RISK ASSESSMENT SUMMARY SHEET

Black imported fire ant (*Solenopsis richteri*)

- A small, mostly black ant, up to 2mm long. Named for its painful bite and sting.
- One of the less successful invasive ant species, having been outcompeted by *S. invicta* in its non-native range in the USA.
- Damages crops and farm machinery and bites and stings people.
- Considered a medium risk to the EU, where it is not yet present.
- Unlikely to be able to establish in the wild in GB but could persist indoors.

Joe MacGown, Mississippi Entomological Museum

History in GB

Not established in GB. Unlikely to survive in the wild in GB under foreseeable conditions but could persist indoors and in protected conditions. The only non-native population known is from the USA where it was introduced in the 1910s. It was subsequently displaced in much of its non-native range by the invasive *S. invicta* and hybrids between the species frequently occur.

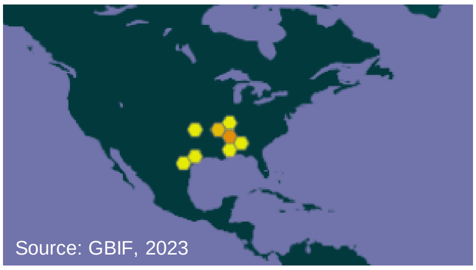
Native Distribution

Native to parts of Brazil, Argentina, Chile, Paraguay and Uruguay


From Wikipedia, based on Ross et al 2010

Introduced range

Introduced to southern USA


Source: GBIF, 2023

Impacts

Evidence of impact is lacking but is likely to be similar to the more studied *S. invicta*. Overall risk is low because this species is unlikely to establish in GB, despite possible impacts if it were to establish.

Environmental (moderate, low confidence)

- May alter arthropod communities through predation and competition. Foraging and nest building could impact nutrient cycling and increase plant growth as shown by *S. invicta.*

Economic (moderate, low confidence)

- Trade could be negatively impacted through increased import regulations and control measures, or restrictions on high-risk goods.

Social (moderate, high confidence)

- Bites and stings can be painful may lead to anaphylactic shock in some people. Medical issues due to stings are perceived as being a major problem in its introduced range.
- Could become a nuisance in lawns, recreational areas, golf courses, etc.

Introduction pathway

Potentially introduced with containers and air freight, particularly associated with soil and horticultural products.

Spread pathway

Natural (moderate, high confidence) - nuptial flight of queens may move considerable distances; colonies can also spread by budding.

Human (major, high confidence) - mostly likely to be moved with plants and horticultural products, also with vehicles.

Summary

	Response	Confidence
Entry	MODERATE	MEDIUM
Establishment	UNLIKELY	HIGH
Spread	SLOW	MEDIUM
Impact	MODERATE	LOW
Overall risk	LOW	LOW

GB NON-NATIVE ORGANISM RISK ASSESSMENT SCHEME

Name of organism: *Solenopsis richteri* Forel, 1909
Author: Dr Jenni A. Stockan, James Hutton Institute
Risk Assessment Area: Great Britain
Version: Draft 1 (Nov 2022), Peer Review (Jan 2023), NNRAF 1 (Mar 2023), Draft 2 (Jun 2023), NNRAF 2 (Oct 2023), Draft 3 (Nov 2023), NNRAF 3 (Dec 2023)
Signed off by NNRAF: December 2023
Approved by GB Committee: April 2024
Placed on NNSS website: *to be completed*

What is the principal reason for performing the Risk Assessment?

The GB Committee for non-native species is considering whether to add this species to the list of species of special concern. This assessment will form part of the evidence used to inform the Committee's decision. This species is being considered because it is on the EU list of species of Union Concern and may pose a potential threat to GB via introduction with horticultural products.

SECTION A – Organism Information		
Stage 1. Organism Information	**RESPONSE**	**COMMENT**
1. Identify the organism. Is it clearly a single taxonomic entity and can it be adequately distinguished from other entities of the same rank?	Yes Scientific name: *Solenopsis richteri* Forel 1909 Class: Insecta Order: Hymenoptera Family: Formicidae Genus: Solenopsis Westwood, 1840 Original name: *Solenopsis pylades* var. *richteri* Forel 1909 Synonyms: *Solenopsis saevissima* var. *oblongiceps* Santschi 1936, *Solenopsis pylades* var. *tricuspis* Forel, 1912, *Solenopsis saevissima* st. *richteri* Forel 1909, *Solenopsis saevissima* var. *tricuspis* Forel, 1912. A full and up to date list can be found at www.antweb.org. Common name: Black Imported Fire Ant (BIFA) *Solenopsis* ants have a two-segmented waist, absence of spines on the propodeum and long hair in the middle of the clypeus. Workers have ten-segmented antenna, the last two of which form a distinct club. *Solenopsis richteri* and the closely related *invicta* share the characteristic of a median tooth and two lateral teeth along the front edge of the clypeus (Bolton 1987; 1994). *S. richteri* is darker (dark brown to black) than *S. invicta* with a characteristic yellow spot on the gaster.	
2. If not a single taxonomic entity, can it be redefined? (if necessary use the response box to re-define the organism and carry on)	N/A A key to *Solenopsis* species based on Pitts et al. (2018) is provided on www.antwiki.org.	

	S. richteri and *S. invicta* commonly hybridise where their non-native ranges overlap in the USA. Chemotaxonomic analyses of venom alkaloids and cuticular hydrocarbons are the best methods to distinguish hybrids (Valles et al. 2021). This risk assessment does not consider hybrids. *Solenopsis richteri* is less well known than *S. invicta*, though thought to be biologically similar. Evidence based on *S. invicta* is therefore used to supplement that of *S. richteri* throughout this risk assessment.
3. Does a relevant earlier risk assessment exist? (give details of any previous risk assessment)	Yes A risk assessment for *S. richteri* exists for the European Union (Blight 2021). The final version was adopted in 2020 and the risk assessment area included Great Britain. This risk assessment concluded that entry into the EU is moderately likely but more likely if the range of *S. richteri* increases beyond the Americas. Establishment was scored as likely with limited data predicting 2% of the land area of the EU would be suitable climatically. This area included parts of France, Germany, Ireland and western Britain. A risk assessment for fire ants (*Solenopsis* spp.) exists for the Netherlands though there is less focus on *richteri* compared to other species (Noordijk 2010). This risk assessment states that worker fire ants are regularly found during import inspections. On occasion, nests of both *S. invicta* and *S. geminata* have been found during inspections with the latter establishing itself once indoors (Noordijk 2010). *Solenopsis richteri* has not been found during inspections. The risk assessment concludes that establishment indoors is possible resulting in social, economic and ecological damage, but establishment outdoors is unlikely due to unsuitable climate. A risk assessment for New Zealand concluded that *S. richteri* had a low risk of entry but a moderate risk of establishment, being potentially limited by climatic conditions (Harris et al. 2005).
4. If there is an earlier risk assessment is it still entirely valid, or only partly valid?	Entirely valid for the European Union, but not specifically for Great Britain. The EU risk assessment predates this one by only two years.
5. Where is the organism native?	The native range of *S. richteri* extends across Brazil, Argentina, Chile, Paraguay and Uruguay (www.antwiki.org; Ward 2008).

6. What is the global distribution of the organism (excluding the risk assessment area)?	*Solenopsis richteri* is believed to have been introduced to the USA in 1918 but not confirmed until 1930 (Ward 2008). It spread slowly over the first twelve years and then more rapidly for several years, covering much of south-eastern USA. Subsequent competition with *S. invicta*, which was introduced between 1933 and 1945, reduced the distribution to Alabama and Mississippi but with new populations occasionally arising (e.g. Tennessee) (Trager 1991; Jones et al. 1997). A hybrid zone of *S. invicta/richteri* exists at the south and east of its range including parts of Alabama, Mississippi and Georgia (Ward 2008). *Solenopsis richteri* was reported from Saudi Arabia (Khan et al. 1999) but this was an identification error and the true identity of the ant was confirmed as *Pachycondyla sennaarensis* (Morrison et al. 2004). The species is not known to have established in any other locations outside its native range.
7. What is the distribution of the organism in the risk assessment area?	N/A Not known to occur.
8. Is the organism known to be invasive (i.e. to threaten organisms, habitats or ecosystems) anywhere in the world?	Yes. *Solenopsis richteri* is generally considered to be invasive though less so than the related *S. invicta* and *S. geminata* (e.g. Ward 2008; Global Invasive Species Database 2022). It has social, ecological and economic impacts where it has been introduced and is a minor crop pest in its native range (Taber 2000). Peterson and Nakazawa (2008) considered it to be non-invasive but with the potential to invade, including to southern Europe.
9. Describe any known socio-economic benefits of the organism in the risk assessment area.	There are no socio-economic benefits in its non-native range.

SECTION B – Detailed assessment

PROBABILITY OF ENTRY

Important instructions:

- Entry is the introduction of an organism into the risk assessment area. Not to be confused with spread, the movement of an organism within the risk assessment area.
- For organisms which are already present in the risk assessment area, only complete the entry section for current active pathways of entry or if relevant potential future pathways. The entry section need not be completed for organisms which have entered in the past and have no current pathways of entry.

QUESTION	RESPONSE	CONFIDENCE	COMMENT
1.1. How many active pathways are relevant to the potential entry of this organism? (If there are no active pathways or potential future pathways respond N/A and move to the Establishment section)	many	high	*Solenopsis richteri* has the potential to be introduced via transport and trading routes, particularly where contaminated soil is present.
1.2. List relevant pathways through which the organism could enter. Where possible give detail about the specific origins and end points of the pathways. For each pathway answer questions 1.3 to 1.10 (copy and paste additional rows at the end of this section as necessary).	a) Transport-Stowaway (Hitchhikers in or on airplane) b) Transport-Contaminant (nursery material and other matters from the horticultural trade) c) Transport-Stowaway (nests transported in container/bulk, including sea freight train…etc.) Any commerce originating from the Americas has the potential to transport ants. However, only nests or fertilised queens present a risk of establishment. Ninety-seven percent of ant interceptions in Australia derived from air or sea transport with the top commodities being: (i) live trees, plants, cut flowers; (ii) wood and wood products; and (iii) edible vegetables, fruit and nuts (Suhr et al. 2019). Entry into the USA was thought to be via fruit produce (in shipping cargo) or ballast soil (Taber 2000). A nest of the related *S. invicta* was imported into the Netherlands in the soil of *Ficus* plants but the origins of a nest of *S. geminata* is unknown (Noordijk 2010). *Solenopsis papuana* has been imported via food produce to New Zealand		

	on multiple occasions (Harris & Berry 2005; Ward et al. 2006). *Solenopsis invicta* is believed to have entered China via ports and various commodities have been implicated including wood, turf, nursery stock, cattle forage and wastepaper (Wang et al. 2020 and references therein). How *S. invicta* invaded Australia is unknown but shipping from the USA is implicated.		
Pathway name:	**a) Transport-Stowaway (Hitchhikers in or on airplane)**		
1.3. Is entry along this pathway intentional (e.g. the organism is imported for trade) or accidental (the organism is a contaminant of imported goods)? (If intentional, only answer questions 1.4, 1.9, 1.10, 1.11)	accidental	high	This only applies to newly mated queens.
1.4. How likely is it that large numbers of the organism will travel along this pathway from the point(s) of origin over the course of one year? Subnote: In your comment discuss how likely the organism is to get onto the pathway in the first place.	unlikely	medium	*Solenopsis richteri* has not been found during import inspections in New Zealand, Australia, Hawaii or the Netherlands. Limited data suggests that of live ants intercepted at ports and airports, few are queens (Blight 2021). It is unlikely that large numbers could travel along this pathway.
1.5. How likely is the organism to survive during passage along the pathway (excluding management practices that would kill the organism)? Subnote: In your comment consider whether the organism could multiply along the pathway.	moderately likely	low	Queen ants can survive for several weeks on their own fat reserves. Most (90%) ants found during Australian import inspections were alive (Suhr et al. 2019). It is extremely unlikely that a nest could be established on an airplane but in any case, the first brood would be workers and in *Solenopsis,* these are incapable of reproducing.
1.6. How likely is the organism to survive existing management practices during passage along the pathway?	very likely	high	There are no management practices against hitchhiking ants in or on airplanes in place.

1.7. How likely is the organism to enter the risk assessment area undetected?	likely	high	Queens or small nests could be easily overlooked and thus enter the area undetected.
1.8. How likely is the organism to arrive during the months of the year most appropriate for establishment?	likely	high	Only the summer months in Britain are likely to be warm enough for nest founding and brood development but the organism could conceivably arrive from North or South America at that time of year. In *S. invicta* nuptial flights occur mainly May to August in the USA but can occur all year round in the subtropics (Lofgren et al. 1975).
1.9. How likely is the organism to be able to transfer from the pathway to a suitable habitat or host?	likely	high	*Solenopsis richteri* is most closely associated with sunny, open non-forested habitats in its native range (Briano et al. 2012). It appears to prefer disturbed grasslands and has been found in pastures, cultivated fields, roadsides and lawns (Taber 2000). However, nests have also been found in unusual places such as airport runway lights (Global Invasive Species Database). Locations near to water are preferred as the queen needs moist soil for nest building (Lofgren et al. 1975). If winged on arrival, it could disperse several kilometres by flying or be blown on air currents (Ward 2008). In the extreme, *Solenopsis invicta* can travel up to 32 km to find a suitable nest site (Wojcik et al. 2001) but most queens are likely to travel less than 1.6 km.
1.10. Estimate the overall likelihood of entry into the risk assessment area based on this pathway?	unlikely	medium	The likelihood is scored unlikely because the number of queen ants travelling through this pathway is expected to be relatively low. Harris et al. (2005) scored the likelihood of introduction of a *S. richteri* queen ant by aircraft to New Zealand as low and Blight (2021) scored it moderately likely for Europe.
Pathway name:	**b) Transport-Contaminant (nursery material and other matters from the horticultural trade)**		
1.3. Is entry along this pathway intentional (e.g. the organism is imported for trade) or accidental (the	accidental	high	This concerns nests which are transported in contaminated soil by the horticultural trade. It includes established nests or new nests, either founded prior to transport or on route. Nests may be transported in soil, nursery stock,

organism is a contaminant of imported goods)? (If intentional, only answer questions 1.4, 1.9, 1.10, 1.11)			hay, mulch, animal manure, bark, turf…etc. A free volume of 10 ml soil should be sufficient for an incipient colony composed by a queen and several workers (Blight 2021). Nursery products via shipping or road transport are thought to have been important pathways for the movement of *S. invicta* (Lofgren et al. 1975).
1.4. How likely is it that large numbers of the organism will travel along this pathway from the point(s) of origin over the course of one year? Subnote: In your comment discuss how likely the organism is to get onto the pathway in the first place.	moderately likely	medium	There are no data on *S. richteri* nests arriving through the horticultural trade in Europe, the USA, New Zealand or Australia. No ants are listed as notifiable pests in Great Britain and therefore they do not appear in import lists. Many South American countries are not major trading partners with Great Britain so material arriving from the USA or Brazil presents the highest risk. Plant pots, in particular, are attractive nest sites for a number of species of ants and are known to be one of the preferred habitats for *S. invicta* in invaded regions (Blight 2021). Both polygynous and monogynous populations occur in *S. richteri*. Monogyny is more common in their native range (50-75% nests) (Harris et al. 2005 and references therein). Polygynous colonies can include up to 180 queens (Calcaterra et al. 2000) and up to 500,000 workers (Tschinkel 2006). As the species is likely to be polydomous, it is not clear how these figures for queens and workers relate to individual nests. The likelihood of reinvasion after eradication is the same as the likelihood of introduction in the first place.
1.5. How likely is the organism to survive during passage along the pathway (excluding management practices that would kill the organism)? Subnote: In your comment consider whether the organism could multiply along the pathway.	very likely	high	Ant queens can survive several weeks on their own body fat reserves. In *S. invicta* new queens can survive up to 95 days if contained within a nest (Markin et al. 1972). Worker ants can survive up to 10 days without food. Mortality of any caste is likely to increase with increasing travel time. *S. richteri* can develop from eggs into adults in as little as two weeks (www.invasive.org), so if there is sufficient food available and warm temperatures, a nest could increase in size during passage.

1.6. How likely is the organism to survive existing management practices during passage along the pathway?	likely	low	Importing goods containing soil and plant/plant products into Great Britain from outside EU member states Liechtenstein and Switzerland, requires a Phytosanitary Certificate, the process of which involves inspection of the goods, a risk assessment and any other measures as deemed necessary by the Department of Environment, Food and Rural Affairs (DEFRA) and the Animal and Plant Health Agency (APHA-PHSI). Some plants and soil are prohibited from some countries entirely.
1.7. How likely is the organism to enter the risk assessment area undetected?	likely	medium	Larger nests are quite visible but newly founded, young or small nests would be inconspicuous in soil and could easily arrive undetected.
1.8. How likely is the organism to arrive during the months of the year most appropriate for establishment?	likely	high	The horticultural trade is active throughout the year.
1.9. How likely is the organism to be able to transfer from the pathway to a suitable habitat or host?	likely	high	Potted plants and plant materials are likely to be transported to nurseries, garden centres, green or hot houses, or directly to sites where they are to be planted (e.g. for landscaping). All of these sites are likely to provide or be adjacent to, suitable habitat and/or conditions for establishment.
1.10. Estimate the overall likelihood of entry into the risk assessment area based on this pathway?	moderately likely	medium	Noordijk (2010) and Blight (2021) considered the horticultural trade the most likely pathway for *S. richteri* to be introduced into Europe. Horticultural trade is also the most likely route into Great Britain given past introductions of tramp ants (Espadaler et al. 2007; Buckham-Bonnett 2019).
Pathway name:	**c) Transport-Stowaway (nests transported in container/bulk, including sea freight train…etc.)**		
1.3. Is entry along this pathway intentional (e.g. the organism is imported for trade) or accidental (the organism is a contaminant of imported goods)?	accidental	high	This section concerns nests transported on commerce other than that associated with the horticultural trade. Almost any cargo container has the potential to contain nests including those carrying machinery, building materials, dried wood, used cars, mining equipment, packaging materials and aquaculture materials. Goods that may contain soil contaminants are of particular risk. Nests of any size could be transported via this pathway. Entry

(If intentional, only answer questions 1.4, 1.9, 1.10, 1.11)			of *S. richteri* into the USA from South America was likely via produce arriving at the port of Mobile (Taber 2000).
1.4. How likely is it that large numbers of the organism will travel along this pathway from the point(s) of origin over the course of one year? Subnote: In your comment discuss how likely the organism is to get onto the pathway in the first place.	moderately likely	medium	There are no data on *S. richteri* nests arriving in Europe. Ants are not listed as quarantine pests in Great Britain and therefore do not appear in lists of intercepted pests. Sea containers and all articles of commerce were scored by Harris et al. (2005) as presenting a high likelihood of introduction for nests of *Solenopsis* species to New Zealand. Not least because *S. richteri* has been found nesting in a range of artificial habitats including around plumbing, under carpets, electric equipment and meters, traffic signal control boxes and airport runway lights (Global Invasive Species Database 2022). Polygynous nests may include tens of queens and thousands of workers. Ant nests of any size might get onto the pathway as hitchhikers in cargo containers. The likelihood of reinvasion after eradication is the same as the likelihood of introduction in the first place.
1.5. How likely is the organism to survive during passage along the pathway (excluding management practices that would kill the organism)? Subnote: In your comment consider whether the organism could multiply along the pathway.	very likely	high	Ant queens can survive several weeks on their own body fat reserves. In *S. invicta* new queens can survive up to 95 days if contained within a nest (Markin et al. 1972). Worker ants can survive up to 10 days without food. Mortality of any caste is likely to increase with increasing travel time. *S. richteri* can develop from eggs into adults in as little as two weeks (www.invasive.org), so if there is sufficient food available and warm temperatures, a nest could increase in size during passage.
1.6. How likely is the organism to survive existing management practices during passage along the pathway?	very likely	high	In most of the commodities in this pathway, there are no management practices in place. Phytosanitary certification is needed for machinery that has been used in the agricultural or forestry industries and for wood and wood products.

1.7. How likely is the organism to enter the risk assessment area undetected?	likely	high	Only a small amount of commerce is inspected and even then, small nests could easily be missed, and the species arrive undetected.
1.8. How likely is the organism to arrive during the months of the year most appropriate for establishment?	likely	high	Commerce that could transport *S. richteri* nests arrives in the risk assessment area throughout the year. A nest arriving in the winter months and immediately transported to an outdoor setting is much less likely to survive.
1.9. How likely is the organism to be able to transfer from the pathway to a suitable habitat or host?	likely	high	Many commodities could be transported onwards to locations which contain suitable habitat for *S. richteri*.
1.10. Estimate the overall likelihood of entry into the risk assessment area based on this pathway?	moderately likely	medium	Based on the high numbers and types of containers and commodities that can be associated with *S. richteri*, entry along pathway can be considered as being moderately likely.
End of pathway assessment, repeat as necessary.			
1.11. Estimate the overall likelihood of entry into the risk assessment area based on all pathways (comment on the key issues that lead to this conclusion).	moderately likely	medium	There are no reported interceptions of the species in Britain or across Europe, however, this is likely due to a lack of data rather than true absence. The species distribution in its introduced range has contracted reducing the risk of it being accidentally introduced into Britain. Introduction via horticultural imports, or as a hitchhiker on sea or air freight is possible in the future. Thus, a score of moderately likely is appropriate. This should be reconsidered in the event of range expansion or introduction elsewhere, particularly if any evidence of interception or introduction to Europe emerges.

PROBABILITY OF ESTABLISHMENT			
Important instructions: • For organisms which are already well established in the risk assessment area, only complete questions 1.15, 1.21 and 1.28 then move onto the spread section. If uncertain, check with the Non-native Species Secretariat.			
QUESTION	**RESPONSE**	**CONFIDENCE**	**COMMENT**
1.12. How likely is it that the organism will be able to establish in the risk assessment area based on the similarity between climatic conditions in the risk assessment area and the organism's current distribution?	unlikely	medium	*Solenopsis richteri* appears to be a heat and humidity loving species restricted to subtropical regions (M. Hamer *pers. comm.*). It occurs in areas with the following climatic variables: mean annual temperature 14.8-21.0 °C, minimum temperature -1.0-12.6 °C, mean annual precipitation 641-1735 mm and mean annual solar radiation 14.4-17.7 MJ/m2/day (Harris et al. 2005). Further climatic parameters are listed in Harris et al. 2005. Bertelsmeier et al. (2015) developed a climate model for *S. richteri* based on its presence/absence range, both native and introduced. Using a threshold value of probability (0.5, range 0-1), they predicted that only 2% of the area of Europe was currently suitable for *S. richteri* and this would decline by 2080. However, the 'current' situation was modelled on climate data from 1960-1990. The area 'currently' suitable in Britain included western Scotland and north-western England, with a probability value 0.5-0.6. Elsewhere in Europe, parts of France, Germany and almost all of Ireland were currently suitable. Under future climate (2080) predictions, only a small part of south-western Scotland would be suitable. The models were based on four temperature variables and two precipitation variables and it is changes to the latter, which are more likely to make Britain less suitable by 2080. Notably, Britain was less suitable than the introduced range of *S. richteri* in the USA (Bertelsmeier et al. 2015). Beckmann et al. (2023) predicted Britain to be climatically unsuitable currently and until 2070 with two patches becoming suitable in NW England and S Wales by 2090. However, they noted the low number of records used in the model may not comprehensively reflect the environmental preferences of the ant.

			Morrison et al. (2004) predicted that *S. invicta* could possibly achieve ‘reproductive success’ in the extreme south of England. However, *S. richteri* appears to differ from *S. invicta* in being less tolerant of heat and desiccation (Chen et al. 2014) so climate models developed for the latter species are unlikely to add greater certainty to the potential current or future range of *S. richteri*.
1.13. How likely is it that the organism will be able to establish in the risk assessment area based on the similarity between other abiotic conditions in the risk assessment area and the organism’s current distribution?	likely	high	*Solenopsis richteri* prefers disturbed soils, which are found everywhere (Harris et al. 2005). Nuptial flights occur on days which are warm, sunny, with little wind and following a period of precipitation. Soil temperatures and moisture appear to be critical to nest establishment but there is data only for the related *S. invicta* which should be treated with caution as it is thought to prefer warmer conditions than *S. richteri*. Soil temperatures of 18-24°C are needed for *S. invicta* queens to successfully found nests (Markin et al. 1971; Rhoades & Davies 1967). Colony growth ceases for *S. invicta* at temperatures below 24°C (Porter 1988). Foraging of *S. invicta* occurs optimally at 18-30°C with locomotion limits 3.6-40°C (Palomo et al. 2003). Over winter, consecutive days near or below freezing will increase mortality.
1.14. How likely is it that the organism will become established in protected conditions (in which the environment is artificially maintained, such as wildlife parks, glasshouses, aquaculture facilities, terraria, zoological gardens) in the risk assessment area?	very likely	high	It is very likely that *S. richteri* could establish indoors.

Subnote: gardens are not considered protected conditions			
1.15. How widespread are habitats or species necessary for the survival, development and multiplication of the organism in the risk assessment area?	widespread	high	Grasslands, the preferred and primary habitats of *S. richteri*, are common. However, it has also been found nesting in walls, deadwood, and a range of artificial situations suggesting that potential habitats are widespread. Establishment would be most likely in (sub)urban settings with mildly warmer climates (W. Nentwig *pers. comm.*).
1.16. If the organism requires another species for critical stages in its life cycle then how likely is the organism to become associated with such species in the risk assessment area?	N/A	high	*Solenopsis richteri* does not require another species for establishment.
1.17. How likely is it that establishment will occur despite competition from existing species in the risk assessment area?	moderately likely	low	Within its native range *S. richteri* can attain high densities of up to 707 nests/ha and be dominant in disturbed habitats (Blight 2021). Little is known about the competitive interactions between *S. richteri* and other ant species, especially those species which are native to Britain. The only native *Solenopsis* species (*S. fugax)* is unlikely to compete given its behaviour and ecology. Britain has several highly competitive introduced and invasive species such as the Argentine ant *Linepithema humile*, the invasive garden ant *Lasius neglectus* and the Pharaoh ant *Monomorium pharaonis*, but currently these species are localised (*L. humile*, *L. neglectus*) in their distribution or present in buildings only (*M. pharaonis*).
1.18. How likely is it that establishment will occur despite predators, parasites or pathogens already present in the risk assessment area?	likely	medium	No specific natural enemies are known (Blight 2021) and therefore only generalist predators (such as spiders, birds…etc.) or non-specific pathogens (e.g. *Beauveria bassiana*) are likely to have an impact on the ant's ability to establish.

1.19. How likely is the organism to establish despite existing management practices in the risk assessment area?	likely	medium	There are no specific management practices in place against invasive ants in Britain. Eradication of single nests indoors is straightforward in buildings (e.g. Noordijk 2010) but much less so outdoors. However, some eradication programmes of *S. invicta* have been successful (Hoffmann et al. 2016; Wylie et al. 2016).
1.20. How likely are management practices in the risk assessment area to facilitate establishment?	unlikely	medium	There are no specific management practices against invasive ants in Britain. If ant control is carried out, it is localised (using pesticide sprays, baited traps…etc.). Management practices are unlikely to facilitate established.
1.21. How likely is it that biological properties of the organism would allow it to survive eradication campaigns in the risk assessment area?	likely	medium	Eradication of invasive ants outdoors is difficult but possible (Hoffmann et al. 2016). Large nests/colonies are more difficult to eradicate than smaller ones.
1.22. How likely are the biological characteristics of the organism to facilitate its establishment?	likely	high	A new *S. richteri* queen prefers moist soil for nest founding (Lofgren et al. 1975) and outbreaks have been attributed to heavy precipitation events (Ward 2008). It also requires open habitat. Despite this, nests have been found in a range of natural and artificial situations suggesting that nest site availability is not a barrier to nest establishment. *Solenopsis richteri* nests take up to two years to mature (reach full size) but the production of reproductives can take place within 6-8 months of a nest being founded (Ward 2008). Both monogynous and polygynous populations of *S. richteri* exist. This social structure is genetically determined (Helleu et al. 2022) and so the source population determines which form is introduced. In the USA only monogynous colonies are present whereas both monogynous and polygynous colonies exist in the species native range. Polygyny is associated with more rapid population growth in *S. invicta* at least (Fletcher et al. 1980). *Solenopsis richteri* is omnivorous and opportunistic (Lofgren et al. 1975) and presumed to feed on a wide range of invertebrate prey items, honeydew from Homopterans, and seeds.

1.23. How likely is the capacity to spread of the organism to facilitate its establishment?	moderately likely	medium	*Solenopsis richteri* has only established in the USA. After an initial spread, its range has contracted due to competition with *S. invicta*. It has a restricted flight period: nuptial flights have only been recorded as taking place between 22.9-33.3 °C. Dispersal distances for *S. richteri* are not known but for polygynous colonies of *S. invicta* it is 10-40 m/year (Porter 1988). Most *S. invicta* queens will stay within c.1.6 km of their natal nest but in extreme examples can travel up to 32 km (Wojcik et al. 2001).
1.24. How likely is the adaptability of the organism to facilitate its establishment?	moderately likely	medium	Fire ants (*Solenopsis* spp.) are often termed pioneer species as they can quickly react to exploit newly created habitat. However, *S. richteri* is one of the least successful invasive ant species which might indicate a moderate adaptability.
1.25. How likely is it that the organism could establish despite low genetic diversity in the founder population?	moderately likely	high	Invasive ants have become established following the introduction of only a single nest or queen (Holway et al. 2002). The related *S. geminata* has successfully established despite low genetic diversity in its introduced range (Lenancker et al. 2022). The same is likely to apply to *S. richteri*.
1.26. Based on the history of invasion by this organism elsewhere in the world, how likely is to establish in the risk assessment area? (If possible, specify the instances in the comments box.)	moderately likely	high	There are no documented cases of *S. richteri* being intercepted at ports and airports aside from one confirmed case in the USA. However, both identified and unidentified *Solenopsis* species are regularly intercepted (Noordijk 2010; Suarez et al. 2005; Bertelsmeier et al. 2018; Harris et al. 2005). Ants are not listed as quarantine pests in Britain or the EU and, therefore there is a lack of data on the frequency with which they are imported. The majority of interceptions are likely to be of non-reproducing worker ants (Blight 2021).
1.27. If the organism does not establish, then how likely is it that transient populations will continue to occur? Subnote: Red-eared Terrapin, a species which cannot re-produce	likely	medium	No known populations of *S. richteri* have ever occurred in Britain. Climate models (Bertelsmeier et al. 2015) have predicted that parts of Britain are currently suitable for this species but will become less so in the future. Indoor establishment is also possible. The chances of establishment are similar with each import of a queen or nest so even if species persistence is not possible, repeated introductions are, and increasing so with global trade and travel.

in the risk assessment area but is established because of continual release, is an example of a transient species.			
1.28. Estimate the overall likelihood of establishment (mention any key issues in the comment box).	unlikely	high	Suitable habitat is available. Climate models are not in agreement: One predicts parts of Britain may be suitable with a trend towards increasing unsuitability, whilst another predicts unsuitability currently but small patches of suitability by 2090. Environmental preferences of the ant are not comprehensively known but fire ants can evolve to adapt to a new environment.

PROBABILITY OF SPREAD

Important notes:

- Spread is defined as the expansion of the geographical distribution of a pest within an area.

QUESTION	RESPONSE	CONFIDENCE	COMMENT
2.1. How important is the expected spread of this organism in the risk assessment area by natural means? (Please list and comment on the mechanisms for natural spread.)	moderate	high	Natural spread can occur through three mechanisms. Firstly, new queens can disperse following a nuptial flight. The dispersal distance for *S. richteri* is not known but estimates for *S. invicta* are up to 32 km (Wojcik et al. 2001). Prevailing winds can assist in moving queens further than they would under their own power (Taber 2000). Mortality of queens dispersing via this method can be high. Production of reproductives can take place within 6-8 months of a nest being founded (Ward 2008) and for *S. invicta* c.4,500 reproductives (males and queens) are produced each year (Tschinkel 1988). Polygynous colonies can also spread by budding. A mated queen will leave the nest with some workers and establish a new nest nearby. This could remain connected to the maternal nest temporarily or permanently (polydomy). This strategy is less risky and can allow rapid spread over a localised area. Polydomy is known for *S. invicta* (Helanterä 2022) and assumed for *S. richteri.* Dispersal of *S. invicta*, and presumably *S. richteri* as well given its hydrophobic cuticle (Zhou et al. 2020), can take place via water (Ward 2008; Ko et al. 2022). The ants form a tightly packed raft on the surface of the water, principally in response to flooding.
2.2. How important is the expected spread of this organism in the risk assessment area by human assistance? (Please list and comment on the mechanisms for human-assisted spread.)	major	high	*Solenopsis* ants have been transported via planes and ships. They have also been transported by private and commercial cars and trucks which would be a pathway of greater relevance should the species establish in Europe (Taber 2000; Harris et al. 2005; Ward 2008). The horticultural trade where nests are transported in plants, soil or other materials is probably the main human assisted pathway of relevance to Britain (Blight 2021).

2.3. Within the risk assessment area, how difficult would it be to contain the organism?	very difficult	medium	It would likely be very difficult to contain. Its success would be determined by habitat and climate suitability, and competition with other ants. Established indoor colonies would be easier to contain than outdoor.
2.4. Based on the answers to questions on the potential for establishment and spread in the risk assessment area, define the area endangered by the organism.	~20,000 km^2	medium	The model produced by Bertelsmeier et al. (2015) predicted that less than a third of Britain would be climatically suitable, but within this there are areas for which it is not known whether the habitat would be suitable (e.g. moorland, deciduous and coniferous forest, saltmarsh, seacliffs…etc.).
2.5. What proportion (%) of the area/habitat suitable for establishment (i.e. those parts of the risk assessment area where the species could establish), if any, has already been colonised by the organism?	0-10	very high	There is no evidence that *S. richteri* is present in the assessment area.
2.6. What proportion (%) of the area/habitat suitable for establishment, if any, do you expect to have been invaded by the organism five years from now (including any current presence)?	0-10	medium	*Solenopsis richteri* was estimated to have dispersed 11 km in its first 12 years in the USA (Ward 2008). Thus, less than 1% of the area suitable in Britain would be colonised within five years.
2.7. What other timeframe (in years) would be appropriate to estimate any significant further spread of the organism in the risk assessment area? (Please comment on why this timeframe is chosen.)	10	medium	If the species does establish, then 10 years might be appropriate given the high level of uncertainty around dispersal capability, and habitat and climate suitability.

2.8. In this timeframe what proportion (%) of the endangered area/habitat (including any currently occupied areas/habitats) is likely to have been invaded by this organism?	0-10	medium	Based on *S. richteri* initial rate of spread in the USA (Ward 2008), the proportion of area occupied after 20 years is likely to be less than 10%.
2.9. Estimate the overall potential for future spread for this organism in the risk assessment area (using the comment box to indicate any key issues).	slowly	medium	The species is not yet established. Spread is dependent on introduction. *S. richteri* is abundant and widespread across its native range. It did experience a period of rapid spread in its introduced range before being negatively impacted by *S. invicta.* A slight spread in the USA predicted by Vinson & Sorensen (1986) has not happened but it continues to appear in new locations (e.g. Seltzer et al. 2023).

PROBABILITY OF IMPACT

Important instructions:

- When assessing potential future impacts, climate change should not be taken into account. This is done in later questions at the end of the assessment.
- Where one type of impact may affect another (e.g. disease may also cause economic impact) the assessor should try to separate the effects (e.g. in this case note the economic impact of disease in the response and comments of the disease question, but do not include them in the economic section).
- Note questions 2.10-2.14 relate to economic impact and 2.15-2.21 to environmental impact. Each set of questions starts with the impact elsewhere in the world, then considers impacts in the risk assessment area separating known impacts to date (i.e. past and current impacts) from potential future impacts. Key words are in bold for emphasis.

QUESTION	RESPONSE	CONFIDENCE	COMMENTS
2.10. How great is the economic loss caused by the organism within its existing geographic range **excluding the risk assessment area**, including the cost of any current management?	moderate	low	There are very few documented economic impacts of *S. richteri*. In Brazil, *S. richteri* is considered a pest of potato, eating the tubers and branches (Taber 2000) but elsewhere in its native and introduced range it is not considered a major pest (Way & Khoo 2003). In its introduced range, damage to farm machinery has been reported (Green 1952) which can be caused by the ants chewing through cables or by their hard nest mounds causing blade snags. Due to quarantine regulations, all shipments of nursery trees with roots/soil from infested areas are required to be chemically treated. The cost of this (US $635-2043 per hectare of trees) is met by the consumer (Ward 2008). Much of the reported economic impacts consider either *S. invicta* or fire ants more generally (usually *S. invicta, S. germinata and S. richteri*). Angulo et al. (2022) estimated the economic costs for *Solenopsis* spp. to be US$31.89 billion with US$21 billion of this being the cost of eradicating *S. invicta* from Australia. Proportionally, Ward (2008) calculated the cost attributable to *S. richteri* to be in the region of US$75 million. Another cost-benefit analysis in Australia estimated the likely cost of failing to eradicate *S. invicta* at US$8.5-45 billion (Wylie & Janssern-May 2017). Bodey et al. (2022) estimated the cost of *S. invicta* in New Zealand in 2017 to be US$590 million due to monitoring, management and damage costs.

			The following have been reported for *S. invicta*. *S. richteri* has the potential to cause similar problems though it is unlikely that *S. richteri* would have the same level of impact due to its predominately monogynous social structure. In urban settings, costs include damage to roadways and electrical equipment, medical and veterinary costs, and recreational costs. Fire ant mounds can cause damage to machinery including farm equipment (Ward 2008). They are reported to cause crop wilting or even death likely due to the indirect effects of increasing populations of plant-feeding hemipterans (e.g. aphids, scale insects). They reduce the populations of other insects (both beneficial and pest) (Ward 2008). Seed removal by *S. invicta* from wheat can result in the loss of the entire crop (Vogt et al. 2003).
2.11. How great is the economic cost of the organism **currently** in the risk assessment area **excluding management** costs (include any past costs in your response)?	N/A	N/A	Not known to be present in the risk assessment area.
2.12. How great is the economic cost of the organism likely to be **in the future** in the risk assessment area **excluding management** costs?	moderate	low	Future costs are very difficult to estimate given the uncertainty around habitat and climate suitability, and the lack of economic impact information for this species specifically. The scale of impact will depend on population size. Although one climate model predicts suitability, this is unlikely to be optimal and the population is likely to be constrained by the conditions needed for foraging, nuptial flights and overwintering. Establishment in suboptimal areas will limit population size and reduce impacts (Blight 2021). If established, trade costs could be negatively impacted through increased import regulations and control measures, or restrictions on high-risk goods (Noordijk 2010). Agriculture, forestry and tourism industries could be affected through direct (e.g. stings) and indirect effects (e.g. greater checks or treatment of trees).
2.13. How great are the economic costs **associated with managing** this organism	N/A	N/A	Not known to be present in the risk assessment area.

currently in the risk assessment area (include any past costs in your response)?			
2.14. How great are the economic costs **associated with managing** this organism likely to be **in the future** in the risk assessment area?	moderate	low	Future costs are very difficult to estimate given the uncertainty around habitat and climate suitability. Management costs will depend on population size. Establishment in suboptimal areas will limit population size and reduce impacts (Blight 2021). Although the average management costs of invasive ants worldwide is only 4.13%, for *Solenopsis* spp. this figure is far higher; pre-invasive management costs for *S. invicta* constitutes 53.57% of the total (Angulo et al. 2022). Management costs for *S. richteri* are likely to differ significantly from *S. invicta.*
2.15. How important is environmental harm caused by the organism within its existing geographic range **excluding the risk assessment area**?	moderate	low	There is little direct evidence for environmental harm caused by *S. richteri.* Indirectly, increased use of pesticides in infested areas is likely to cause environmental harm. For *S. invicta*, nest building causes soil compaction (Ward 2008), chemical changes including acidification and a reduction in organic matter (Wang et al. 2019). These effects will be localised. Most of the reported biodiversity impacts of fire ants relate to *S. invicta.* For reviews of impacts of *S. invicta* on biodiversity see, e.g. Wojcik et al. (2001), Wang et al. (2019). Below are some of the reported impacts: • Reductions in predators of crop pest populations, • Reductions in beneficial insects including dung beetles, parasitoids and pollinators, • Decreased pollinator activity, • Change in arthropod community, • Toxic effects on arthropods of consuming pesticide-treated fire ants, • Implicated in decline of rare butterfly and mollusc, • Predation on young and weak vertebrates, • Blindness in mammals due to stings, which subsequent effects on behaviour and mortality, • Reduced growth and survival of mammals, • Predation on young birds, • Reduced seed production.

			For *S. invicta* significant declines and local extinctions have been reported for native ant species (e.g. Porter & Savignano 1990). However, Morrison (2002) proposed the impacts were short term and that after twelve years native arthropod and ant species diversity had returned to pre-invasion levels. The study also found ant species that were not present following invasion by *S. invicta* and vice versa but attributed some of these to be rare/cryptic species that might have been missed by the sampling process. Nest losses in grassland birds have been reported for *S. richteri* (Hale et al. 2011). It competes with birds, fish and crabs for polychaete worms in the intertidal zone (Palomo et al. 2003). *Solenopsis richteri* has the potential to cause similar effects on native biodiversity impacts as *S. invicta*, with its abundance a more critical factor determining the scale of impact.
2.16. How important is the impact of the organism on biodiversity (e.g. decline in native species, changes in native species communities, hybridisation) **currently** in the risk assessment area (include any past impact in your response)?	N/A	N/A	Not known to be present in the risk assessment area.
2.17. How important is the impact of the organism on biodiversity likely to be in the **future** in the risk assessment area?	moderate	low	The impact will depend on population density and could be locally major. For *S. invicta*, Morrison (2002) stated the effects were greatest during and shortly after establishment.
2.18. How important is alteration of ecosystem function (e.g. habitat change,	N/A	N/A	Not known to be present in the risk assessment area.

nutrient cycling, trophic interactions), including losses to ecosystem services, caused by the organism **currently** in the risk assessment area (include any past impact in your response)?			
2.19. How important is alteration of ecosystem function (e.g. habitat change, nutrient cycling, trophic interactions), including losses to ecosystem services, caused by the organism likely to be in the risk assessment area in the **future**?	moderate	low	Impacts will depend on population density and could be locally major. The main alterations would be to arthropod communities through predation and competition. The following impacts are based on *S. invicta* but are likely to hold true for *S. richteri*. Foraging and nest building could impact nutrient cycling and increase plant growth (Lafleur et al. 2005). Plants could also be affected by structural changes to soil properties (Lafleur et al. 2005) or altered levels of herbivory, for example by reducing numbers of predators/parasitoids but increasing plant pests such as aphids (Ness & Bronstein 2004). *Solenopsis invicta* may facilitate seed dispersal but it may also hinder it through competition with native dispersers and seed predation (Ness & Bronstein 2004). It is difficult to assess whether any of the impacts would differ from those of native species.
2.20. How important is decline in conservation status (e.g. sites of nature conservation value, WFD classification) caused by the organism **currently** in the risk assessment area?	N/A	N/A	Not known to be present in the risk assessment area.
2.21. How important is decline in conservation status (e.g. sites of nature conservation value, WFD classification) caused by the organism likely to be in the **future** in the risk assessment area?	minor	low	In its introduced range, the species primarily inhabits disturbed grassland which is not likely to be of high conservation value. However, there are some natural habitats within the predicted range of climatically suitable parts of Britain (Bertelmeier et al. 2015) which currently support a range of rare species including invertebrates (e.g. intertidal, semi-natural grassland, acid grassland).
2.22. How important is it that genetic traits of the organism could be carried to other species, modifying their	minimal	very high	Only one other *Solenopsis* species (*fugax*) occurs in Britain and there is no evidence this could hybridise with *S. richteri*.

genetic nature and making their economic, environmental or social effects more serious?			
2.23. How important is social, human health or other harm (not directly included in economic and environmental categories) caused by the organism within its existing geographic range?	moderate	high	Medical issues due to stings are perceived as being a major problem in the introduced range, less so in their native range though there are still reports (e.g. see Haddad & Larsson 2015). A reported 0.6-6% of those stung (*S. invicta/richteri* and hybrid) have a severe allergic reaction resulting in anaphylactic shock (Ward 2008) but deaths are rare. Cases of anaphylaxis appear to be no more common for fire ant stings compared to other insect stings. However, the ants' habit of nesting in disturbed grassland brings them into greater contact with humans. Those employed in agriculture may be particularly at risk from stings. Limb amputations and skin grafts have also been reported complications resulting from stings (Adams 1986). It could potentially be a pest of managed grasslands such as lawns, recreational areas and golf courses.
2.24. How important is the impact of the organism as food, a host, a symbiont or a vector for other damaging organisms (e.g. diseases)?	moderate	low	*Solenopsis invicta* increases the populations of certain aphids which negatively impacts crops through direct feeding and aphid-vectored disease (Coppler et al. 2007).
2.25. How important might other impacts not already covered by previous questions be resulting from introduction of the organism? (specify in the comment box)	N/A	N/A	No other effects were found.
2.26. How important are the expected impacts of the organism despite any natural control by other organisms,	moderate	medium	There are no specific natural enemies of *Solenopsis* spp. in Britain. Thus, only generalist natural enemies of ants (e.g. birds, reptiles, spiders and beetles) may affect the ant and these are highly unlikely to control populations.

such as predators, parasites or pathogens that may already be present in the risk assessment area?			
2.27. Indicate any parts of the risk assessment area where economic, environmental and social impacts are particularly likely to occur (provide as much detail as possible).	SW Scotland, NW England	low	Assuming western parts of northwest Britain would be most suitable for the ant, then parts of southwest Scotland and northwest England would be more likely to suffer impacts due to high human population densities and agricultural grasslands.
2.28. Estimate the overall impact of this organism in the risk assessment area (using the comment box to indicate any key issues).	moderate	low	The species is not currently present in the risk assessment area. If established in the future, it could have a moderate socioeconomic, environmental and ecological impact though this would depend on population density.

RISK SUMMARIES			
	RESPONSE	**CONFIDENCE**	**COMMENT**
Summarise Entry	moderately likely	medium	Potential pathways exist including trading links to the Americas which could bring in stowaways/hitchhikers on air and sea freight. Anything containing soil is thought to be highest risk based on imports of other ant species including *S. invicta* and *S. geminata*. Other non-native ant species have been introduced to Britain from North and South America. There are no documented cases of entry nor establishment beyond the USA but particularly for Britain and Europe, not every imported ant is recorded. The proportion of ants which are queens is likely to be low but data is limited.
Summarise Establishment	unlikely	high	There is suitable habitat available. The ants could arrive at times of year suitable for establishment. One climate model has predicted that western Britain is currently suitable but not optimal. The model is based on current distribution but does not include factors such as frost days. Another model predicts unsuitable habitat currently. The native *Solenopsis fugax* in Britain has a restricted southern distribution. There are no specific natural enemies and no highly competitive ant species present in the areas, identified as limiting factors for establishment.
Summarise Spread	slowly	medium	Habitat availability is not likely to slow spread but climate could. Conditions are likely to be suboptimal imposing a seasonal activity cycle and the need for hibernation. Nuptial flights which require high temperatures, little wind and precipitation are likely to limit spread of monogynous populations in particular. Human-assisted transport is likely to provide a suitable means of spread within Britain.
Summarise Impact	moderate	low	There is currently limited published information on the impacts of *S. richteri* in its introduced range in the USA. It is unlikely that *S. richteri* has the same level of impact that *S. invicta* has. Fire ants more generally have resulted in significant direct and indirect economic costs as a result of damage to machinery, infrastructure, crops and the need to implement control measures. They have significant medical

			implications due to allergic reactions. Negative biodiversity and ecosystem impacts have been reported, particularly to other arthropods and ground nesting birds.
Conclusion of the risk assessment	low	low	*Solenopsis richteri* is considered one of the least successful invasive ants but its introduction to the USA did result, at least for a time, in significant spread. Pathways to Britain clearly exist but conditions for establishment and persistence are more uncertain. If it did establish, its distribution would likely be patchy, constrained by climate. It has the potential to have a moderate socioeconomic, environmental and ecological impact. This assessment of low risk should be reconsidered if its distribution expands beyond the Americas, especially to Europe.

Additional questions are on the following page ...

ADDITIONAL QUESTIONS - CLIMATE CHANGE			
3.1. What aspects of climate change, if any, are most likely to affect the risk assessment for this organism?	Temperature Precipitation	medium	The only existing climate model predicted Britain was currently suitable, but with a low level of habitat suitability index. The model did not consider variables such as number of frost days and soil temperatures which might be more important for the ant at least in relation to nest establishment and brood development. An increase in late frost is predicted under climate change. Higher resolution models, including additional parameters, would give a greater level of certainty to current and future suitability.
3.2. What is the likely timeframe for such changes?	50 years	low	The index value of the existing climate model declined by 2080 indicating Britain would increasingly become less suitable.
3.3. What aspects of the risk assessment are most likely to change as a result of climate change?	Establishment Spread Impact	low	Establishment, spread and impact could all be affected by climate change as this is likely to be one of the key drivers which would determine population density.
ADDITIONAL QUESTIONS – RESEARCH			
4.1. If there is any research that would significantly strengthen confidence in the risk assessment please summarise this here.	Climate suitability, dispersal	medium	Higher resolution climate modelling would usefully predict which areas of Britain might be able to support the ant now and in the future. Experimental data on tolerance limits could add greater certainty to climate modelling. Much of the biological data on *S. richteri* is based on that of *S. invicta*. Data on queen numbers in polygynous colonies, conditions for nuptial flights, success rates for nest establishment, queen dispersal and nest budding distances would strengthen confidence in the risk assessment. There is a lack of data on interceptions as ants are not listed as quarantine organisms.

Please provide a reference list on the following page ...

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