RAPID RISK ASSESSMENT SUMMARY SHEET

Updated: April 2017

Tree-of-Heaven (*Ailanthus altissima*)

- Popular ornamental tree native to China, introduced to GB in 1751.
- Mainly established in the south/south east of England.
- Listed among the 100 worst invasive species by DAISIE.
- Currently no reports of negative impacts in GB, but potential future impacts on biodiversity and infrastructure could be high.

History in GB

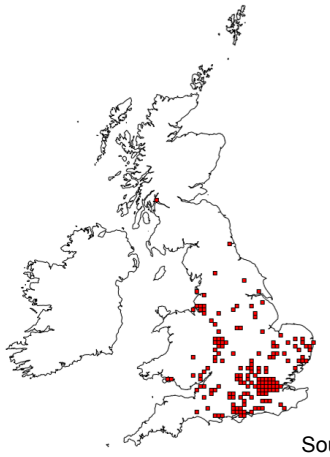
Originally introduced into cultivation in GB in 1751, but not recorded in the wild until 1935. Current main distribution area is the south/south-east of England, particularly Greater London and in and around Cambridge. There are also records from the north of England and southern Scotland. In total it has been recorded in 200 of 2823 total hectads across GB, but these data do not include planted specimens in gardens, parks and as urban street trees which are potential sources of further establishment and spread.

Native distribution

Native to China

Source: NNSIP 2017

Distribution in GB



Source: NBN 2017

Impacts

Potential future impacts include:

Environmental

- Invasion of habitats of high value for biodiversity conservation, e.g. riparian habitats, open dry oak woodlands, open shrub habitats, dunes and grasslands. *Ailanthus altissima* is fast growing and forms dense thickets which compete with native vegetation. It also produces toxins which accumulate in the soil and inhibit the growth of other plants.

Economic

- Control costs related to the clearance of invasions along transport structures.
- Infrastructure damage from roots of plants growing on walls and roofs of historic buildings, and potential damage to sewers.

Social

- Contact with the leaves can cause severe dermatitis.
- Pollen can cause allergies.

Introduction pathways

Ornamental - popular ornamental plant for use in gardens and parks and as a street tree, still available in trade. Has also been linked to forestry and bee keeping.

Spread pathways

Natural - (very slowly) through root suckering. Root suckers have been observed up to 27m from the parent tree
- (slowly) through seed dispersal. Seeds have been spread by wind (or in river water) up to 100m.

Human-aided (very rapid) - through transportation and ornamental planting in new locations.

Summary

	Risk	Confidence
Entry	VERY LIKELY	VERY HIGH
Establishment	VERY LIKELY	VERY HIGH
Spread	RAPID	HIGH
Impacts	HIGH	MODERATE
Conclusion	HIGH	HIGH

Information about GB Non-native Species Risk Assessments

The Convention on Biological Diversity (CBD) emphasises the need for a precautionary approach towards non-native species where there is often a lack of firm scientific evidence. It also strongly promotes the use of good quality risk assessment to help underpin this approach. The GB risk analysis mechanism has been developed to help facilitate such an approach in Great Britain. It complies with the CBD and reflects standards used by other schemes such as the Intergovernmental Panel on Climate Change, European Plant Protection Organisation and European Food Safety Authority to ensure good practice.

Risk assessments, along with other information, are used to help support decision making in Great Britain. They do not in themselves determine government policy.

The Non-native Species Secretariat (NNSS) manages the risk analysis process on behalf of the GB Programme Board for Non-native Species. Risk assessments are carried out by independent experts from a range of organisations. As part of the risk analysis process risk assessments are:

- Completed using a consistent risk assessment template to ensure that the full range of issues recognised in international standards are addressed.
- Drafted by an independent expert on the species and peer reviewed by a different expert.
- Approved by an independent risk analysis panel (known as the Non-native Species Risk Analysis Panel or NNRAP) only when they are satisfied the assessment is fit-for-purpose.
- Approved for publication by the GB Programme Board for Non-native Species.
- Placed on the GB Non-native Species Secretariat (NNSS) website for a three month period of public comment.
- Finalised by the risk assessor to the satisfaction of the NNRAP.

To find out more about the risk analysis mechanism go to: www.nonnativespecies.org

Common misconceptions about risk assessments

To address a number of common misconceptions about non-native species risk assessments, the following points should be noted:

- Risk assessments consider only the risks posed by a species. They do not consider the practicalities, impacts or other issues relating to the management of the species. They therefore cannot on their own be used to determine what, if any, management response should be undertaken.
- Risk assessments are about negative impacts and are not meant to consider positive impacts that may also occur. The positive impacts would be considered as part of an overall policy decision.
- Risk assessments are advisory and therefore part of the suite of information on which policy decisions are based.
- Completed risk assessments are not final and absolute. Substantive new scientific evidence may prompt a re-evaluation of the risks and/or a change of policy.

Period for comment

Draft risk assessments are available for a period of three months from the date of posting on the NNSS website*. During this time stakeholders are invited to comment on the scientific evidence which underpins the assessments or provide information on other relevant evidence or research that may be available. Relevant comments are collated by the NNSS and sent to the risk assessor. The assessor reviews the comments and, if necessary, amends the risk assessment. The final risk assessment is then checked and approved by the NNRAP.

*risk assessments are posted online at:
https://secure.fera.defra.gov.uk/nonnativespecies/index.cfm?sectionid=51
comments should be emailed to nnss@apha.gsi.gov.uk

Rapid Risk Assessment of: *Ailanthus altissima*, Tree of Heaven
Author: Katharina Dehnen-Schmutz
Suggestion citation: Dehnen-Schmutz, K (2016). GB Non-native Organism Rapid Risk Assessment for *Ailanthus altissima*. www.nonnativespecies.org

Version: Final (May 2015) - Draft 1 (April 2014), NNRAP 1st review (November 2014), Peer Review (February 2015).
Signed off by NNRAP: June 2015
Approved by Programme Board: February 2017
Placed on NNSS website: April 2017

GB Non-native species Rapid Risk Assessment (NRRA)

Introduction:

The rapid risk assessment is used to assess invasive non-native species more rapidly than the larger GB Non-native Risk Assessment. The principles remain the same, relying on scientific knowledge of the species, expert judgement and peer review. For some species the rapid assessment alone will be sufficient, others may go on to be assessed under the larger scheme if requested by the Non-native Species Programme Board.

Guidance notes:

- We recommend that you read all of the questions in this document before starting to complete the assessment.
- Short answers, including one word answers, are acceptable for the first 10 questions. More detail should be provided under the subsequent questions on entry, establishment, spread, impacts and climate change.
- References to scientific literature, grey literature and personal observations are required where possible throughout.

1 - What is the principal reason for performing the Risk Assessment? (Include any other reasons as comments)

Response: *PROVIDED (To rapidly assess the risk associated with this species in GB)*

2 - What is the Risk Assessment Area?

Response: *PROVIDED (GB)*

3 - What is the name of the organism (scientific and accepted common; include common synonyms and notes on taxonomic complexity if relevant)?

Response: *Ailanthus altissima* (Mill.) Swingle, Tree-of-heaven

4 - Is the organism known to be invasive anywhere in the world?

Response: Yes. *A altissima* is a native plant of China but it's non-native range includes all continents except Antarctica with a broad latitudinal range from the temperate to meridional zone (Kowarik and Säumel 2007). In Europe, the species is listed among the "100 of the worst" in the

DAISIE database (www.europe-aliens.org) and reported as established in most countries. A global review of invasive trees lists the species as invasive in 11 out of 15 regions including Europe, North America and New Zealand (Richardson and Rejmánek 2011).

5 - What is the current distribution status of the organism with respect to the Risk Assessment Area?

Response: *A. altissima* has been introduced into the Risk Assessment Area in 1751 and was first reported outside cultivation in 1935 (Preston et al. 2002). The current main distribution area of records outside cultivation is in the south/south-east of England with a focus in the Greater London area and more recently in and around Cambridge. There are also records from the north of England and southern Scotland. In total, it has been recorded in 200 hectads (BSBI 2015) out of 2823 total hectads for the Risk Assessment Area. However, these recording schemes would not normally include planted trees except if in a "wild" situation (Preston et al. 2002). No data are available about the extent of planted *A. altissima* in gardens, parks and as urban street trees which are potential sources of further establishment and spread.

6 - Are there conditions present in the Risk Assessment Area that would enable the organism to survive and reproduce? Comment on any special conditions required by the species?

Response: Yes. *A. altissima* is present in the Risk Assessment Area for over 250 years (Preston et al. 2002) confirming its ability to survive. Seed production in GB was described as rare in 2002 (Preston et al. 2002), but Hill & Wagner (2011) describe very large seed production in warm summers in the south-east and London, whereas reproduction of northern occurrences is probably mainly by clonal growth. Establishment of seedlings is more likely in open habitats, and the species has been classified as shade intolerant. Distribution patterns in Europe and North America have been linked to higher summer heat sums (Kowarik and Säumel 2007). Young seedlings are the most vulnerable life stage and can suffer high mortality rates in severe frost of -10°C and below, whereas older trees can suffer shoot dieback at temperatures below -15°C (Kowarik and Säumel 2007). However, the tree is known to survive temperatures as low as -33°C (Kowarik and Säumel 2007). *A. altissima* grows on a wide range of soil types. In a forestry plantation experiment established at several sites in lowland England between 1989 and 1995 *A. altissima* was one of the worst performing species in a sample of 44 native and non-native tree species monitored over a period of 14 years although it did survive on all but one of the sites (Willoughby et al. 2007)

7 - Does the known geographical distribution of the organism include ecoclimatic zones comparable with those of the Risk Assessment Area or sufficiently similar for the organism to survive and thrive?

Response: Yes. Climatic conditions in other parts of Europe where *A, altissima* occurs as well as in North America are comparable to those in the Risk Assessment Area. The species is established, although with rare frequency, in urban areas in Denmark (NOBANIS 2005), which is the most northern established occurrence in Europe.

8 - Has the organism established viable (reproducing) populations anywhere outside of its native range (do not answer this question if you have answered 'yes' to question 4)?

Response: NA

9 - Can the organism spread rapidly by natural means or by human assistance?

Response: Yes. Natural spread of *A. altissima* occurs by root suckering and seed dispersal. Root

suckers were observed to distances up to 27m from the parent tree, with clonal populations extending to 120m along roadsides (Kowarik and Säumel 2007). Natural long distance dispersal of seeds is mainly by wind reaching distances of more than 100 m that can be accelerated along roads and railway lines (Kowarik and Säumel 2007). Experimental evidence also confirmed seed dispersal in urban rivers to at least 1.2 km (Säumel and Kowarik 2010) and the ability of seeds to remain viable after 3 weeks in the water (Kowarik and Säumel 2008).
Spread over longer distances occurs by the trade of plants for planting. *A. altissima* is used as an ornamental plant in parks, as street tree in urban areas and in gardens. Due to its ability to tolerate high air pollution levels and low susceptibility to pests and diseases it has been particular promoted for use in urban areas (Säumel and Kowarik 2010). The Royal Horticultural Society's Plant Finder (RHS 2015) lists 15 nurseries selling the species. An earlier edition (RHS 2009) listed 25 nurseries selling the species which might be an indication of a declining popularity.

10 - Could the organism itself, or acting as a vector, cause economic, environmental or social harm in the Risk Assessment Area?

Response: Yes. *A. altissima* is causing environmental, economic and social harm in areas where it is invasive and has been identified as one of just three alien plants species having the most widespread ecological and economic impact in Europe (Vila et al. 2010). Potential environmental impacts in the Risk Assessment area could include the invasion of habitats of high value for biodiversity conservation such as riparian habitats, open dry oak woodlands, open shrub habitats, dunes and grasslands. The main economic impacts would result from control measures related to the clearance of invasions along transport structures and the destructive damage from roots of plants growing on walls and roofs of historic buildings as well as potential damages to sewers. Contact with the leaves can cause severe dermatitis and the pollen can cause allergies.

Entry Summary

Estimate the overall likelihood of entry into the Risk Assessment Area for this organism (comment on key issues that lead to this conclusion).

Response: ***very likely***

Confidence: ***very high***

Comments (include list of entry pathways in your comments):

The species is already present in the Risk Assessment Area (Preston et al. 2002). Further risk of entry results mainly from (in order of importance):

1. Continued use as an ornamental in gardens and parks and as a street tree. The plant is still a popular ornamental available for sale from 15 nurseries in the 2015 edition of the RHS's online Plant Finder.

2. The use of the species for plantations for wind breaks, erosion control or as a forest tree. However, this pathway seems much less likely as no evidence could be found for previous use or future recommendation for these purposes. For example, the timber was classified as low quality and the species did not perform very well in forestry plantation trials in England (Willoughby et al. 2007).

3. *A. altissima* provides a nectar source for bees and has been listed as a suitable plant for beekeepers in Britain (Howes 1979). The species is included in a list of "trees useful to bees" by the British Beekeepers Association (BBKA 2007).

Establishment Summary

Estimate the overall likelihood of establishment (comment on key issues that lead to this conclusion).

Response: ***very likely***

Confidence: ***very high***

Comments (state where in GB this species could establish in your comments, include map if possible):
A. altissima is already considered established in England, but not in Wales and Scotland (Hill & Wagner 2011). Establishment in areas outside the species current main distribution in the southeast of England seems very likely depending on the extent of past plantings as well as sufficient summer temperature heat sums (Kowarik and Säumel 2007). Possible further areas of more widespread establishment are urban areas in the whole of the Risk Assessment Area particular in England and southern Wales, with less frequent establishment in urban areas in the north of England and in southern Scotland. Outside urban areas establishment seems most likely along transport infrastructure and in disturbed habitats in lowland areas and surroundings of the already existing established populations.

Spread Summary

Estimate overall potential for spread (comment on key issues that lead to this conclusion).

Response: ***rapid***

Confidence: ***high***

Comments (include list of spread pathways in your comments):

A. altissima has rapidly increased its distribution in the Risk Assessment Area in recent years. From 87 hectad records up to 1999 (Preston et al. 2002) to 200 hectads in 2015 (BSBI 2015).

Further spread of *A. altissima* in the Risk Assessment area is most likely to occur:
- very slowly by vegetative spread (root suckering) from existing trees with distances of up to 27m which can occur even without top crown damage (Fryer 2010).
- slowly through natural distribution of seeds by wind (more than 100 m), or in river water (up to 1.2 km), along transport corridors (Kowarik and Säumel 2007). As the species is already well established and seed producing in the London area the numerous railway and road links from there to the rest of the country provide potential spread passages.
- very rapid through human transportation and planting in new locations.

Impact Summary

Estimate overall severity of impact (comment on key issues that lead to this conclusion)

Response: ***high***

Confidence: ***moderate***

Comments (include list of impacts in your comments):

There are no reports of negative impacts of *A. altissimia* in GB and the current impacts are assumed to be low (Hill & Wagner 2011). Impacts reported from elsewhere that are likely to arise in the Risk Assessment Area in the future are the following:

1. Economic impacts resulting from damage to sewers, foundations, buildings, archaeological sites and transport structures in particular railways seem to be the most severe risks of impacts. In the German Federal State of Hesse (21,100 km^2) annual costs resulting from *A. altissima* are estimated to be up to €5 million including €1.5 million for treatment of allergies caused by the species. In 2007, 61% of the 64,000 km of railway track were treated, with costs ranging from €6400/ha for herbicide treatment to about €30,000/ha for thermal (fire and steam) control (Lezcano-Caceres 2010).

2. The main environmental impact is the ability of the species to rapidly colonise new habitats where it may negatively impact on native species through competition and allelopathic effects (Lawrence et al. 1991, Motard et al. 2011) as well as altering ecosystem services. This is of particular concern if the invaded habitats are natural or semi-natural habitats such as dry open woodlands or dunes. The extent of these impacts depends on the likelihood of the species to reach these habitats which are often outside its current main distribution in the Risk Assessment Area. Within Europe, the most severe environmental impacts are observed in Mediterranean countries whereas in other parts where the species is up to now mainly found in urban areas environmental impacts are less frequently observed. Similar, the current environmental impact of *A. altissima* in the Risk Assessment Area is estimated to be low because it is mainly found in urban man-made habitats (Hill & Wagner 2011 However, evidence from central Europe also suggests that in recent years *A. altissima* has started to invade more natural and semi-natural areas, for example sand dunes, sandy grasslands, dry oak woods on rocky slopes as well as riparian woodlands in the Rhine valley in Germany and the Danube valley in Austria (Radkowitsch 2008).

3. Health impacts of *A. altissima* include allergic reactions to pollen (Kowarik and Säumel 2008) and dermatitis caused by the sap (Bennett et al. 2013).

Climate Change

What is the likelihood that the risk posed by this species will increase as a result of climate change?

Response: ***high***

Confidence: ***high***

Comments (include aspects of species biology likely to be effected by climate change (e.g. ability to establish, key impacts that might change and timescale over which significant change may occur):

A. altissima is highly likely to be favoured by climate change in Britain. Evidence from central Europe suggests that establishment success of *A. altissima* seedlings seems to be favoured by warmer summers. The expansion of the distribution from *A. altissima* since the 1980s in central Europe from urban areas with warmer summers to more northern cities and cities with oceanic climate has been attributed to periods of successive years with milder climate (Kowarik and Säumel 2008). Furthermore, seed production currently low in northern parts of the risk assessment area (Hill & Wagner 2011) is likely to increase with climate warming. *A. altissima* is also well adapted to drought to which it adapts by growing a more extensive root system (Kowarik and Säumel 2008). Climate change projections for Britain forecast warmer and drier summers by 2020 (Defra 2009) thus removing potential current climatic constraints to the species' establishment and spread from existing occurrences. This could happen within the next 10-20 years, and recording evidence by botanists suggests already an increased occurrence of successful seedling establishment in recent years.

Conclusion

Estimate the overall risk (comment on the key issues that lead to this conclusion).

Response: ***high***

Confidence: ***high***

Comments:
A. altissima is already present in the Risk Assessment Area
- it is already established and its distribution is increasing rapidly.
- climate change is very likely to further improve the natural growing conditions for *A. altissima* and increase its potential range.
- the potential economic impact on transport infrastructure and other building structures could be high.
- the species is known to be a highly damaging invasive species in other parts of it's non-native range.
- it is highly likely to have negative impacts on native species in natural and semi-natural habitats

Management options (brief summary):

1 - Has the species been managed elsewhere? If so, how effective has management been?

Response: Yes. *A. altissima* is managed throughout it's non-native range for example in North America and many European countries. Effective management of established plants/populations is very difficult because of the species' ability to regenerate from its extensive root system (for example Radkowitsch 2008, Gover et al. 2004). The success of effective management therefore depends upon follow up treatments over several years (Kowarik and Säumel 2007).

2 - List the available control / eradication options for this organism and indicate their efficacy.

Response:
- Physical control: hand pulling of seedlings (highly effective if all roots removed), cutting (only effective with follow up treatment of regrowth over several years), cutting of seed bearing branches of adult trees to prevent seed spread (effective for prevention of spread, but may have to be done every year), girdling i.e. removal of the bark in older trees (seems not to prevent resprouting)
- Combination of cutting and subsequent herbicide treatment of regrowth over several years (effective, but more difficult to implement in natural and semi-natural habitats).
- stem or stump injections with herbicides have been successfully used (DiTomaso & Kyser 2007) to kill *A. altissima*, however, there seems to be risk to no-target neighbouring plant species being affected as well (Lewis & McCarthy 2008).

3 - List the available pathway management options (to reduce spread) for this organism and indicate their efficacy.

Response:
1. Prevention of further plantings of the species – most effective as the creation of further potential seed sources is prevented.
2. Collect data of current planted distribution and set up monitoring scheme. Already planted and mature trees are the most likely cause for future establishment success and spread of *A. altissima*– removal of trees close to habitats or transport structures where an invasion would have high negative impacts should be considered.

4 - How quickly would management need to be implemented in order to work?

Response: Management of new established seedlings and young plants should be done before formation of the extensive root system and tap root and before the plants start producing seeds and flowers, usually in 3-5 year old plants but also as early as in 1 year old plants (Kowarik and Säumel 2007).

References

Provide here a list of the references cited in the course of completing assessment

List:

BBKA 2007. Trees useful to bees. British Beekeepers Association, Information Leaflet L2, http://www.bbka.org.uk/files/library/bbka_trees_for_bees_3-way_1306864371.pdf

Bennett, W. O., Paget, J. T., and D. Mackenzie. 2012. Surgery for a tree surgeon? Acute presentation of contact dermatitis due to *Ailanthus altissima*. Journal of Plastic, Reconstructive & Aesthetic Surgery 66(3):e79-80. doi: 10.1016/j.bjps.2012.11.040

BSBI 2015. BSBI Distribution Database. Botanical Society of Britain & Ireland, http://bsbidb.org.uk/maps/#taxonid=2cd4p9h.a86&taxon=Ailanthus%20altissima, accessed: April 2015.

DEFRA 2009. Adapting to climate change. UK climate projections. Department for Environment, Food and Rural Affairs, PB13274, p. 1-43, https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/69257/pb13274-uk-climate-projections-090617.pdf

DiTomaso, J. M., & Kyser, G. B. (2007). Control of Ailanthus altissima using stem herbicide application techniques. *Arboriculture & Urban Forestry*, *33*(1), 55-63.

Fryer, J. L. 2010. Ailanthus altissima. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). Available: http://www.fs.fed.us/database/feis/ [2013, October 6].

Gover, A., Kuhns, L. and J. Johnson. 2004. Managing Tree-of-Heaven (*Ailanthus altissima*) on Roadsides. Roadside Vegetation Management Factsheet 3. http://plantscience.psu.edu/research/projects/vegetative-management/publications/roadside-vegetative-mangement-factsheets/3ailanthus-on-roadsides/view

Hill, M. and M. Wagner. 2011. Tree-Of-Heaven, *Ailanthus altissima*. Factsheet. GB Non-native Species Information Portal, accessed September 2013. https://secure.fera.defra.gov.uk/nonnativespecies/factsheet/downloadFactsheet.cfm?speciesId=101

Howes, F. N. 1979. Plants and beekeeping. Faber and Faber, London.

Kowarik, I. and I. Säumel. 2007. Biological flora of Central Europe: *Ailanthus altissima* (Mill.) Swingle. Perspectives in Plant Ecology, Evolution and Systematics **8**:207-237.

Kowarik, I. and I. Säumel. 2008. Water dispersal as an additional pathway to invasions by the primarily wind-dispersed tree Ailanthus altissima. Plant Ecology **198**:241-252.

Lawrence, J. G., Colwell, A., & Sexton, O. J. (1991). The ecological impact of allelopathy in Ailanthus altissima (Simaroubaceae). *American Journal of Botany*, 948-958.

Lewis, K., & McCarthy, B. (2008). Nontarget tree mortality after tree-of-heaven (Ailanthus altissima) injection with imazapyr. *Northern Journal of Applied Forestry*, *25*(2), 66-72.

Lezcano – Caceres, H.L. 2010 Ecological characteristics and economic impact of non native Ailanthus altissima (MILL.) swingle in Hesse, Germany. PhD thesis, Universität Göttingen, eDiss http://hdl.handle.net/11858/00-1735-0000-0006-B69A-B

Motard, E., Muratet, A., Clair-Maczulajtys, D., & Machon, N. (2011). Does the invasive species Ailanthus altissima threaten floristic diversity of temperate peri-urban forests?. *Comptes rendus biologies*, *334*(12), 872-879.

NOBANIS 2005: Ailanthus altissima in Denmark. Online database of the North European and Baltic Network on invasive alien species, http://www.nobanis.org/NationalInfo.asp?countryID=DK&taxaID=2152 , accessed, October 2013.

Preston, C. D., D. A. Pearman, and T. D. Dines. 2002. New Atlas of the British and Irish Flora. Oxford University Press, Oxford.

Radkowitsch A. 2008. Ailanthus altissima. Steckbrief in Neoflora Handbuch invasiver gebietsfremder Arten in Deutschland. Floraweb, Bundesamt für Naturschutz. http://www.floraweb.de/neoflora/handbuch/ailanthusaltissima.pdf

RHS 2009: RHS Plant finder 2009-2010. Dorling Kindersley, London, pp 971.

RHS 2015: RHS Horticultural Database, https://www.rhs.org.uk/plants, accessed April 2015.

Richardson, D. M. and M. Rejmánek. 2011. Trees and shrubs as invasive alien species - a global review. Diversity and Distributions **17**:788-809.

Säumel, I. and I. Kowarik. 2010. Urban rivers as dispersal corridors for primarily wind-dispersed invasive tree species. Landscape and Urban Planning 94:244-349.

Vila, M., C. Basnou, P. Pyšek, M. Josefsson, P. Genovesi, S. Gollasch, W. Nentwig, S. Olenin, A. Roques, D. Roy, P. E. Hulme, and DAISIE partners. 2010. How well do we understand the impacts of alien species on ecosystem services? A pan-European, cross-taxa assessment. Frontiers in Ecology and the Environment **8**:135-144.

Willoughby, I., V. Stokes, J. Poole, J. E. J. White, and S. J. Hodge. 2007. The potential of 44 native and non-native tree species for woodland creation on a range of contrasting sites in lowland Britain. Forestry **80**:531-553.