GB Non-native Species Rapid Risk Assessment (NRRA)

Rapid Risk Assessment of: *Lasius neglectus* (Invasive Garden Ant)
Author: Phillip Buckham-Bonnett, Elva J H Robinson

Version: Draft 1 (*06/05/2016*), Peer Review (*04/11/2016)*, NNRAP 1st review (*Nov 2016*), Draft 2 (*11/01/2017*), etc.
Signed off by NNRAP: TBC
Approved by Programme Board: [sent September 2015]
Placed on NNSS website: TBC

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: *To rapidly assess the risk associated with this species in Great Britain*

2 - What is the Risk Assessment Area?

Response: *Great Britain*

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

Response:

Lasius neglectus Van Loon, Boomsma & Andrásfalvy, 1990 (Hymenoptera, Formicidae)
Common names: Invasive Garden Ant (preferred), Asian Super-Ant

The species has sometimes been incorrectly synonymised with *Lasius turcicus* due to morphological similarities (Seifert, 2000). In records predating its description in 1990, the species is often thought to be *Lasius alienus*.

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

Response:

Yes. *Lasius neglectus* is a widespread invasive pest in Europe and Asia Minor and has been recorded at over two hundred sites across twenty countries (see Figure 1).

Global distribution information can be found at: www.creaf.uab.es/xeg/Lasius/Ingles/distribution.htm

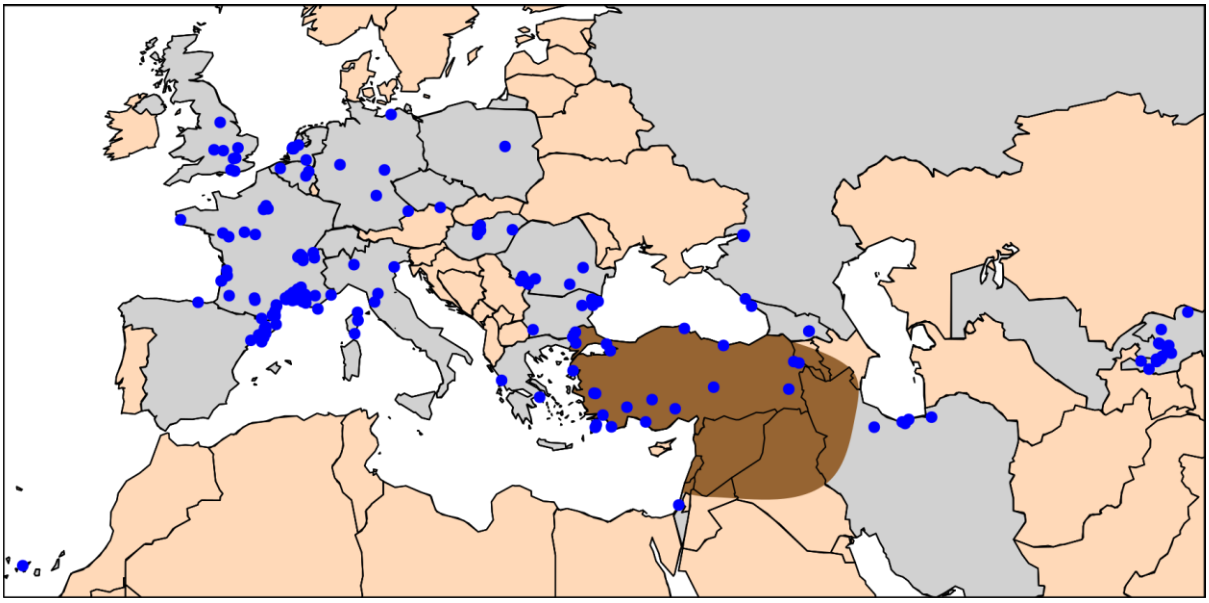

Figure 1 – Map showing the location of all known *Lasius neglectus* colonies. Blue dots represent locations where the ant has been found, countries with colonies are indicates in grey, and the likely home range of the ant [adapted from Cremer et al. (2008)**]** is indicated in brown**.** Data from (Boase, *pers. comm.*; Espadaler and Bernal, 2015; Gippet et al., 2016; Le Parisiene, 2015; *pers. obs.* [PBB])**.**

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

Response:

As of the NRRA Draft 2 date, *Lasius neglectus* is established at seven locations in Great Britain and has been successfully eliminated from one location (see Figure 2).

It was first found at Hidcote Manor, Gloucestershire in 2009 where it occupies approximately 14ha (Boase, 2014; Fox, 2010)**.** A small satellite colony has formed in a quarry approximately 800m to the East of the main colony most likely as a result of transport from Hidcote (Boase, *pers. comm.*).

Lasius neglectus was found in low numbers at Stowe, Buckinghamshire in 2010 on building materials imported from Italy. An immediate eradication response appears to have prevented the species becoming established at this site (Boase, *pers. comm.*).

Lasius neglectus was found in the Cambridge University Botanic Gardens in 2010 (*pers. obs.* [PBB]) where it is now well established covering an area of approximately five hectares (Boase, *pers.comm*, *pers. obs.* [PBB]).

In 2014 *Lasius neglectus* was found in Hendon, North London. An initial inspection found the species occupies at least one hectare of residential and commercial properties (Boase, *pers. comm.*).

In 2016 *Lasius neglectus* was found in the village of Kirk Smeaton in North Yorkshire. It extends approximately 500 metres along a road and currently affects in the region of sixty residential properties (*pers. obs.* [PBB]).

In 2016 *Lasius neglectus* was also found in the grounds and buildings of a farm and school near Rodmell in East Sussex where it occupies at least two to three hectares (Boase, *pers.comm.*). Control attempts so far have had little success.

In 2016 *Lasius neglectus* was also detected in Eastbourne, East Sussex where it occupies an area of at least 7ha. The species is found in residential properties, gardens, college buildings and pavements and has reached pest status (Boase, *pers. comm.*).

In 2016 a *Lasius neglectus* colony was detected in a luxury apartment block in the vicinity of Holland Park, London (W8). The extent of this infestation is unknown (Boase, *pers. comm.*).

Moreover, *Lasius neglectus* is taxonomically cryptic (i.e. superficially similar to some British ant species), therefore hard to detect. This means *L. neglectus* usually goes unnoticed until it reaches pest status and is therefore likely to be present at more sites than currently known. It is important to note that the size of a colony is not necessarily and indicator of establishment date as colonies can grow and shrink at different rates (Tartally et al., 2016).

Lasius neglectus is often found in and around buildings. This is likely a result of human mediated transport and factors such as the availability of suitable nest sites. Warmth for overwintering may also be a benefit but *Lasius neglectus* is able to overwinter in much colder areas that Great Britain, for example sites where the mean air temperature in the coldest month of -4.4°C (Seifert, 2000).

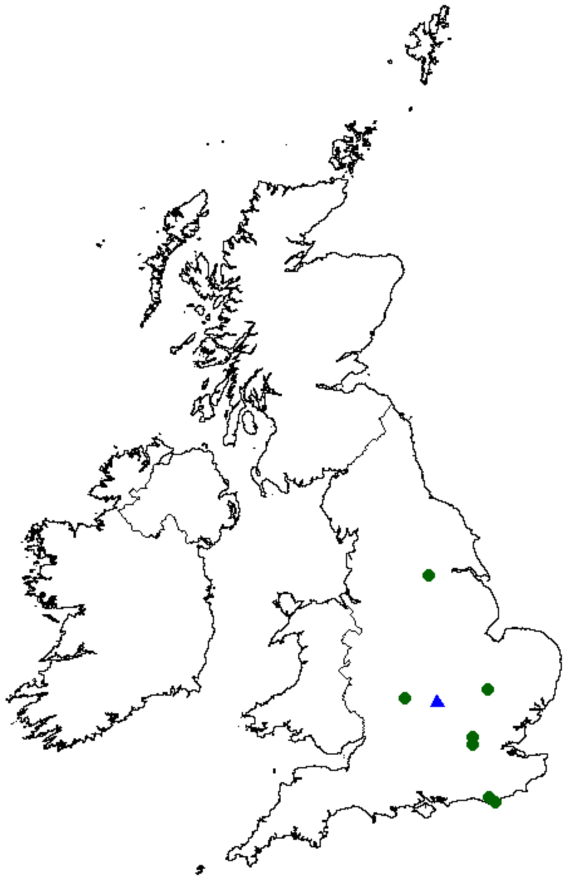

Figure 2 – The location of known *Lasius neglectus* colonies (green circles), sites where the species has been eradicated (blue triangles). Information correct as of NRRA review date.

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:

The whole of Great Britain (with the exception of some mountainous regions) is thought to be currently climatically suitable for *Lasius neglectus*, with the potential range increasing under climate change forecasts (Bertelsmeier et al., 2015a). *Lasius neglectus* can survive in a wide range of habitats. Whilst it is usually found in highly disturbed areas such as gardens, parks, urban areas and pasture (Boase, 2014; Czechowska and Czechowski, 2003; Espadaler, 1999; Recerca and Forestals, 2003), it can also invade natural sites (Paris and Espadaler, 2012).

Lasius neglectus exhibits very flexible foraging behaviour, exploiting a wide range of food sources. It forages on both floral and extra-floral plant nectaries (Espadaler et al., 2007; *pers. obs.* [PBB]) and forms mutualisms with a diverse group of honeydew producing insects, including some of which are non-native (*pers. obs.* [PBB]). This means that the species is highly likely to be able to find food sources at new sites. Once established, *L. neglectus* causes an increase in the abundance of taxa such as aphids which it utilises as a food resource (Paris and Espadaler, 2009) promoting its continued success.

Lasius neglectus forms supercolonies comprising multiple non-antagonistic nests that can each contain multiple queens (Boomsma et al., 1990; Espadaler et al., 2004). This, combined with the species's aggressive behaviour towards other ant species (Bertelsmeier et al., 2015b; Cremer et al., 2006; Santarlasci et al., 2014) means that native ant communities are unable to resist the spread of the invasive ant. The low parasite prevalence in *L. neglectus* and low levels of intraspecific aggression (Cremer et al., 2008) also contribute to its ability to readily establish, survive, and thrive in novel locations.

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 – see response to questions 4 and 6.

8 - Has the organism established viable (reproducing) populations anywhere outside of its native range (answer N/A if you have answered 'yes' to question 4)?

Response:

N/A

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

Response:

Natural spread

Unlike most species in the genus *Lasius*, *Lasius neglectus* queens do not usually fly during or post mating. However, queen morphology suggests that they should be capable of flight (Espadaler and Rey, 2001) and on one occasion a queen was found suspended in a spider's web in a location that would have been difficult to access without flight (Schultz and Seifert, 2005). The rarity of dispersal by flight means that the spread of the invasive ant locally is relatively slow and the species does not tend to arrive at novel sites via this means. Instead, colonies bud off new nests from existing colonies (dependent colony foundation). Budding involves a queen (or queens) moving to a new nest site with part of the population of adult workers. The area occupied by colonies has been recorded as expanding by an average of 13m per year in all directions with new buds forming up to 30m away (Tartally, 2006). Elsewhere, figures ranging between an increasing radius of 2.75m and 10.6m per year have been reported (Espadaler and Bernal, 2007).

The rate of natural spread is dependent upon the habitat available in the location of the colony. *Lasius neglectus* is less likely to spread into areas dominated by coniferous plants than warmer, more open areas (Tartally, 2006), and dense, overgrown vegetation is unfavourable (Schultz and Seifert, 2005). Roads and pavements provide a conduit for the rapid spread of *L. neglectus* (Tartally, 2006; *pers. obs.* [PBB]) by providing warm and robust nest sites. The dependence of some colonies on aphids in large trees has been suggested as a factor limiting their spread (Van Loon et al., 1990) but the species also shows a preference for isolated trees over core woodland areas (Paris and Espadaler, 2012). This suggests a trade off between thermal requirements and food availability. *Lasius neglectus* appears to be thermophilic in Great Britain, and most abundant in open habitats with exposed soil or stones with nearby food sources (*pers. obs.* [PBB]).

The maximum possible area occupied by a *Lasius neglectus* colony is unknown but the largest reported area is 20ha (Le Parisiene, 2015). This is considerably larger than any of the known Great Britain colonies.

Human mediated dispersal

Human mediated dispersal in the soil of potted plants is the most likely mechanism for the spread of *Lasius neglectus* over distances greater than 100m (Espadaler et al., 2007; Schultz and Busch, 2009; Van Loon et al., 1990). *Lasius neglectus* is frequently found in location that are associated with botanical exchange (see question 5). Other possible mechanisms for accidental human mediated dispersal include the disposal of construction or green waste (Boase, 2014). The movement of soil and building materials are likely to be important for human mediated dispersal at local and regional scales (i.e. hundreds of metres to hundreds of kilometres). For example the movement of soil to build embankments is linked to the establishment of sixty nine *L. neglectus* supercolonies in the vicinity of Lyon, France (Gippet et al., 2017). The behavioural, chemical and genetic similarities between and within populations in Europe (Ugelvig et al., 2008) support the hypothesis of natural dispersal over short distances and human mediated dispersal over large distances.

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

Response:

Environmental Harm
Lasius neglectus saturates the habitat it invades and reaches very high abundances (Espadaler et al., 2004; Van Loon et al., 1990). *Lasius neglectus* is highly aggressive towards other ants (Cremer et al., 2006) and its numerical advantage allows it to outcompete larger native ant species (Santarlasci et al., 2014). The effects on native ant species can be dramatic with their being excluded from the core area of *Lasius neglectus* colonies (Tartally, 2000). In addition to its impact on native ant communities, the presence of *L. neglectus* also reduces the overall species diversity in an area and in particular reduces the richness of isopods (Nagy et al., 2009). In contrast, the presence of the invasive ant tends to lead to an increase in the abundance of aphids (Paris and Espadaler, 2009), and other non-aphid Hemiptera (Nagy et al., 2009). *Lasius neglectus* feeds on honeydew excreted by Hemiptera and protects them from predators and parasitoids (Espadaler, 1999). In Spain *Lasius neglectus* is estimated to collect more than twice as much honeydew per tree than native ants. This removal of phloem sap is likely to have a not insignificant impact on the health of the trees (Paris and Espadaler, 2009). There have even been anecdotal reports that the aphid load resulting from the presence of *Lasius neglectus* can kill the host trees (Espadaler, 1999). Impacts are highly localised around each colony.

Economic Harm
The biggest potential for economic harm from *Lasius neglectus* is probably via its interaction with aphids. If *Lasius neglectus* were to spread into agricultural areas, particularly those using organic farming methods, it could have a significant impact on yield. The deleterious effects of native ant species (via their interaction with aphids) on crop plants have already been reported (Banks and Macaulay, 1967).

Lasius neglectus has been blamed for damaging electrical equipment in a variety of locations where is it a pest species (Espadaler, 1999; Jolivet, 1986; Rey and Espadaler, 2004). Whilst the precise monetary value of this damage is rarely assessed, a colony at Saint-Desirat, France is estimated to have caused €5000 worth of damage over 4 years (Le Parisiene, 2015). The cost of reducing ant numbers within homes both in terms of materials used and expertise required is likely to be significant over time. The presence of *L. neglectus* could also have a negative impact on the value of property in an area, if the infestation were publicised. Measures taken to prevent the spread of ants from existing locations (e.g. restrictions on the movements of plants and soil) also result in a cost both in terms of inconvenience and money (Boase, 2014).

Social Harm
Lasius neglectus workers do not possess a sting, do not spray formic acid, and are too small to break the skin when biting humans. However, the species readily invades homes, causing distress to residents, and can interfere with activities such as gardening (*pers. obs.* [PBB]). There are no known human allergies to *L. neglectus*. The social harm caused by *L. neglectus* is through annoyance rather than danger.

Vector
The nests of *Lasius neglectus* are home to various myrmecophiles (ant-partnered symbionts), including species such as the cricket *Myrmecophilus fuscus* which are not native to Great Britain (Stalling et al., 2015). Some of these, for example the woodlouse *Platyarthrus schoblii* have been co-introduced outside of their native range alongside the invasive ant (Tartally et al., 2004). Whilst these are not known to cause economic or social harm, their impact on native myrmecophiles (e.g. the woodlouse *Platyarthrus hoffmannsteggii*) is unknown. Some *L. neglectus* colonies in Europe are infected with the fungal pathogen *Laboulbenia formicarum* (Tragust et al., 2015). This ant-specific pathogen is originally from North America and if introduced to Great Britain could potentially spread to native ant species as it has on Madeira (Espadaler and Santamaria, 2003). In North America, the pathogen is known to infect 17 species in the ant subfamily Formicinae (references in: Espadaler et al., 2011).

Table 1 – Summary of harm caused by *Lasius neglectus* with locations of examples

Harm	Location	References
Host/ mutualist to other invertebrates not native to Great Britain	Great Britian [Hidcote], Hungary, Spain	(Hornung et al., 2005; Stalling et al., 2015; Tartally et al., 2004; *pers. obs.* [PBB])
Host for ant pathogens not native to Great Britain	France, Spain	(Konrad et al., 2015; Tragust et al., 2015)
Alters native invertebrate community structure	Hungary	(Nagy et al., 2009)
Increases aphid abundance locally	Great Britain [Cambridge, Hidcote, Kirk Smeaton], Hungary, Spain	(Nagy et al., 2009; Paris and Espadaler, 2009; *pers. obs.* [PBB]; Sheld, *pers. comm.*)
Damages plants (through interaction with aphids)	Spain	(Espadaler, 1999)
Excludes native ant species	Great Britain	(Boase, 2014; *pers. obs.* [PBB])
Damage to electrical equipment	Great Britain [Kirk Smeaton], France, Spain	(Jolivet, 1986; Le Parisiene, 2015; Sheld, *pers. comm.*)
Annoyance and distress to residents in affected areas	Great Britain [Cambridge, Hidcote, Kirk Smeaton, Rodmell], Netherlands	(Mabelis et al., 2010; *pers. obs.* [PBB])
Economic losses due to control measures etc	Great Britain [Hidcote]	(Boase, 2014)

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):

Lasius neglectus has already arrived in Great Britain and is known to be established at seven locations (see Figure 2). It is not known whether these populations represent independent introductions from outside Great Britain. There is a risk of further introductions, both from Europe and from existing Great Britain populations.

The most likely pathway for the entry of *L. neglectus* into Great Britain is in the soil associated with potted plants. Therefore, the species is most likely to arrive at areas associated with horticultural exchange as these will have a higher propagule pressure. This includes sites involved in the horticultural trade (e.g. garden centres) but also those involved with plant curation, display or research (e.g. botanic gardens and gardens open to the public). Shipping ports and airports tend to have a high propagule pressure for non-native ant species (Ward et al., 2006). The ability for *L. neglectus* to survive in highly disturbed habitats means that Great Britain points of entry linked to horticultural exchange with Europe are also high risk locations.

Accidental transport with building materials from Europe (as seen with the arrival at Stowe in 2010) is also possible.

Further pathways relating to the spread of *Lasius neglectus* within the Great Britain are detailed in the "Spread Summary" section.

Establishment Summary

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

Response: *likely*
Confidence: *very high*

Comments (state where in Great Britain this species could establish in your comments):

A mathematical model suggests that the climate of the whole of the Great Britain (with the exception of some mountainous regions) is currently within the climatic range of existing *Lasius neglectus* populations (both native and invasive). The suitable area is expected to increase under climate change (Bertelsmeier et al., 2015a). (See Bertelsmeier et al. (2015a) Figure 3 for a map.) Whilst this approach does not account for the possible effects of anthropogenic microclimate at invasion sites, *L. neglectus* is reported from one site in its native range that has a mean air temperature in the coldest month of -4.4°C (Seifert, 2000). This indicates that the species should be able to survive British winters.

Lasius neglectus is very flexible in both its foraging behaviour (Espadaler et al., 2007; Schultz and Busch, 2009, *pers. obs* [PBB]) and the range of habitats it can occupy (Paris and Espadaler, 2012; Seifert, 2000). In addition, *L. neglectus* is highly aggressive towards other ant species (Cremer et al., 2006). These factors mean the species is well suited to establishment in novel areas (see Question 6).

There are, however, several examples of *Lasius neglectus* colonies ceasing to expand, shrinking, or even disappearing after having become established (Tartally et al., 2016, 2004). The factors contributing to these changes are unclear but could include: climatic variables; a reduction in resource availability (e.g. food or nest sites); adaptation of local pathogens or competitors; and genetic impediments resulting from inbreeding or isolation (Tartally et al., 2016).

Spread Summary

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

Overall response: *intermediate*
Confidence: *high*

Sub scores:

Natural spread only:
Response: *slow*
Confidence**:** *high*

Human facilitated spread only:
Response: *rapid*
Confidence**:** *high*

Comments (in your comments list the spread pathways and discuss how much of the total habitat that the species could occupy has already been occupied):

Lasius neglectus currently only occupies a very small fraction of the total habitat that it could potentially occupy, in part due to its low rate of natural dispersal.

Natural spread
Once established at a site, a *Lasius neglectus* colony will expand the area that it occupies if there is suitable habitat for it to expand into. Highly disturbed habitats and urban areas where sufficient food resources are available are likely to allow a higher rate of spread than areas such as grassland or dense woodland. The rate of spread is likely to be low and natural dispersal to new sites unlikely.

Human facilitated spread
The risk of human facilitated spread is high. *Lasius neglectus* is cryptic (i.e. sufficiently similar to native ant species to not be noticed) and is a small species so there is a high likelihood of it not being noticed upon import to Great Britain. Not all known Great Britain populations have measures in place to prevent the spread to new locations so there is also a high risk of accidental transport. Moreover, it is highly likely that further unknown populations exist and the risk of spread from these is also high. With the exception of sites liked with horticultural exchange, it is difficult to predict where the species might be transported. Two Great Britain populations (Hendon and Kirk Smeaton) do not have any apparent strong links with the horticulture so it is unclear how *Lasius neglectus* arrived at these sites.

Potential pathways for spread include:
Transport in soil with potted plants
Transport on building materials or waste
Transport in soil (bulk quantities)
Transport in garden waste
Transport in agricultural materials e.g. hay.

Impact Summary

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

Overall response: *moderate*
Confidence: *medium*

Sub-scores

Environmental impacts:
Response: *major*
Confidence**:** *medium*

Economic impacts:
Response: *moderate*
Confidence: *medium*

Social impacts:
Response: *minor*
Confidence: *medium*

Comments (include list of impacts in your comments):

Environmental impacts
The environmental impact of *Lasius neglectus* can be severe but tend to be highly localised around colonies. Impacts include: reducing the abundance of native ants; reducing the richness of native isopods; acting as a vector for other non-native species and diseases; increasing the abundance of Hemiptera (particularly aphids); and potentially impacting plant health via the increase in Hemiptera numbers.

Economic Impacts
Economic impacts resulting from *Lasius neglectus* include: costs relating to the replacement of damaged electrical equipment; the cost of control/ eradication measures; loss of income as a result of control/ eradication measures; a potential impact on property value; and the potential for negative impacts on agricultural production.

Social impacts
The main social impact of *L. neglectus* is the distress and inconvenience caused when it invades homes, properties and gardens.

Uncertainty
The medium confidence in these response levels is in part due to: a lack of data on the impacts of *Lasius neglectus* in Great Britain; the fact that it has only emerged as a pest in the last 30 years so long-term effects are unknown; and the difficulty is estimating the true abundance of this ant in the Great Britain.

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):

Lasius neglectus is probably near to the northern edge of its potential range in Great Britain. Whilst the potential Great Britain range will only slightly increase under climate change (Bertelsmeier et al., 2015a), an increase in average temperatures would most likely increase the favourability of Great Britain to the establishment of this species. In Great Britain *Lasius neglectus* appears to be thermophilic in its habitat preference at the local scale (*pers. obs.* [PBB]). Thermophily has also been reported in the most northerly known populations of *L, neglectus* on the European mainland (Schultz and Busch, 2009).

A change in climate that leads to less severe winters or overall warming in Great Britain is likely to be conducive to the spread and persistence of *Lasius* neglectus. A change in Great Britain's climate may also lead to an increase in the demand for and importing of plants native to infected countries such as France and Spain. This could increase the rate at which *Lasius neglectus* arrives in Great Britain.

Conclusion

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

Response: *high*
Confidence: *medium*

Comments:

Whilst the impacts of *Lasius neglectus* can be severe, both economically and environmentally, they tend to be very localised around colonies. The whole of Great Britain represents a potential habitat for this species but the natural spread of colonies is slow and they are unlikely to reach new sites via natural means. However, the species is cryptic meaning that novel introductions could easily be overlooked. In addition, *Lasius neglectus* populations tend to be identified only once the ant reaches pest status. It is therefore likely that the species is more abundant than we are currently aware and the risk of accidental human-mediated spread from unknown populations is high. The rate at which new populations are discovered globally is increasing exponentially (Espadaler et al., 2007).

A lack of data on the effects of *Lasius neglectus* in Great Britain and the long term stability and survival of *Lasius neglectus* colonies generally adds uncertainty to this conclusion.

Management options (brief summary):

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

Response:

Multiple studies have reported that control attempts have been unsuccessful but have not indicated what measures were employed (Espadaler, 1999; Schultz and Busch, 2009)**.**

A field-based trial in Spain used a fourfold approach to attempt to reduce *Lasius neglectus* numbers (Rey and Espadaler, 2004). Trees were fogged with insecticides to kill aphid, tree trunks were painted with a contact insecticide, soil in and around the colony was injected with insecticides and granular bait stations were deployed in houses (see Table 2 for details). This approach had some success in reducing ant numbers. However, the effects were reduced by rainfall in the second year, the contribution of each component is unclear and phoxim (the pesticide used in two of the approaches) is no longer approved for use in the European Union (European Commission 2007/393/EC, 2007).

A field-based trail in Great Britain used a single approach to control *Lasius neglectus* numbers (Boase, 2014). A gel-based insecticide bait (Maxforce® Quantum gel) was used applied in and around houses (see Table 3 for details). This approach achieved a 91% reduction in ant number over one week. However, application of gel-based pesticides is highly labour intensive and unsuitable for scaling up to large areas. A laboratory-based trial of the efficacy of four granular pesticides has been unable to identify a commercially available granular insecticide bait that performs as well as Maxforce® Quantum gel (Buckham-Bonnett et al., *in prep*).

One successful eradication has occurred in Great Britain. The *Lasius neglectus* arriving at Stowe on stone from Italy were immediately identified allowing the whole shipment to be fumigated with phosphine (Boase, 2014). Subsequent surveys for the ant at Stowe have found no evidence of its presence.

Table 2 – Insecticide products and use in Rey and Espadaler (2004)

Product	Ingredient	Concentration of active ingredient	Concentration after dilution	Use	Approximate application
Fendona®	α- cypermethrin	6%	0.04%	Tree trunk spray	0.6 L /tree
Baythion®	phoxim (foxim)	50%	0.05%	Soil injection	5 L /injection (100 L/house)
Efitax®	α- cypermethrin	4%	0.00%	Tree canopy fogging	4 L /tree
Confidor®	imidacloprid	20%	0.02%	Tree canopy fogging	4 L /tree
Blattanex®	phoxim (foxim)	0.08%	NA (granular)	Bait stations in houses	5 - 10 per house

Table 3 – Insecticide products and use in Boase (2014)

Product	Ingredient	Concentration of active ingredient	Concentration after dilution	Use	Approximate application
Maxforce® Quantum	imidacloprid	0.03%	NA (gel)	Injected into bait stations/ natural cracks and crevices	0.2 g/m^2

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

Response:
If a *Lasius neglectus* colony is identified when it is small (i.e. within approximately two years of establishment), intensive treatment with a variety of measures (see Table 4) followed by monitoring to ensure the treatment's effectiveness should result in its eradication.

There have been no successful attempts at eradicating large colonies but their size can be limited using the methods outlined in Table 4. Granular baits appear to have a low palatability for *Lasius neglectus* (Buckham-Bonnett et al, *in prep*) whereas gel-based insecticides are effective but highly labour intensive to apply. Water storing crystals such as those used against the Argentine ant (Boser et al., 2014) are likely to be the best toxicant delivery method for large areas, but research into their use with *Lasius neglectus* is required. This should include an evaluation of the effectiveness of various different active ingredients for the species (Hoffmann et al., 2016).

Table 4 – control/eradication options

Measure	Disadvantages	Effectiveness
Gel ant baits	Highly labour intensive application	High
Granular ant baits	Low palatability for *Lasius neglectus*	Medium - Low
Fumigation	Works best in an enclosed area	High
Contact pesticides e.g. painted on trees.	Highly labour intensive application Effects reduced by rain	Medium
Water storing crystals (laced with insecticide)	Untested with *Lasius neglectus*	Likely high

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

Response:

Spread from outside Great Britain
Preventing the import of *Lasius neglectus* into Great Britain is likely to be difficult due to its wide geographical distribution. However, monitoring sites with a high propagule pressure e.g. botanic gardens, garden centres etc. would help to increase the probability that the ant was caught soon enough after arrival for eradication to take place.

Spread from within Great Britain
A list of pathway management practices in place at Hidcote to prevent the spread of *Lasius neglectus* to other locations is provided in Table 1 of Boase (2015). In summary, these measures prohibit the removal from site of materials which could also contain queens/ brood of *L.neglectus*. The measures include preventing the transport of plants off site (unless from an ant free area), prohibiting the disposal of garden waste off site, and preventing

building waste/ soil being removed from the site. The application of management strategies such as these are particularly important at sites which distribute plants to other locations.

Garden waste/ rubbish bins collected by councils for infested areas also present a potential (although less likely) pathway. This could lead to the ants being transferred to waste processing sites and then on to other new locations. If a colony were located on farmland, the movement of materials such as soil could facilitate the spread of the ant.

It is likely that new potential pathways will emerge that are specific to the area new colonies inhabit. Assessment of new cases is required to ensure that these pathways are identified.

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

Response:

As the number of new cases discovered globally is increasing exponentially (Espadaler et al., 2007), the sooner pathway management practices are implemented, the more effective they are likely to be. Preventing the spread of *Lasius neglectus* to new locations is the most important measure, followed by steps to eradicate new colonies as soon after establishment as possible.

However, it is likely to be very difficult and expensive to eradicate large established colonies so a rapid response here is not important. The cost of potential control measures alongside other long term economic impacts of the ant should be considered before a decision not to eradicate large colonies is made.

References

Banks, C.J., Macaulay, E.D.M., 1967. Effects of *Aphis fabae* Scop, and of its attendant ants and insect predators on yields of field beans (*Vicia faba* L.). Ann. Appl. Biol. 60, 445–453.

Bertelsmeier, C., Luque, G.M., Hoffmann, B.D., Courchamp, F., 2015a. Worldwide ant invasions under climate change. Biodivers Conserv 24, 117–128.

Bertelsmeier, C., Ollier, S., Avril, A., Blight, O., Jourdan, H., Courchamp, F., 2015b. Colony-colony interactions between highly invasive ants. Basic Appl Ecol 17, 106–114.

Boase, C., 2014. *Lasius neglectus* (Hymenoptera : Formicidae) in the UK : status, impact and management, in: Proceedings of the Eighth International Conference on Urban Pests. pp. 223–228.

Boomsma, J.J., Brouwer, A.H., Van Loon, A.J., 1990. A new polygynous *Lasius* species (Hymenoptera: Formicidae) from central Europe. Insectes Soc. 37, 363–375.

Boser, C.L., Hanna, C., Faulkner, K.R., Cory, C., Randall, J.M., Morrison, S.A., 2014. Argentine Ant Management in Conservation Areas: Results of a Pilot Study. Monogr. West. North Am. Nat. 7, 518–530.

Buckham-Bonnett, P., Aguión, A., Boase, C., Lee, P., Robinson, E.J.H., *in prep*. Evaluating the palatability and toxicity of commercially available pesticides for large scale use on the Invasive Garden ant (*Lasius neglectus*).

Cremer, S., Ugelvig, L. V, Drijfhout, F.P., Schlick-Steiner, B.C., Steiner, F.M., Seifert, B., Hughes, D.P., Schulz, A., Petersen, K.S., Konrad, H., Stauffer, C., Kiran, K., Espadaler, X., d'Ettorre, P., Aktaç, N., Eilenberg, J., Jones, G.R., Nash, D.R., Pedersen, J.S., Boomsma, J.J., 2008. The evolution of invasiveness in garden ants. PLoS One 3, e3838.

Cremer, S., Ugelvig, L. V, Lommen, S.T.E., Petersen, K.S., Pedersen, J.S., 2006. Attack of the invasive garden ant: aggression behaviour of *Lasius neglectus* (Hymenoptera: Formicidae) against native *Lasius* species in Spain. Myrmec. Nachr 9, 13–19.

Czechowska, W., Czechowski, W., 2003. Further record of *Lasius neglectus* Van Loon, Boomsma et Andrasflavy (Hymenoptera:Formicidae) for Warsaw, with a key to the Polish species of the subgenus *Lasius* s.str. Fragm. faun. 46, 195–202.

Espadaler, X., 1999. *Lasius neglectus* Van Loon, Boomsma & Andrásfalvy, 1990 (Hymenoptera, Formicidae), a potential pest ant in Spain. Orsis 14, 43–46.

Espadaler, X., Bernal, V., 2007. *Lasius neglectus*. Control Trials. [WWW Document]. URL http://www.creaf.uab.es/xeg/Lasius/Ingles/control.htm (accessed 2.18.16).

Espadaler, X., Bernal, V., 2015. *Lasius neglectus* a polygynous, sometimes invasive, ant: Distribution [WWW Document]. URL http://www.creaf.uab.es/xeg/lasius/Ingles/distribution.htm (accessed 2.2.16).

Espadaler, X., Lebas, C., Wagenknecht, J., Tragust, S., 2011. *Laboulbenia formicarum* (Ascomycota, Laboulbeniales), an exotic parasitic fungus, on an exotic ant in France. Vie Milieu 61, 41–44.

Espadaler, X., Rey, S., 2001. Biological constraints and colony founding in the polygynous invasive ant *Lasius neglectus* (Hymenoptera, Formicidae). Insectes Soc. 48, 159–164.

Espadaler, X., Rey, S., Bernal, V., 2004. Queen number in a supercolony of the invasive garden ant, *Lasius neglectus*. Insectes Soc. 51, 232–238.

Espadaler, X., Santamaria, S., 2003. *Laboulbenia formicarum* Thaxt. (Ascomycota, Laboulbeniales) crosses the Atlantic. Orsis 18, 97–101.

Espadaler, X., Tartally, A., Schultz, R., Seifert, B., Nagy, C., 2007. Regional trends and preliminary results on the local expansion rate in the invasive garden ant, *Lasius neglectus* (Hymenoptera, Formicidae). Insectes Soc. 54, 293–301.

European Commission 2007/393/EC, 2007. Commission decision of 6 June 2007 concerning the non-inclusion of diazinon in Annex I to Council Directive 91/414/EEC and the withdrawal of authorisations for plant protection products containing that substance.

Fox, M.G., 2010. First incursion of *Lasius neglectus* (Hymenoptera: Formicidae), an invasive polygynous ant in Britian. Br. J. Ent. Nat. Hist. 23, 259–261.

Gippet, J.M.W., Mondy, N., Diallo-Dudek, J., Bellec, A., Dumet, A., Mistler, L., Kaufmann, B., 2017. I'm not like everybody else: urbanization factors shaping spatial distribution of native and invasive ants are species-specific. Urban Ecosyst. 20, 157–169.

Hoffmann, B.D., Luque, G.M., Bellard, C., Holmes, N.D., Donlan, C.J., 2016. Improving invasive ant eradication as a conservation tool: A review. Biol. Conserv. 198, 37–49.

Hornung, E., Vilisics, F., Tartally, A., 2005. Occurrence of *Platyarthrus schoblii* (Isopoda, Oniscidea) and its ant hosts in Hungary. Eur. J. Soil Biol. 41, 129–133.

Jolivet, P., 1986. Les fourmis et la télévision. L' Entomol. 42, 321–323.

Konrad, M., Grasse, A. V, Tragust, S., Cremer, S., 2015. Anti-pathogen protection versus survival costs mediated by an ectosymbiont in an ant host. Proc. Biol. Sci. 282, 20141976.

Le Parisiene, 2015. Ardèche : un village envahi par les fourmis [WWW Document]. Le Paris. URL http://www.leparisien.fr/rhone-alpes/ardeche-un-village-envahi-par-les-fourmis-12-04-2015-4685979.php (accessed 2.18.16).
Mabelis, B.A., Van Loon, A.J., Dekoninck, W., 2010. Verovert de plaagmier Nederland? Entomol. Ber. 70, 30–36.
Nagy, C., Tartally, A., Vilisics, F., Merkl, O., Szita, É., Szél, G., Podlussány, A., Rédei, D., Csösz, S., Pozsgai, G., Orosz, A., Szövényi, G., Markó, V., 2009. Effects of the invasive garden ant, *Lasius neglectus* Van Loon, Boomsma & András-Falvy, 1990 (Hymenoptera: Formicidae), on arthropod assemblages: pattern analyses in the type supercolony. Myrmecol News 12, 171–181.
Paris, C.I., Espadaler, X., 2009. Honeydew collection by the invasive garden ant *Lasius neglectus* versus the native ant *L. grandis*. Arthropod. Plant. Interact. 3, 75–85.
Paris, C.I., Espadaler, X., 2012. Foraging Activity of Native Ants on Trees in Forest Fragments Colonized by the Invasive Ant *Lasius neglectus*. Psyche (Stuttg). 2012, 1–9.
Recerca, C. De, Forestals, A., 2003. Exotic ants in the Canary Islands (Hymenoptera, Formicidae). Vieraea 31, 1–7.
Rey, S., Espadaler, X., 2004. Area-wide management of the invasive garden ant *Lasius neglectus* (Hymenoptera: Formicidae) in Northeast Spain. J. Agric. Urban Entomol. 21, 99–112.
Santarlasci, A., Martelloni, G., Frizzi, F., Santini, G., Bagnoli, F., 2014. Modeling warfare in social animals: a "chemical" approach. PLoS One 9, e111310.
Schultz, R., Busch, T., 2009. The northernmost record of the invasive garden ant, *Lasius neglectus* (Hymenoptera: Formicidae). Myrmecol News 12, 183–186.
Schultz, R., Seifert, B., 2005. *Lasius neglectus* (Hymenoptera: Formicidae)–a widely distributed tramp species in Central Asia. Myrmecol News 7, 47–50.
Seifert, B., 2000. Rapid range expansion in *Lasius neglectus* (Hymenoptera, Formicidae) – an Asian invader swamps Europe. Mitt. Mus. Nat. kd. Berl., Dtsch. entomol. Z. 47, 173–179.
Stalling, T., Espadaler, X., Carrón, N.O.Z., 2015. First record of the ant-loving cricket *Myrmecophilus fuscus* Stalling, 2013 (Orthoptera: Myrmecophilidae) in mainland Spain. Sociobiology 62, 481–483.
Tartally, A., 2000. Notes on the coexistence of the supercolonial *Lasius neglectus* Van Loon, Boomsma et Andrásfalvy 1990 (Hymenoptera: Formicidae) with other ant species. Tiscia 1990, 43–46.
Tartally, A., 2006. Long term expansion of a supercolony of the invasive garden ant, *Lasius neglectus* (Hymenoptera: Formicidae). Myrmec. Nachr 9, 21–25.
Tartally, A., Antonova, V., Espadaler, X., Csősz, S., Czechowski, W., 2016. Collapse of the invasive garden ant, *Lasius neglectus*, populations in four European countries. Biol. Invasions 1–5.
Tartally, A., Hornung, E., Espadaler, X., 2004. The joint introduction of *Platyarthrus schoblii* (Isopoda: Oniscidea) and *Lasius neglectus* (Hymenoptera : Formicidae) into Hungary. Myrmec. Nachr 6, 61–66.
Tragust, S., Feldhaar, H., Espadaler, X., Pedersen, J.S., 2015. Rapid increase of the parasitic fungus *Laboulbenia formicarum* in supercolonies of the invasive garden ant *Lasius neglectus*. Biol. Invasions 17, 2795–2801.
Ugelvig, L. V, Drijfhout, F.P., Kronauer, D.J.C., Boomsma, J.J., Pedersen, J.S., Cremer, S., 2008. The introduction history of invasive garden ants in Europe: integrating genetic, chemical and behavioural approaches. BMC Biol. 6.
Van Loon, A.J., Boomsma, J.J., Andrasfalvy, A., 1990. A new polygynous *Lasius* species (Hymenoptera: Formicidae) from central Europe. Insectes Soc. 37, 348–362.
Ward, D.F., Beggs, J.R., Clout, M.N., Harris, R.J., O'Connor, S., 2006. The diversity and origin of exotic ants arriving in New Zealand via human-mediated dispersal. Divers. Distrib. 12, 601–609.