is no guarantee that insect pests will be prevented from moving on certified stock. Recent interceptions or outbreaks of insect pests on grapevine in the UK (Malumphy, 2011) indicate that there is a risk from vines being moved between European countries.

16.2 Eradication and containment: *N. innumerabilis* is very slow to spread naturally so eradication and containment of an outbreak is feasible. However, this pest could be confused easily with other, established scale pests, e.g. *Pulvinaria hydrangea* and *P. regalis* in urban situations, and so go unrecognised for many years, after which time eradication may be impossible. In vineyards, *N. innumerabilis* could spread to suitable woody hosts in the surrounding field boundaries and this again will depend on the time taken to detect it. Statutory control of *N. innumerabilis* would require destruction of the host, if the outbreak was limited (e.g. indoors), or the use of insecticides. These would be most effective if applied when the crawler stage is present in summer, or before bud-burst in spring, when the females are overwintering on hosts.

16.3 Non-statutory control: If *N. innumerabilis* became established and was not under statutory measures, it could be controlled via monitoring in relation to damage thresholds and applying selective insecticides when necessary.

17. Summary and conclusions of the rapid PRA

Provide an overall summary and conclusions and then short text on each section:

This rapid PRA shows that: *Neopulvinaria innumerabilis* is a significant pest and / or virus vector on grapevine in North America, south-east Europe and the Caucasus. Since the mid-2000s it has become a problem on grapevine in the Balkans but has remained a minor pest in France. There are no reported outbreaks of *N. innumerabilis* in the UK and it has never been intercepted. Based on summer temperatures, it is unlikely to establish in the UK, although suitable woody, deciduous hosts occur: commercial and ornamental grapevine species, other Vitaceae and possibly *Acer*. If it established, *N. innumerabilis* would spread very slowly, unless it was moved with host plants. In the UK climate, *N. innumerabilis'* impact is likely to be small, both in terms of feeding damage and as a virus vector. It would be possible to eradicate outbreaks indoors, or at an early stage outdoors. This rapid assessment shows that:

Risk of entry is moderately likely on plants for planting, either for ornamental or vineyard use. *N. innumerabilis* is a member of a successful group of invasive scale insects and it would be difficult to detect when females overwinter on the host.

Risk of establishment is unlikely outdoors and under protection. *N. innumerabilis'* main host, grapevine, is widely grown in southern England and alternative hosts are abundant in ornamental / amenity situations. In its native range, *N. innumerabilis* occurs in climates with colder winters than found in the UK. However, UK summers are cooler than those at *N. innumerabilis*' range limit in northern France.

Economic, environmental and social impact: The main impact will be economic because environmental and social impacts have not been reported from elsewhere. Direct impact from feeding is likely to be small in commercial vineyards and there is a possibility of damage to ornamentals indoors or in sheltered situations. A small, indirect, economic impact could be caused as a vector of Grapevine leafroll-associated viruses and Grapevine virus A. These viruses have been reported, on single plantings, twice in the UK but the extents of their distributions are unknown.

Endangered area is the main wine growing regions of the UK – south-east and south-west England – and sheltered / urban situations that support ornamentals in warm micro-climates.

Risk management options: The large number of potential hosts moved in trade and the difficulty of detecting the pest makes exclusion unfeasible. Eradication and containment could be achieved with selective insecticides, if an outbreak was detected early enough, because natural spread is very slow. Non-statutory control would be possible through insecticide use, informed by monitoring in relation to damage thresholds.

Key uncertainties and topics that would benefit from further investigation

1. A better understanding of where UK vineyards obtain their planting stock in Europe, and how grapevines are moved / traded in the UK, would reduce uncertainty over the likelihood of entry and spread.
2. The status of Grapevine leaf roll associated virus-1 and -3, and of Grapevine virus A, in the UK would improve the assessment of indirect impacts due to *N. innumerabilis'* role as a virus vector.

18. Is there a need for a detailed PRA or for a more detailed analysis of particular sections of the PRA? If yes, select the PRA area (UK or EU) and the PRA scheme (UK or EPPO) to be used.

(For completion by the Plant Health Risk Group) ✓ *(put a tick in the box)*

No	✓				
Yes		PRA area: UK or EU		PRA scheme: UK or EPPO	

19. Images of the pest

	*Photo 2 (e.g. symptoms?)*
Neopulvinaria innumerabilis - mature females with egg sacs on grapevine.	*Source/ copyright owner*

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20. Given the information assembled within the time scale required, is statutory action considered appropriate / justified?

[*For completion by the Plant Health Risk Group*] *(put a tick in the box)*

Yes Statutory action	✓	No Statutory action	

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Appendix 1. World-wide host associations of *Neopulvinaria innumerabilis* (Rathvon), Cottony maple scale.

The pest is native to North America, introduced in Europe and western Asia and absent from the UK. Hosts: 'spp.' indicates multiple species are used in a genus, 'sp.' shows when the species was not specified. Hosts occurring in the UK are listed to species.

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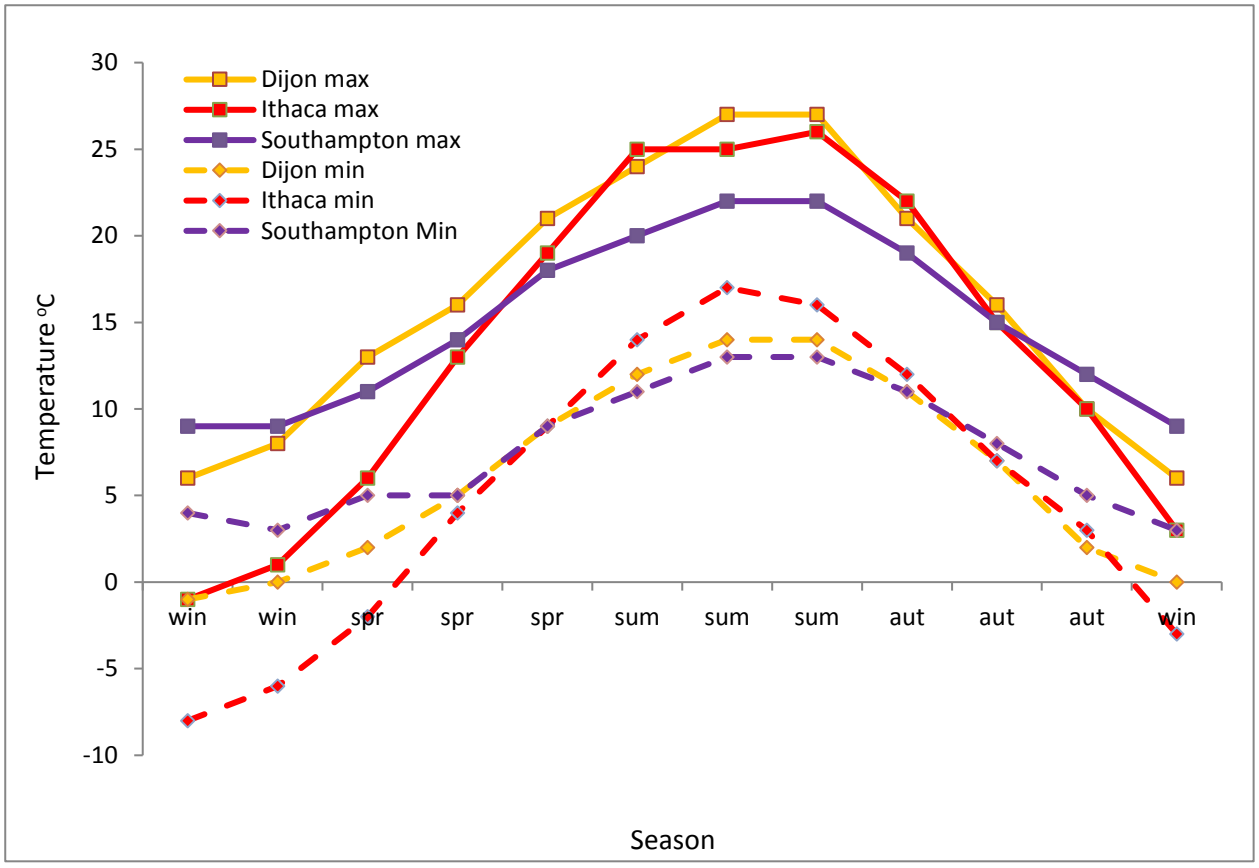
Host family	Host name	Common name (for hosts in UK or introduced range)	Where the host is used in the pest's introduced range	Host in the UK?	Economic /, social / environmental importance of host in the UK
Aceraceae	*Acer spp.*				
	Acer negundo	box-elder	Turkey	UK	economic
	Acer rubrum	red maple		UK	economic
	Acer platanoides	Norway maple	Georgia	UK	economic
	Acer pseudoplatanus	sycamore	Turkey	UK	economic / environment
	Acer saccharinum	silver maple		UK	economic
Actinidiaceae	*Actinidia deliciosa*	kiwi fruit	Slovenia		
Anacardiaceae	*Rhus sp.*	sumac		UK	economic
Aquifoliaceae	*Ilex glabra*				
	Ilex aquifolium	holly	Croatia	UK	economic / environment
Asteraceae	*Solidago sp.*				
Betulaceae	*Alnus rubra*				
	Betula sp.	birch		UK	economic / environment
Bignoniaceae	*Catalpa bignonioides*	southern catalpa	Turkey		
Carpinaceae	*Carpinus caroliniana*				

Host family	Host name	Common name (for hosts in UK or introduced range)	Where the host is used in the pest's introduced range	Host in the UK?	Economic /, social / environmental importance of host in the UK
Cornaceae	*Cornus spp.*				
	Cornus sanguinea	dogwood	France, Georgia	UK	economic / environment
Ebenaceae	*Diospyros spp.*	persimmon	Georgia, Slovenia		
Empetraceae	*Ceratiola ericoides*				
Fagaceae	*Fagus spp.*	beech		UK	economic / environment
	Quercus spp.				
	Quercus sp.	oak	Turkey	UK	economic / environment
Grossulariaceae	*Ribes grossularia*	gooseberry		UK	economic
	Ribes nigrum	black currant		UK	economic
Hippocastanaceae	*Aesculus flava*				
Juglandaceae	*Carya ovata*				
	Juglans spp.				
	Juglans regia	walnut	Georgia, Slovenia	UK	economic / environment
Lauraceae	*Lindera benzoin*				
	Sassafras variifolium				
Leguminosae	*Acacia sp.*	unidentified acacia	Georgia		
	Amorpha fruticosa	bastard indigo	Italy		
	Gleditsia triacanthos	honey locust	France	UK	economic
	Mimosa sp.				
	Phaseolus vulgaris	common bean	Georgia	UK	economic
	Robinia pseudoacacia	false acacia	France, Turkey	UK	economic
Lythraceae	*Punica granatum*	pomegranate	Georgia		
Magnoliaceae	*Magnolia grandiflora*	magnolia		UK	economic
Moraceae	*Morus alba*	white mulberry	Turkey	UK	economic
Myricaceae	*Myrica cerifera*				
Philadelphaceae	*Philadelphus coronarius*	mock-orange	France	UK	economic
Platanaceae	*Platanus occidentalis*	oriental plane	Turkey	UK	economic
Rosaceae	*Crataegus sp.*	unidentified hawthorn	Turkey		

Host family	Host name	Common name (for hosts in UK or introduced range)	Where the host is used in the pest's introduced range	Host in the UK?	Economic /, social / environmental importance of host in the UK
	Crataegus monogyna	common hawthorn	France, Georgia, Turkey	UK	economic / environment
Rosaceae cont.	*Cydonia oblonga*	quince	Georgia		
	Malus	apple	Georgia	UK	economic / environment
	Prunus spp.	peach / stone fruits	Georgia	UK	economic / environment
	Pyrus sp.	pear	Georgia	UK	economic / environment
	Spiraea sp.	unidentified spiraea	Turkey	UK	economic
Rutaceae	*Poncirus trifoliata*	trifoliate orange	Georgia		
Salicaceae	*Populus sp.*	poplar	Georgia	UK	economic / environment
	Salix nigra	willow		UK	economic / environment
Tiliaceae	*Tilia spp.*				
	Tilia sp.	lime	Turkey		
	Tilia x europaea	common lime	France	UK	economic / environment
Ulmaceae	*Celtis spp.*				
	Ulmus spp.	elms		UK	economic / environment
Vitidaceae	*Parthenocissus quinquefolia*	Virginia creeper	Croatia, France, Italy	UK	economic
	P. tricuspidata	Boston ivy	France	UK	economic
	Vitis spp.	vines	France		
	Vitis vinifera	grapevine	Croatia, France, Georgia, Italy, Slovenia, Turkey	UK	economic

Appendix 2.

Mean maximum and minimum monthly temperatures in the UK (Southampton) and near the northern range limits of *Neopulvinaria innumerabilis* in its native (Ithaca, Great Lakes area of New York state, USA) and introduced distributions (Dijon, in the Burgundy region, France).



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