RISK ASSESSMENT SUMMARY SHEET

Electric ant (*Wasmannia auropunctata*)

- Also known as little fire ant. Small, approx. 1.5 mm, light to golden brown in colour. Its name derives from its painful sting relative to its size.
- Among the 100 worst invasive species as determined by the IUCN due to its negative impact on natural ecosystems, agriculture and human health.
- Considered high risk in the EU, with populations in Spain, France and Cyprus.
- Unlikely to be able to establish outdoors in GB under foreseeable climate conditions. However, there is potential for indoor establishment.

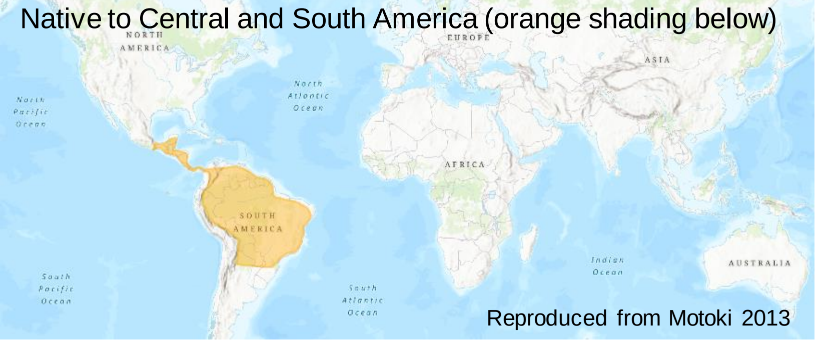
Source: AntWeb.org

History in GB

Was established in greenhouses at Kew Gardens in the early part of the 20th century, but no longer thought to be present. Occasionally intercepted on imported commodities, but not thought to be established in GB.

Native Distribution

Native to Central and South America (orange shading below)



Reproduced from Motoki 2013

GB Distribution

Not established in GB, despite occasional introduction. Nearest populations are in France and Spain.

Impacts

The impact of this species is likely to be limited by its inability to establish outdoors in GB. However, establishment indoors could still cause a nuisance.

Environmental (major, medium confidence)

- Elsewhere causes substantial declines in native ants, other arthropods, and potentially larger fauna such as birds, reptiles and other vertebrates. Establishment is more likely in coastal areas, where it could affect shorebirds.
- Has the potential to cause serious changes to ecosystems through alteration of invertebrate communities.

Economic (moderate, medium confidence)

- Substantial sums are spent controlling this species worldwide, primarily to minimise negative impacts by stinging humans and livestock.

Social (moderate, high confidence)

- Delivers a painful sting. Has the potential to be an important pest of people and buildings, as it is elsewhere in the world.

Introduction pathway

Can hitchhike with many commodities through many pathways. It is considered a tramp species having been spread globally by human activities.

Spread pathway

Natural (minor, medium confidence) active dispersal (via budding) or passive dispersal (rafting on logs, vegetation or refuse, landslides, high winds and storm events).

Human (major, high confidence) transport of potted plants, chopped wood / logs, and green and oversized waste have been implicated in its spread within countries.

Summary

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

GB NON-NATIVE ORGANISM RISK ASSESSMENT SCHEME

Name of organism: *Wasmannia auropunctata* (Roger, 1863)
Author: Dr Jenni A. Stockan, James Hutton Institute
Risk Assessment Area: Great Britain
Version: Draft 1 (Jan 2023), 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**
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: *Wasmannia auropunctata* (Roger, 1863) Class: Insecta Order: Hymenoptera Family: Formicidae Genus: *Wasmannia* Forel, 1893 Original name: *Tetramorium auropunctatum* Synonyms: *Wasmannia atomum* (Santschi 1914), *Wasmannia australis* Emery 1894, *Wasmannia glabra* Santschi 1894, *Wasmannia laevifrons* Emery 1894, *Wasmannia obsura* Forel 1912, *Wasmannia panamana* (Enzmann 1947), *Wasmannia pulla* Santschi 1931, *Wasmannia nigricans* Emery 1906, *Wasmannia rugosa* (Forel 1886) (Montgomery et al. 2022). Common name: Little fire ant is the preferred common name though it is also known by a wide range of other names (see Gunawardana & Wetterer 2015). Workers are monomorphic and 1.2-2.0 mm in body size (Holway et al. 2002; Longino & Fernández 2007; Harris et al. 2005), Queens are 4.5-5.0 mm and males 4.2-4.5 mm (Montgomery et al. 2022). They are light to golden brown in colour with a darker gaster. The pedicel is two-segmented with the petiole 'hatchet-shaped'. Antennae are 11-segmented with the last two forming a club. The antennal scape is received into a long groove. The thorax possesses long, sharp epinotal spines and the body is generally heavily sculptured with sparse, long, erect hairs (Wetterer & Porter 2003). *Wasmannia auropunctata* could be confused with some species of the genus *Ochetomyrmex*. However, *Ochetomyrmex* have less developed antennal scrobes, no clypeal apron, and there is a slightly impressed mesonotal suture. The genus *Ochetomyrmex* is not known to be invasive (Blight 2020). Confusion could also occur with the native *Solenopsis fugax.* A key distinguishing feature is that *Solenopsis* lack propodeal spines (Blight 2020).

	A key to the identification of species of the genus *Wasmannia* was provided by Longino & Fernández (2007) and by Cuezzo et al. (2015).
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. Although *W. auropunctata* is morphologically variable, there is no evidence that it is composed of multiple cryptic species (Longino & Fernández 2007).
3. Does a relevant earlier risk assessment exist? (give details of any previous risk assessment)	Yes. A risk assessment for *W. auropunctata* exists for the European Union (Blight 2020). The overall risk to the EU was concluded to be high. Entry was likely, via sea and air freight, the horticultural trade and the web market for queen ants. The species had already established in Spain (Espadaler et al. 2018) and since the publication of the risk assessment has established in France (Blight, unpubl.) and Cyprus (Demetriou et al. 2022). Establishment in the UK was thought possible (Blight 2020). Another risk assessment predicted medium risk for entry to New Zealand, mainly due to trading links and passenger travel from infected Pacific islands, but a low risk of establishment due to climate unsuitability (Harris et al. 2005). However, there is a difference in how the New Zealand EU risk assessments interpret climate requirements. Both these risk assessments consider the potential impact of the ant to be high.
4. If there is an earlier risk assessment is it still entirely valid, or only partly valid?	Entirely valid for the EU, but not specifically for GB. The European Union risk assessment (Blight 2020) predates this risk assessment by three years. Since publication, *W. auropunctata* has been reported as having established in another two European countries (France and Cyprus). However, the risk assessment remains entirely valid as the newly colonised areas were predicted to be climatically suitable, the suspected pathways are already known ones, and impacts are yet to be documented. The risk assessment for New Zealand is still relevant due to climatic similarities with Britain.
5. Where is the organism native?	Central and South America.

	Wasmannia auropunctata is native to Central and South America. There is uncertainty about the native northern limit of its distribution, but it is presumed native as far north as Mexico (Wetterer & Porter 2003; Montgomery et al. 2022). It is not known to occur in Chile. It is a true generalist in its choice of habitats and nesting sites occurring in wet to dry and early successional to mature habitats (Antwiki.org 2022). In its native range it is more abundant in forest and agroforestry than pastures and crops (Rojas & Fragoso 2021). Two genetic clades have been identified in South America: Clade A which occurs in the north and clade B which occurs south of Brazil and is more cold-tolerant (Coulin et al. 2019). Rey et al. (2012) hypothesised that it was cold adaptation at the southern limit of its range that allowed the species to successfully establish in Israel.
6. What is the global distribution of the organism (excluding the risk assessment area)?	Established on all continents except Antarctica. It has been introduced to parts of west Africa (Gabon, Cameroon and Central African Republic), the Middle East (Israel), Europe (Spain, France and Cyprus), USA (Florida), Galapagos Islands, Federated States of Micronesia (e.g. Guam), Melanesia (e.g. New Caledonia, Solomon Islands, Tuvalu, Vanuata, Papua New Guinea), Polynesia (e.g. Wallis and Futuna, Hawaii, Tahiti), Atlantic islands (Bermuda and the Bahamas), Australia and China (Guangdong and Taiwan) (Wetterer & Porter 2003; Boer & Vierbergen 2008; Vonshak et al. 2009b; Espadaler et al. 2018; Blight 2020; GBIF.org 2022; Antwiki.org 2022; Demetriou et al. 2022; Mao et al. 2022; Samuel 2022). While most introductions are accidental, some deliberate introductions have taken place for perceived biological control reasons (e.g. Solomon Islands) (Wetterer & Porter 2003; Rey et al. 2013). It is widely distributed across many Caribbean islands (Antmaps 2023). These populations are generally thought to be introductions but could be a mix of introduced and native. Islands include Dominica, Guadeloupe, Dominican Republic, Puerto Rico and Cuba (Wetterer & Porter 2003). A worker *W. auropunctata* was reported from an uninhabited islet in Italy, but no established population has been found and this is now thought to be a misidentification (Jucker et al. 2008; Demetriou et al. 2022 and references therein). It has established indoors in Britain (Kew, London), Germany, the Netherlands, USA (Illinois), Canada (various states) and New Zealand (Donisthorpe 1908; Wetterer & Porter 2003; Antwiki.org 2022), but the current status is often unknown. It is no longer known to be present at Kew nor in Germany.

	Furthermore, there are unconfirmed records for a number of locations, e.g. Arizona, South Africa, Sumatra and Sulawesi (Antwiki.org 2022).
7. What is the distribution of the organism in the risk assessment area?	May be present indoors. Considered well established in almost all greenhouses at Kew Gardens from at least 1907-1937 (Donisthorpe 1908; Brangham 1938). Recent surveys at Kew did not find the species (D. Hicks, *pers. comm.* Jun 2023). It was also intercepted in a banana store in Manchester in 1922 (Donisthorpe 1927).
8. Is the organism known to be invasive (i.e. to threaten organisms, habitats or ecosystems) anywhere in the world?	Yes. *Wasmannia auropunctata* is considered to be highly invasive and one of the top 100 'World's Worst' invaders (Lowe et al. 2000). It has known negative impacts on native arthropods, birds, reptiles and vertebrates.
9. Describe any known socio-economic benefits of the organism in the risk assessment area.	The species could provide some pest control benefits to crops and in orchards and has been introduced to regions outside of the risk assessment area for biological control. It has been reported to control true bugs, psyllids and weevils (Majer 1986; Jaffe et al. 1990; Way & Khoo 1992; Kondo et al. 2018; Newson et al. 2021; Montgomery et al. 2022). In the Solomon Islands, *W. auropunctata* controls a serious pest of coconuts, *Amblypelta cocophaga*, and displaces two other dominant pest ants, *Iridomyrmex cordatus* and *Pheidole megacephala*, which do not protect coconut palms from *A. cocophaga* (Macfarlane 1985 cited in Way & Khoo 1992).

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	very high	*Wasmannia auropunctata* can hitchhike with many commodities through many pathways (Blight 2020). It is considered a tramp species having been spread globally by human activities (Montgomery et al. 2022).
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).	i) Contaminant (e.g. of nursery material, plants, food, timber trade, bulk cargo) ii) Stowaway (on aeroplanes (including passenger luggage) or other vehicles) iii) Transport-Stowaway (nests transported in container/bulk, including sea freight, airfreight, train, etc.) The species could enter as a contaminant in nursery material, food and the timber trade, which have all been implicated in past introductions, or as a stowaway in containers or with bulk cargo (e.g. construction materials, packing materials such as wooden pallets), on aeroplanes (including in luggage) or other vehicles. The horticultural trade is implicated in the introduction of the species to Cyprus (Demetriou et al. 2022), but the pathway(s) of introduction of the established populations in France and Spain are unknown. Other pathways including deliberate release (as biological control) and via natural corridors (e.g. waterways) are currently too unlikely to be considered in this assessment. Escape (e.g. from greenhouses) is not covered as there		

	is no evidence it still occurs at Kew. Blight (2020) identified that the commercial trade in ant colonies could provide a potential pathway into Europe if not sufficiently regulated. This species is thought to establish nests only through budding where a queen and workers leave their natal nest to found a new one nearby. Independent nest founding, via nuptial flights and a dispersing queen, is thought to be unlikely (Ulloa-Chacon & Cherix 1990). Mating flights have only been observed in the native range and in the introduced populations in Puerto Rico and the Galapagos Islands (Meier 1994; Rosselli & Wetterer 2017). Therefore, only a queen with workers is likely to be able to establish a new population.		
Pathway name:	**i) Contaminant (e.g. of nursery material, plants, food, timber trade…etc.)**		
i.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	very high	This concerns nests which are transported in soil by the horticultural trade, timber trade, in fruit and vegetable produce or other commerce. *Wasmannia auropunctata* has been intercepted in ornamental and nursery plants, cut flowers, woven baskets and matting, timber, and fruits and vegetables in the USA and Australia (Walsh et al. 2004; Harris et al. 2005; Lee et al. 2015). Since 1920 more than 34% of ant interceptions in the US have been on food (Blight 2020).
i.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.	likely	medium	At least one nest of *W. auropunctata* has previously reached Britain and multiple nests have reached Europe (Spain, France, Cyprus). However, interception data is limited. Boer & Vierbergen (2008) reported 2-5 interceptions between 1988 and 2008 for the Netherlands. Lee et al. (2020) listed only one interception of *W. auropunctata* into Taiwan. Harris et al. (2005) stated that large numbers were present in some interceptions into Australia but there were only two interceptions in New Zealand. In contrast, the species is regularly intercepted in Hawaii (Wetterer & Porter 2003). Many introduced populations are associated with strong trade ties and shipping routes (Foucaud et al. 2010; Montgomery et al. 2022). No ant species are listed as notifiable pests in Britain and therefore they do not appear in import lists. Most interceptions are likely to be

			of individual workers, with no potential for reproduction, but there is little data on interception rates for different castes. *Wasmannia auropunctata* nests opportunistically using any available space. They generally exploit natural cavities under leaf debris, logs or stones, in clumps of grass, in twigs or between leaves (Wetterer & Porter 2003; Vonshak et al. 2009b; de Souza-Campana et al. 2017). Nests can be on the ground or in trees (Clark et al. 1982). They will also nest in electrical sockets, vehicles, machinery, pallets, metal pipes, furniture, concrete cracks, loose gravel, drains and culverts and refuse waste (Montgomery et al. 2022). Monogynous (single queen) and polygynous (multiple queens) colonies exist (Wetterer & Porter 2003). Polygynous nests can contain over 100 queens and thousands of workers (Vonshak et al. 2009b).
i.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.	likely	high	Ant queens can survive several weeks without food. Some species will eat their own eggs/larvae when faced with a lack of food (Modlmeier et al. 2013). *Wasmannia auropunctata* is a true generalist in its food habits so is likely to be able to find food in most situations (Blight 2020). Reproduction can occur with (sexual) and without males (clonality) (e.g. Foucaud et al. 2010) throughout most of the year (Passera 1984 cited in Harris et al. 2005).
i.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 or that could contain soil/plant debris (e.g. farm machinery) into Britain requires a pre-notification and can require 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 for Food, Environment and Rural Affairs (DEFRA) and the Animal and Plant Health Agency (APHA-PHSI). Inspection rates for plants for planting may be as high as 100% depending on the source.

			Water and chemical treatment of containerised nursery plants is not 100% effective for this ant species (Hara et al. 2011). Nests can be small and difficult to identify (Clark et al. 1982) and could be present in a wide range of commodities which are not checked by quarantine inspectors.
i.1.7. How likely is the organism to enter the risk assessment area undetected?	very likely	medium	Detection will depend on the size of the nest. Larger nests with active workers are likely to be detected but small nests could easily be overlooked.
i.1.8. How likely is the organism to arrive during the months of the year most appropriate for establishment?	likely	medium	Transport of commodities that could be contaminated with *W. auropunctata* arrive all year round. Outdoors establishment is more likely at warmer times of year.
i.1.9. How likely is the organism to be able to transfer from the pathway to a suitable habitat or host?	very likely	medium	Colonies of *W. auropunctata* are highly mobile and will readily relocate if disturbed (Ulloa-Chacon & Cherix 1990). It uses a wide range of wet and dry habitats including native and plantation forest, shrublands, riverbanks, fields, orchards and coastal grasslands (Jeanne 1979; Perfecto & Vandermeer 1996; Ramos et al. 2003; Wetterer & Porter 2003; Gunawardana & Wetterer 2015; Lee et al. 2021; Jourdan et al 2022). In both its native and introduced range it is commonly found in urban areas such as roadsides, parks and gardens, around buildings and car parks (Delabie et al. 1995; Fowler et al. 1990; Gunawardana & Wetterer 2015; Lee et al. 2021; Demetriou et al. 2022). In introduced areas it seems to entirely associate with human disturbed habitats and often establishes in nurseries (Wetterer & Porter 2003; Solomon & Mikheyev 2005; Tindo et al. 2012).
i.1.10. Estimate the overall likelihood of entry into the risk assessment area based on this pathway?	likely	medium	*Wasmannia auropunctata* has entered the risk assessment area at least twice before along this pathway, though it is only ever known to have established indoors. An increasing global distribution of the ant increases the routes with which the ant could enter. The presence of the ant at multiple sites in Europe is of particular concern, for example, Spain is a major fruit/vegetable exporter to Britain.

Pathway name:	**ii) Stowaway (on aeroplanes (including passenger luggage).**		
ii.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 mainly concerns individual queens or workers; it is unlikely a nest could travel along this pathway. Limited data from Australia and New Zealand suggest air passenger luggage is a primary source of entry.
ii.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	*Wasmannia auropunctata* has been found during import inspections in Australia (Harris et al, 2005). There is high air travel frequency between Britain and the three countries in Europe with known *W. auropunctata* populations. The limited data on interceptions suggest the proportions of queens is low (Blight 2021). Nuptial flights are only known to occur in the native range and most nest founding is through budding. Moreover, independent colony founding in *W. auropunctata* is not known and the likelihood of a queen and several workers reaching an aircraft is low (Blight 2021). It is therefore unlikely that large numbers could travel along this pathway.
ii.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	Ant queens can survive several weeks on their own body fat reserves. Independent colony founding has not been documented for this species and therefore there is no data on how long a queen might survive. The queen of this species has, in general, a reasonably short lifespan compared to other species of ants (c.1 year) (Passera 1994 cited in Harris et al. 2005). Increased journey time is likely to increase mortality. It is unlikely that the species would multiply along this pathway.
ii.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 or ant queens in or on airplanes in place, searches of vehicles arriving by road/rail and personal luggage are limited.

ii.1.7. How likely is the organism to enter the risk assessment area undetected?	very likely	high	The tiny size of this ant makes it very likely to be overlooked and thus it could easily enter the risk assessment area undetected.
ii.1.8. How likely is the organism to arrive during the months of the year most appropriate for establishment?	likely	medium	Transport that could contain stowaway ants occurs all year round. Establishment is more likely at warmer times of year.
ii.1.9. How likely is the organism to be able to transfer from the pathway to a suitable habitat or host?	likely	medium	*Wasmannia auropunctata* is extremely catholic in its choice of habitat. Entry as a stowaway will bring it into proximity of suitable urban habitats such as roadsides, parks, buildings and car parks. Harris et al. (2005) recommended surveillance around airports as one of the first places the ant might establish.
ii.1.10. Estimate the overall likelihood of entry into the risk assessment area based on this pathway?	moderately likely	medium	The number of queens entering via this pathway is likely to be low and there is uncertainty whether independent colony foundation is possible.
Pathway name:	**iii. Transport-Stowaway (nests transported in container/bulk, including sea freight, airfreight, cars, train, etc.)**		
iii.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 section concerns nests transported on commerce other than that associated with the horticultural trade. Almost any cargo container has the potential to contain nests of any size including those carrying vehicles and machinery, building materials, furniture, timber, bark, packaging materials and aquaculture materials (Roque-Albelo & Causton 1999; Walsh et al. 2004). The presence of the ant in Western Europe makes transport by road and rail a possibility.
iii.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?	likely	medium	Ants are not listed as quarantine pests in Great Britain and therefore do not appear in lists of intercepted pests. At least one nest of *W. auropunctata* has previously reached Britain and multiple nests have reached Europe (Spain, France, Cyprus). Harris et al. (2005) considered sea freight as the main source of introductions. However, interception data is limited (see above). *Wasmannia auropunctata* nests opportunistically in both natural and artificial cavities.

Subnote: In your comment discuss how likely the organism is to get onto the pathway in the first place.			
iii.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	The chance of survival is high but will decrease with increased travel time. *Wasmannia auropunctata* is a true generalist in its food habits so is likely to be able to find food in most situations (Blight 2020). Reproduction can occur with (sexual) and without males (clonality) (e.g. Foucaud et al. 2010) throughout most of the year (Passera 1984 cited in Harris et al. 2005). A nest is unlikely to increase in size during transit because the brood development time is weeks.
iii.1.6. How likely is the organism to survive existing management practices during passage along the pathway?	very likely	high	Nests can be small and difficult to identify (Clark et al. 1982) and could be present in a wide range of commodities which are not checked by quarantine inspectors.
iii.1.7. How likely is the organism to enter the risk assessment area undetected?	very likely	high	The small size of queens and workers makes this species difficult to detect. Only a small amount of commodities are checked by quarantine inspectors.
iii.1.8. How likely is the organism to arrive during the months of the year most appropriate for establishment?	likely	medium	Transport of commodities that could be contaminated with *W. auropunctata* arrive all year round. Outdoors establishment is more likely at warmer times of year.
iii.1.9. How likely is the organism to be able to transfer from the pathway to a suitable habitat or host?	very likely	medium	Colonies of *W. auropunctata* are highly mobile and will use a wide range of habitats including urban.
iii.1.10. Estimate the overall likelihood of entry into the risk assessment area based on this pathway?	likely	medium	An increasing global distribution of the ant increases the routes with which the ant could enter. The presence of the ant at multiple sites in Europe is of particular concern, for example, Spain is a major fruit/vegetable exporter to Britain.

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).	likely	high	Data is lacking on the frequency with which ants enter Britain, and even Europe. It has entered Britain in the past and was established at Kew Gardens for several years. In the last decade, this species has spread and established outdoor populations, in Europe, the Middle East and China. Trade and transport between Britain and infected areas occurs all year round and the species has been intercepted elsewhere on produce and commodities which are imported into Britain.

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	high	The preferred climate of *Wasmannia auropunctata* is a tropical one with >60 mm monthly precipitation. However, it will tolerate a temperate warm climate (Gunawardana & Wetterer 2015). Optimal foraging temperatures are ~30 °C (Bestelmeyer 2000). Soil temperatures (>30 °C) are probably also important (Harris et al. 2005). The mean annual temperature in its native and introduced range of 23 °C (range 2.7-27 °C) (Harris et al. 2005) suggests Britain might be marginal and only the warmest parts in the south would allow establishment. Coulin et al. (2019) reported a tolerance to a minimum temperature of 4.2 °C if preceded by at least 10 days of acclimatisation. The urban heat island of cities might increase the chance of establishment. This species appears to require a more aseasonal climate to survive so even if populations were to establish outdoors in the summer, the species would likely still need to retreat indoors during the winter months (M. Hamer *pers. comm.*). However, cold adaptation at the southern limit of its native range before introduction to Israel is believed to have facilitated establishment (Rey et al. 2012).

			Four climate prediction models have been produced for *W. auropunctata*. The first predicted only the extreme southwest of Britain was suitable climatically (Federman et al. 2013). The model developed by Bertelsmeier et al. (2015) showed increasing suitability in western Britain over the next sixty years in contrast to other European countries. Coulin et al. (2019) used thermotolerance data together with climate data from the species' native and introduced range to predict that suitable climatic conditions for *W. auropunctata* did not occur north of about 43° latitude (e.g. northern Spain, southern France, northern Italy and Greece). Beckmann et al. (2023) predicted Britain was currently unsuitable climatically but could become suitable by 2050.
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?	unlikely	low	The species needs high humidity but avoids very wet soils. Other abiotic preferences are unknown.
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? Subnote: gardens are not considered protected conditions	very likely	very high	*Wasmannia auropunctata* has established populations indoors (e.g. in glasshouses) in several countries including Britain, Germany, the Netherlands and Canada. Even within its native range it can be found within houses and hospitals (Wetterer & Porter 2003).
1.15. How widespread are habitats or species necessary for the survival,	widespread	very high	The species uses a wide variety of habitats which cover a large percentage of the risk assessment area (e.g. forest, shrubland, riverbanks, fields, grasslands, parks, gardens, nurseries, roadsides, cities).

development and multiplication of the organism in the risk assessment area?			
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	very high	This ant is a true generalist and thus is not dependent on any one species for survival. It can feed on nectar (floral and extra-floral), plant parts, honeydew from homopterans (especially scale insects), other invertebrates and even animal faeces (Rosumek 2017; Clemente & Whitehead 2020; Montgomery et al. 2022).
1.17. How likely is it that establishment will occur despite competition from existing species in the risk assessment area?	likely	high	Two behavioural forms of *W. auropunctata* exist. In pristine habitats within its native range, it acts as an insinuator and can face strong competition from other ants (Yitbarex et al. 2019). The Argentine ant *Linepithema humile* can be a competitor but densities of that species in Britain are low. In human disturbed areas in its native range, and in all introduced populations where data exists, it is ecologically dominant (Foucard et al. 2010; Montgomery et al. 2022). The dominant form is highly aggressive to other ant species and can completely exclude other ant species from an area (Jourdan 1997; Clark et al. 1982).
1.18. How likely is it that establishment will occur despite predators, parasites or pathogens already present in the risk assessment area?	very likely	medium	The genus *Wasmannia* is not native to Britain or Europe and no specific natural enemies are present. Only generalist predators or non-specific pathogens are likely to have an impact on the ant's ability to establish. Known natural enemies include spiders, a parasitic wasp and other ants. Tennant (1994) suggests phorid flies probably attack *W. auropunctata*.
1.19. How likely is the organism to establish despite existing management practices in the risk assessment area?	very likely	high	There are no specific management practices in place against invasive ants in Britain. Eradication of single nests indoors is straightforward in buildings but much less so outdoors. Some eradication programmes have been successful though they can require multiple and repeated treatments over months or years (Wetterer & Porter 2003; Harris et al. 2005).
1.20. How likely are management practices in the risk assessment area to facilitate establishment?	unlikely	high	There are no specific management practices against invasive ants in Britain. If ant control is carried out, it is localised (using insecticide sprays, baited traps…etc.). Management practices are unlikely to facilitate establishment.

			Irrigation has assisted the establishment and spread of the species in Cyprus and Israel, allowing it to survive in areas which would otherwise be too dry (Vonshak et al 2009b).
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	high	Only by killing the queen/s which are usually located within a nest, can eradication be successful. These ants build simpler nests than many other species and so the queens are unlikely to be deep underground. This species is likely to be more susceptible to eradication than many other pest arthropods because they do not disperse by air and on the ground they usually only expand several dozen to several hundred meters per year unless they are accidentally transported by people or through flooding (Wetterer & Porter 2003). Nests located in trees require a different approach when applying insecticides.
1.22. How likely are the biological characteristics of the organism to facilitate its establishment?	very likely	high	Independent colony founding by a queen has not been demonstrated for this species but should not be ruled out (Blight 2020). Queens can perform tasks normally carried out by workers if worker numbers in the colony are too low (Ortiz-Alvarado & Rivera-Marchand 2020). Nuptial flights have been observed in the species' native range in Central and South America and the introduced populations in Puerto Rico and the Galapagos Islands (Meier 1994; Rosselli & Wetterer 2017). Natural dispersal is by budding where a queen/s accompanied by workers leave their natal nest and establish another nest nearby. This process means the ant can become extremely abundant in an area. Densities of 0.05-2.7 nests and 1,000-20,000 workers per m^2 have been reported (Clark et al. 1982; Levings & Franks 1982; Lubin 1984; Ulloa-Chacon & Cherix 1990). *Wasmannia auropunctata* has two reproductive strategies: sexual and clonal. Clonal reproduction may have evolved to allow adaptation to either the ecological pressures of floodplain habitat (e.g. fragmentation and the need to reproduce without males) or human-modified habitats (Montgomery et al. 2022). This reproductive strategy prevails in almost all introduced populations and is associated with high densities, ecological dominance and

			adaptation to very low temperatures (Foucaud et al. 2010; Foucaud et al. 2013; Rojas & Fragoso 2021; Antwiki.org 2022).
1.23. How likely is the capacity to spread of the organism to facilitate its establishment?	moderately likely	medium	Torres et al. (2001) suggested they cannot fly far and independent colony founding is unlikely (Ulloa-Chacon & Cherix 1990). Dispersal is therefore mainly through budding. Nests can contain over 100 queens (Vonshak et al. 2009b), reproduction occurs almost all year round and large numbers of sexuals can be produced (Torres et al. 2001). Some long-distance dispersal occurs through natural (e.g. floating on vegetation, debris and logs during floods) and human-mediated means. The movement of soil, potted plants and other goods can cause long-distance spread (Harris et al. 2005). Nests are highly mobile and will readily relocate if disturbed.
1.24. How likely is the adaptability of the organism to facilitate its establishment?	likely	high	Successful establishment in Israel is believed to have been the result of cold adaptation at the southern limit of its native range before introduction (Rey et al. 2012). However, climate prediction models include a high level of uncertainty about how much further north the species could establish outdoors. Humidity is also required for survival and could present a limiting factor (Blight 2020). *Wasmannia auropunctata* queens and workers exhibit behavioural flexibility. Queens can revert to tasks normally performed by workers if there is a reduced workforce (Ortiz-Alvarado & Rivera-Marchand 2020). Older workers can revert to tasks normally undertaken by young workers (Ortiz-Alvarado et al. 2021). Clonal reproduction dominates in introduced populations, although occasional sexual events are needed to maintain colony health (Miyakava & Mikheyev 2015; Montgomery et al. 2022). However, this reproductive plasticity allows the ant to continue to reproduce in the absence of males. It also enables high heterozygosity of workers which may enable them to cope with the biotic and abiotic conditions of human-disturbed habitats (Foucard et al. 2010).

1.25. How likely is it that the organism could establish despite low genetic diversity in the founder population?	very likely	high	Genetic evidence from Israel, Hawaii and Cameroon suggests only a single female and single male genotype was introduced to found populations in those locations (Mikheyev et al. 2009; Vonshak et al. 2009a; Tindo et al. 2012). An advantage of clonality is that even if the number of founders is small, the system prevents rapid erosion of introduced population genetic diversity through drift and therefore limits the genetic side effects of bottlenecks (Foucard et al. 2010).
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.)	unlikely	medium	The furthest north *W. auropunctata* has established is Toulon, France (latitude 43°). North of this, and south of its native range, it has only established indoors. The populations at Kew, London, survived for at least several decades without any evidence of outdoor establishment.
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 in the risk assessment area but is established because of continual release, is an example of a transient species.	unlikely	low	Interception data suggests that *W. auropunctata* nests or queens are not regularly transported (Harris et al. 2005; Boer & Vierbergen 2008; Lee et al. 2020). There is no evidence for transient populations resulting from indoor escapees.
1.28. Estimate the overall likelihood of establishment (mention any key issues in the comment box).	unlikely	medium	There is a high likelihood of indoor establishment based on invasion history but due to climatic suitability and particularly cold winters, the risk of establishment outdoors is low. However, cold adaptation has occurred before in this species. Climate models generally agree that climatically Britain is currently unsuitable but is likely to become suitable within the next 25 years.

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.)	minor	medium	Natural spread can occur through two mechanisms, active and passive dispersal. Active dispersal is predominately, or exclusively, by budding. A mated queen will leave the nest with some workers and establish a new nest nearby. This strategy can allow rapid spread over a localised area. Passive dispersal can occur via rafting on logs, vegetation or refuse, landslides, possibly high winds and storm events (Lubin 1984; Wetterer & Porter, 2003; Walker 2006; Vanderwoude et al. 2014). In Lopé (Gabon) the ants occur predominately along waterways and this pattern strongly suggests moving water facilitates colonisation (Walker 2006). Rates of 73 m/year and 170 m/year have been reported from Gabon and the Galapagos Islands respectively increasing to 500 m/year in optimal conditions (Lubin 1984; Meier 1994; Walsh et a. 2004). A much slower rate of spread is likely in less suitable climates as has been the case in Spain (Espadaler et al. 2018).
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	Human assistance has been a major factor in the spread of *W. auropunctata* (Clark et al. 1982; Walsh et al. 2004). In Gabon, logging has increased spread 60 times faster than by natural means (Walsh et al. 2004). Transport of potted plants, chopped wood and logs, and green and oversized waste have been implicated in the spread of *W. auropunctata* within countries (Vanderwoude et al. 2014; Vanderwoude et al. 2015).
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. Established indoor colonies would be easier to contain than outdoor. Populations can go years undetected which means they can spread substantially before any action is taken (Espadaler et al. 2018).

			However, successful eradication programmes have taken place (e.g. on Hawaii, Galapagos).
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.	SW England, S Wales, SW Scotland ~31,000 km^2	low	Climatic suitability rather than the potential for spread is likely to be the limiting factor for *W. auropunctata*. Based on climate prediction models only the extreme southwest of Scotland and of England, and south Wales are likely to be able to support the ant (Federman et al. 2013; Bertelsmeier et al. 2015).
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	high	There is no evidence *W. auropunctata* is currently present in Britain. It is scored high as slow-growing populations, especially in less climatically suitable areas, can persist for years without detection.
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	high	The species is not known to be present. Under optimal conditions (e.g. El Niño years on Santa Cruz island), it can spread at a rate of 500 m per year (Lubin 1984). However, in Britain reproductive rates are likely to be slow due to sub-optimal climatic conditions. Infestations can be present for years before detection (Montgomery et al. 2022). The population in Spain is thought to have been present for more than five years before it was detected, by which point it covered 5.8 ha (Espalader et al. 2018). Hence <10 % area would be invaded.
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 years	high	The species is not known to be established outdoors in the risk assessment area nor yet in any other climatically similar region. Bertelsmeier et al. (2015) predicted an increased suitability by 2080.
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	high	Based on the spread rates in Spain, after a further ten years the area invaded would still be less than 10%. However, the rate of spread could increase in subsequent decades if climate suitability models are correct.

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	high	Future spread is dependent on future introductions. Spread would likely to be slow in sub-optimal climatic conditions. Establishment resulting from greenhouse escapes is not a known pathway. This should be reconsidered if the species becomes established in central or northern Europe.

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?	major	medium	The overall costs for *W. auropunctata* are not known but estimated to be the second highest of any ant: 43% of the total for invasive ants (Angulo et al. 2022). A high proportion of these costs (~45%) are for knowledge/funding. The remainder is largely post-invasion management costs (Angulo et al. 2022). The estimated costs of *W. auropunctata* (from 1930-2021) were $20b USA, $30k Vanuata, $21m Australia, $25m New Caledonia and Tahiti, $247k Galapagos Islands (Angulo et al. 2022). Costs for Hawaii are predicted to be $6.1b over 35 years under the current management regime dropping to £51m if attempts are made to suppress the population (Montgomery et al. 2022). The estimated total cost of removing *W. auropunctata* from one hectare of infested area on Marchena (Galapagos Islands) was estimated in 2004 to be US$15,584 (Causton et al. 2005). A large proportion of costs have gone towards funding research as little was known about this ant until about 20 years ago. Other costs include eradication or monitoring programmes. For Hawaii, property values, logging and outdoor recreational activity due to stings have been indirect costs (Angulo et al. 2022). The nursery and flower exporting sector was expected to be affected in Hawaii (Motoki et al. 2013). Harris et al. (2005) report no current costs to New Zealand but that a large invasion could lead to movement controls on a

			range of freight, including produce, cut flowers and potted plants, until eradication was achieved or abandoned. There is the potential for *Wasmannia auropunctata* to cause direct and indirect costs to agriculture. Being repeatedly stung reduces field workers' productivity or they may refuse to work altogether leading to land abandonment (Ero et al. 2020; Montgomery et al. 2022). Castineiras & Noyra (1993) calculated a 366-629% increase in unitary costs for crop production caused by the need for insecticides. The ant's sting also has the potential to injure domestic livestock, causing corneal cloudiness and blindness. An increase in tended Homopterans combined with a suppression of their natural enemies can spoil fruit, spread disease, and increase crop loss and rejection – though these effects are only seen at high ant densities (Harris et al. 2005; Cha et al. 2019; Perfecto 2021). Gardeners, subsistence farmers and fruit growers are particularly affected (Wetterer & Porter 2003; Fasi et al. 2016).
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	The species is not present outdoors in the risk assessment area and is not known to be present in greenhouses currently. There is no documented evidence that presence in greenhouses incurs economic costs though gardeners in Canada do report being stung (Naumann 1994).
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	medium	Future costs are very difficult to estimate given the uncertainty around climate suitability. The scale of impact will depend on ant abundance. For New Zealand, Harris et al. (2005) predicted a large invasion could lead to movement controls on a range of freight, including produce, cut flowers and potted plants, until eradication was achieved or abandoned. Many of the economic costs outlined in 2.10 would be applicable to Britain, e.g. increased costs associated with crop production including crop losses, veterinary costs, reductions in outdoor recreation and property values, increased timber costs due to movement controls…etc.
2.13. How great are the economic costs **associated with managing** this	N/A		The species is not currently present outdoors in the risk assessment area.

organism **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	medium	Future costs are very difficult to estimate given the uncertainty around habitat and climate suitability. Management costs will depend on population size.
2.15. How important is environmental harm caused by the organism within its existing geographic range **excluding the risk assessment area**?	moderate	high	Most of the evidence for environmental harm caused by *W. auropunctata* relates to biodiversity impacts. Indirectly, increased use of pesticides in infested areas is likely to cause moderate environmental harm. There is a wealth of evidence that *W. auropunctata* negatively impacts native ant species from pirating food, reducing abundance, reducing species richness to the extreme of excluding them completely (Clark et al. 1982; Brandao & Paiva 1994; Jourdan 1997; Armbrecht & Ulloa-Chacon 2003; Le Breton et al. 2003; Achury et al. 2012; Berman et al. 2013; Mbenoun Masse et al. 2017; Serge et al. 2019;). Other myrmecines have the greatest interaction with *W. auropunctata* (Achury et al. 2008). Arthropod species diversity in *W. auropunctata* invaded areas can be a third of that found in uninvaded areas with phytophagous, omnivores, detritivores and predators most affected (Bousseyroux et al. 2018). Lubin (1984) reported a reduction in the overall abundance and species diversity of flying and tree-dwelling insects. *Wasmannia auropunctata* can reduce the abundance and/or species richness of beetles, spiders and scorpions or eliminate them completely (Lubin 1984; Vonshak et al. 2009b). It can also change the community composition of spiders (Vonshak et al. 2009b). At high, but not low, densities of ants, Jourdan et al. (2022) found a reduction in the biomass of soil invertebrates, except for millipedes. The presence of *W. auropunctata* has been correlated with declines in butterflies, but no mechanistic link is proven as yet (Wetterer & Porter 2003).

			Wasmannia auropunctata attacks and can eat hatchling tortoises and birds (Wetterer et al. 1999; Jourdan et al. 2001). Lizard abundance is reduced in invaded areas (Jourdan et al. 2001). The ant is associated with declines in native birds particularly flightless or shoreline species (Harris et al. 2005; Bousseyroux et al. 2018). The venomous sting of *W. auropunctata* may give it a greater ability to subdue vertebrate and large invertebrate prey (Holway et al. 2002). *Wasmannia auropunctata* stings have been implicated in increased reports of corneal clouding in leopards and elephants (Walsh et al. 2004; Harris et al. 2005). Plants with extra-floral nectaries are protected from herbivory by the ant and hence less attacked by leaf pathogens, resulting in increased growth and seed production (de la Fuente & Marquis 1999; Ness & Bronstein 2004). In Florida, tree damage by a scale insect has been associated with three species of ant including *W. auropunctata* (Williams 1993).
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)?	none	high	The species is not known to be present.
2.17. How important is the impact of the organism on biodiversity likely to be in the **future** in the risk assessment area?	moderate	medium	The impact will depend on population density and could be locally major. At low densities this ant acts as an insinuator species but at high densities is considered an extirpator species (Vonshak et al. 2012). The majority of the effects on biodiversity documented above, are likely to also occur in Britain. In particular, shoreline birds could be disproportionately affected as the area identified as climatically suitable contains long coastlines.
2.18. How important is alteration of ecosystem function (e.g. habitat change, nutrient cycling, trophic interactions), including losses to ecosystem services, caused by the organism **currently** in the	N/A		The species is not currently present in the risk assessment area.

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**?	major	medium	*Wasmannia auropunctata* may indirectly alter litter decomposition and nutrient cycling in the soil by suppressing important microbivore and detritivore populations (Durnham & Mikheyev 2010). It can alter herbivory regimes and grazing communities (Durnham & Mikheyev 2010) and interfere with seed dispersal of myrmecochorous plants by reducing dispersal distances and leaving seed exposed on the soil surface (Ness & Bronstein 2004). Consequently, there could be impacts on plant composition and regeneration. Reductions in abundance and richness of native invertebrates could result in functional homogeneity with reduced ecosystem services and resilience.
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	The species is not 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	Introduced populations are primarily associated with disturbed and human modified habitats. Presence in primary forest, for example, only occurs in the native range.
2.22. How important is it that genetic traits of the organism could be carried to other species, modifying their genetic nature and making their economic, environmental or social effects more serious?	minimal	very high	No closely related species occur in Britain.
2.23. How important is social, human health or other harm (not directly included in economic and environmental categories) caused by the	moderate	high	The ant can be a major residential pest entering houses and hospitals in search of food (Bueno & Fowler 1994; Jourdan 1997; Conant & Hirayama 2000; Jourdan et al. 2002). It has been identified as a vector of bacterial and fungal pathogens in hospitals (Garcia & Lise 2013).

organism within its existing geographic range?			*Wasmannia auropunctata* tends to sting only when trapped or provoked but it is extremely painful relative to its size and can itch intensely for up to 3 days (Spencer 1941, cited in Ayre 1977; Deyrup et al. 2000; Wetterer & Porter 2003). There are reported cases of anaphylactic shock in Israel in areas where *W. auropunctata* is found (Kidon et al. 2022). There are no reported deaths. Where *W. auropunctata* is present in tropical glasshouses in Canada gardeners report being regularly stung (Naumann 1994). It could disrupt outdoor activities. Though the sting is possibly no more painful than native species (e.g. Mutilla, Myrmica), the ants' attraction to disturbed and urban areas could bring it into more frequent contact with humans. There is anecdotal evidence for stings causing corneal clouding, and possibly reduced life expectancy, in domestic dogs and cats (Wetterer 1997; Wetterer et al 1999; Wetterer & Porter 2003). It is also linked to corneal clouding in humans (Rosselli & Wetterer 2017).
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	*Wasmannia auropunctata* increases the populations of certain Homopterans, particularly scale insects, which negatively impacts crops through direct feeding, insect-vectored disease and the build-up of sooty mould (Fowler et al. 1990; de Souza et al. 1998; Michaud & Browning 1999; Wetterer & Porter 2003). It is associated with the Fluted Scale *Icerya purchasi*, an invasive global pest of agricultural and horticultural plants (Harris et al. 2005).
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		No other effects were found.
2.26. How important are the expected impacts of the organism despite any natural control by other organisms, such as predators, parasites or pathogens that	moderate	medium	There are no specific natural enemies of *W. auropunctata* in Britain. Thus, only generalist natural enemies of ants may affect *W. auropunctata* and these are highly unlikely to control populations.

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, SW England, S Wales	medium	South west Scotland, south west England and south Wales are particularly likely to experience impacts as these have been identified as the most climatically suitable. However, given the wide-ranging impacts identified, any area colonised by the ant could be affected.
2.28. Estimate the overall impact of this organism in the risk assessment area (using the comment box to indicate any key issues).	moderate	medium	The species is not currently present outdoors 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	likely	high	The species has been introduced (indoors) and intercepted before. Nests can enter pathways and there is the potential for the species to be transported as a stowaway or contaminant on freight or passenger transport especially with the horticultural trade. The global distribution of the species is increasing and in the last decade has established in several European countries.
Summarise Establishment	unlikely	medium	There is suitable habitat in Britain and the ants could arrive at times of year suitable for establishment. A queen and workers are required for establishment. There are no natural enemies and no highly competitive ant species present. Britain is currently considered to be climatically unsuitable or at least suboptimal. The establishment of indoor populations at similar latitudes/climates has not resulted in any outdoor establishment.
Summarise Spread	slowly	high	Suboptimal climatic conditions will likely constrain foraging activity and reproductive rates. Human-assisted transport is likely to provide a suitable means of spread within Britain.
Summarise Impact	moderate	medium	*Wasmannia auropunctata* can eradicate native ants where it occurs and negatively impact other arthropods, trees, birds, reptiles and vertebrates. There are likely to be socio-economic impacts including medical and on agriculture, trade and recreation. Impacts are strongly linked to population densities.
Conclusion of the risk assessment	low	medium	*Wasmannia auropunctata* is considered one of the world's most invasive organisms and it continues to spread globally. It can, and has previously, entered Britain and establishedindoors. Establishment remains the greatest uncertainty with limited and conflicting evidence of climatic suitability. It has the potential to become a moderate socioeconomic and ecological pest. This assessment should be reconsidered if further adaptive shifts are reported and/or the species establishes at higher latitudes.

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 Humidity	medium	Bertelsmeier et al. (2015) predicted increasing suitability for *W. auropunctata* under climate change. The preferred climate of *Wasmannia auropunctata* is a tropical one with >60 mm monthly precipitation. However, it will tolerate a temperate warm climate (Gunawardana & Wetterer 2015). It was thought intolerant of prolonged drought (Kusnezov 1952) but establishment in Israel, Cyprus and Spain indicates otherwise. *W. auropunctata* can display a niche shift which is what is believed to have happened before introduction to Israel where it is subject to cooler temperatures and less rainfall (Rey et al. 2012). Further adaptation should not be ruled out.
3.2. What is the likely timeframe for such changes?	50 years	low	Climate suitability is predicted to have increased by 2080 (Bertelsmeier et al. 2015).
3.3. What aspects of the risk assessment are most likely to change as a result of climate change?	establishment, spread and impact	medium	Warmer temperatures and/or increased precipitation/humidity will make conditions more suitable for establishment. Activity increases with 2-4 °C increase in soil temperature (Bujan et al. 2022). Consequently, spread and associated impacts will be increased.
ADDITIONAL QUESTIONS – RESEARCH			
4.1. If there is any research that would significantly strengthen confidence in the risk assessment please summarise this here.	entry establishment impact management	high	Research on thermotolerance, ecological impacts and management strategies would improve confidence levels. The following areas are suggested: **Establishment** What do suboptimal temperatures mean in reality? How are survival and reproductive rates affected by suboptimal temperatures? Can models predictions be improved by including additional variables such as local factors and irrigation/desiccation, or by using process-based models? What are the driving forces between ecological factors and genetic adaptation, biological and physiological shifts?

			Impact Is impact proportional to densities? What are the factors driving ecological dominance? More research is needed on the impacts on birds specifically, and on functional diversity and the consequences for ecosystem processes and functions. **Control and management** Eradication strategies have not been tested in temperate climates. Further studies are needed on biological control with pathogenic fungi and parasitic wasps. Natural declines are understudied in invasive ants but better understanding could allow exploitation of features of population dynamics.

REFERENCES:

Achury, R., Ulloa-Chacón, P., Arcila, A. 2008. Ant composition and competitive interactions with *Wasmannia auropunctata* in tropical dry forest fragments. *Revista Colombiana de Entomologia*, **34**: 209-216. https://doi.org/10.25100/socolen.v34i2.9292

Achury, R., Ulloa-Chacón, P., Arcila, A. 2012. Effects of the heterogeneity of the landscape and the abundance of *Wasmannia auropunctata* on ground ant assemblages in a Colombian tropical dry forest. *Psyche*, 2012: 960475. https://doi.org/10.1155/2012/960475

Armbrecht, I. & Ulloa-Chacón P. 2003. The little fire ant *Wasmannia auropunctata* (Roger) (Hymenoptera: Formicidae) as a diversity indicator of ants in tropical dry forest fragments of Colombia. *Environmental Entomology*, **32**: 542–547. https://doi.org/10.1603/0046-225X-32.3.542

Angulo, E., Hoffmann, B.D., Ballesteros-Mejia, L., Taheri, A., Balzani, P., Bang, A., Ranault, D., Cordonnier, M., Bellard, C., Diagne, C., Ahmed, D.A., Watari, Y., Courchamp, F. 2022. Economic costs of invasive alien ants worldwide. *Biological Invasions*, **24**: 2041-2060. https://doi.org/10.1007/s10530-022-02791-w

Antmaps. 2023. *Wasmannia auropunctata*. https://www.antmaps.org [accessed Jan 2023].

Antwiki, 2022. *Wasmannia auropunctata*. https://www.antwiki.org [accessed Dec 2022].

Ayre, G.L. 1977. Exotic ants in Winnipeg. *The Manitoba Entomologist*, **11**: 41–44.

Berman, M., Andersen, A.N., Hely, C., Gaucherel, C. 2013. Overview of the distribution, habitat association and impact of exotic ants on native ant communities in New Caledonia. *PLOS ONE*, **8**: e67245. https://doi.org/10.1371/journal.pone.0067245

Beckmann, B., Rorke, S., Blight, O., Chapman, D. 2023. Projection of environmental suitability for *Wasmannia auropunctata* establishment in Europe. Species Distribution Model produced for NNSS.

Bestelmeyer, B.T. 2000. The trade-off between thermal tolerance and behavioural dominance in a subtropical South American ant community. *Animal Ecology*, **69**: 998-1009. https://doi.org/10.1111/j.1365-2656.2000.00455.x

Bertelsmeier, C., Courchamp, F. 2014. Future ant invasions in France. *Environmental Conservation*, **41**: 217-228. https://doi.org/10.1017/S0376892913000556

Bertelsmeier, C., Luque, G.M., Hoffmann, B.D., Courchamp, F. 2015. Worldwide ant invasions under climate change. *Biodiversity & Conservation*, **24**: 117-128. https://doi.org/10.1007/s10531-014-0794-3

Blight, O. 2020. Risk assessment of *Wasmannia auropunctata* for the European Union. https://doi.org/10.13140/RG.2.2.29275.69925

Boer, P., Vierbergen, B. 2008. Exotic ants in the Netherlands (Hymenoptera: Formicidae). *Entomologische Berichten*, **68**: 121-129.

Bousseyroux, A., Blanvillain, C., Darius, T., Vanderwoude, C., Beaune, D. 2018. Ecological impacts of the little fire ant (*Wasmannia auropunctata*) in Tahiti. *Pacific Conservation Biology*, **25**: 299302.

Brandão, C.R.F., Paiva, R.V.S. 1994. The Galapagos ant fauna and the attributes of colonizing ant species. *In* Exotic ants. D.F. Williams (ed). CRC Press, Boca Raton. pp.1-10.

Brangham, A.N. 1938. Additions to the Wild Fauna and Flora of the Royal Botanic Gardens, Kew: XVIII. The Ants of the Royal Botanic Gardens, Kew. *Bulletin of Miscellaneous Information, Royal Botanic Gardens, Kew*, **1938**: 390-396.

Bujan, J., Nottingham, A.T., Velasquez, E., Meir, P., Kaspari, M., Yanoviak, S.P. 2022. Tropical ant community responses to experimental soil warming. *Biology Letters*, **18**: 20210518. https://doi.org/10.1098/rsbl.2021.0518

Bueno, O.C.; Fowler, H.G. 1994: Exotic ants and native ant fauna of Brazilian hospitals. *In*: Williams, D. F. ed. Exotic ants: biology, impact, and control of introduced species. Boulder, Westview Press. pp. 191–198.

Castineiras, A., Noyra, M. 1993. Distribution and damage caused by *Wasmannia auropunctata* (Roger) (Hymenoptera: Formicidae) in three coffee-growing regions of Cuba. *Centro Agricola*, **20**: 84-95.

Causton, C.E., Sevilla, C.R., Porter, S.D. 2005. Eradication of the little fire ant, *Wasmannia auropunctata* (Hymenoptera: Formicidae), from Marchena Island, Galapagos: On the edge of success? *Florida Entomlogist*, **88**: 159-168. https://doi.org/10.1653/0015-4040(2005)088[0159:EOTLFA]2.0.CO;2

Cha, D.H., Skabeikis, D., Collignon, R.M., Siderhurst, M.S., Choi, M.Y., Vandermeer, R.K. 2019. Behavioural responses of the Little Fire Ant, *Wasmannia auropunctata* (Hymenoptera: Formicidae), to trail chemicals laid on epiphytic moss. *Journal of Insect Behaviour*, **32**: 145-152. https://doi.org/10.1007/s10905-019-09721-0

Chifflet, L., Guzmán, N.V., Rey, O., Confalonieri, V.A., Calcaterra, LA. 2018. Southern expansion of the invasive ant *Wasmannia auropunctata* within its native range and its relation with clonality and human activity. *PLOS ONE*, **13**: e0206602. https://doi.org/10.1371/journal.pone.0206602

Clark, D.B., Guayasamin, C., Pazmino, O., Donoso, C., de Villacis, Y.P. 1982. The tramp ant *Wasmannia auropunctata*: Autoecology and effects on ant diversity and distribution in Santa Cruz Island, Galapagos. *Biotropica*, **14**: 196-207.

Clemente, S. R., Whitehead, S. R. 2020. Ant seed removal in a non-myrmecochorous Neotropical shrub: implications for seed dispersal. *Biotropica*, **52**: 90–100. https://doi.org/10.1111/btp.12728

Conant, P., Hirayama. C. 2000. *Wasmannia auropunctata* (Hymenoptera:Formicidae): established on the Island of Hawaii. *Bishop Museum Occasional Papers*, **64**: 21–22.

Coulin, C., De la Vega, G.J., Chifflet, L., Calcaterra, L.A., Schilman, P.E. 2019. Linking thermos-tolerances of the highly invasive ant, *Wasmannia auropunctata*, to its current and potential distribution. *Biological Invasions*, **21**: 3491-3504. https://doi.org/10.1007/s10530-019-02063-0

Cuezzo, F., Calcaterra, L. A., Chifflet, L., Follett, P. 2015. *Wasmannia* Forel (Hymenoptera: Formicidae: Myrmicinae) in Argentina: systematics and distribution. *Sociobiology*, **62**: 246-265.

Delabie, J.H.C., Nascimento, I.C.Do., Pacheco, P., Casimiro, A.B. 1995. Community structure of house-infesting ants (Hymenoptera: Formicidae) in southern Bahia, Brazil. *Florida Entomologist*, **78**: 264–270.

de la Fuente, M.A.S., Marquis. R.J. 1999. The role of ant-tended extrafloral nectaries in the protection and benefit of a neotropical rainforest tree. *Oecologia*, **118**: 192–202.

Demetriou, J., Georgiadis, C., Roy, H., Martinou, A., Borowiec, L., & Salata, S. 2022. One of the World's Worst Invasive Alien Species *Wasmannia auropunctata* (Hymenoptera: Formicidae) Detected in Cyprus. *Sociobiology*, **69**: e8536. https://doi.org/10.13102/sociobiology.v69i4.8536

de Souza, A.L.B., Delabie, J.H.C., Fowler, H.G. 1998. *Wasmannia* spp. (Hym., Formicidae) and insect damages to cocoa in Brazilian farms. *Journal of Applied Entomology*, **122**: 339–341.

Deyrup, M., Davis, L., Cover, S. 2000. Exotic ants in Florida. *Transactions of the American Entomological Society*, **126**: 293– 326.

Donisthorpe, H. 1908. Additions to the wild fauna and flora of the Royal Botanic Gardens, Kew: VII. Hymenoptera. Formicidae (ants). *Bulletin of Miscellaneous Information, Royal Botanic Gardens, Kew*, **1908**: 121-122.

Donisthorpe, H. 1927. British ants, their life history and classification (2nd edn.). London: G. Routledge and Sons, xvi + 436 pp.

Dunham, A.E., Mikheyev, A.S. 2010. Influence of an invasive ant on grazing and detrital communities and nutrient fluxes in a tropical forest. *Biodiversity Research*, **16**: 33-42. https://doi.org/10.1111/j.1472-4642.2009.00620.x

Errard, C., Delabie, J., Jourdan, H., Hefetz, A. 2005. Intercontinental chemical variation in the invasive ant *Wasmannia auropunctata* (Roger) (Hymenoptera: Formicidae): a key to the invasive success of a tramp species. *Naturwissenschaften*, **92**: 319-323.

Ero, M.M., Dikrey, R., Batari, T., Bonneau, L.J.G. 2020. Investigating the potential impact of little fire ant (LFA), *Wasmannia auropunctata* (Roger) (Hymenoptera: Formicidae) on the oil palm pollinating weevil, *Elaedobius kamerunicus* Faust. (Coleoptera: Curculionidae) and field worker productivity time. *Journal of Palm Oil Research*, **32**: 211-218. https://doi.org/10.21894/jopr.2020.0028

Espadaler, X., Pradera, C., Santana, J.A. 2018. The first outdoor-nesting population of *Wasmannia auropunctata* in continental Europe (Hymenoptera, Formicidae). *Iberomyrmex*, **10**: 1-8.

Fasi, J., Brodie, G., Vanderwoude, C. 2013. Increases in crop pests caused by *Wasmannia auropunctata* in Solomon Islands subsistence gardens. *Journal of Applied Entomology*, **137**: 580-588. https://doi.org/10.1111/jen.12033

Fasi, J. Furlong, M.J., Fisher, D. 2016. Subsistence farmers' management of infestations of the little fire ant in garden plots in Bauro, Makira Province, Solomon Islands. *Human Ecology*, **44**: 765-774. https://doi.org/10.1007/s10745-016-9856-3

Federman, R., Carmel, Y., Kent, R. 2013. Irrigation as an important factor in species distribution models. *Basic and Applied Ecology*, **14**: 651-658. http://dx.doi.org/10.1016/j.baae.2013.09.005

Foucaud, J., Orivel, J., Fournier, D., Delabie, J.H.C., Loiseau, A., Le Breton, J., Cerdan, P., Estoup, A. 2009. Reproductive system, social organisation, human disturbance and ecological dominance in native populations of the little fire ant, *Wasmannia auropunctata*. *Molecular Ecology*, **18**: 5059-5073. https://doi.org/10.1111/j.1365-294X.2009.04440.x

Foucaud, J., Orivel, J., Loiseau, A., Delabie, J.H.C., Jourdan, H., Konghouleux, D., Vonshak, M., Tindo, M., Mercier, J-L., Fresneau, D., Mikissa, J-B., McGlynn, T., Mikheyev, S., Oettler, J., Estoup, A. 2010. Worldwide invasion by the little fire ant: routes of introduction and eco-evolutionary pathways. *Evolutionary Applications*, **3**: 363-374. https://doi.org/10.1111/j.1752-4571.2010.00119.x

Foucaud, J., Rey, O., Robert, S., Crespin, L., Orivel, J., Facon, B., Loiseau, A., Jourdan, H., Kenne, M., Masse Mbenoun, P.S., Tindo, M., Vonshak, M., Estoup, A. 2013. Thermotolerance adaptation to human-modified habitats occurs in the native range of the invasive ant *Wasmannia auropunctata* before long distance dispersal. *Evolutionary Applications*, **7**: 721-734. https://doi.org/10.1111/eva.12058.

Fowler, H.G., Bernardi, J.V.E., Delabie, J.C., Forti, L.C., Pereira-da-Silva, V. 1990. Major ant problems of South America. *In* Vander Meer, R.K.; Jaffe, K.; Cedeno, A. eds Applied myrmecology: a world perspective. Boulder, Westview Press. pp. 3-–14.

Garcia, F.R.M., Lise, F. 2013. Ants associated with pathogenic microorganisms in brazilian hospitals: attention to a silent vector. *Acta Scientiarum. Health Sciences*, **35**: 9-14. https://doi.org/10.4025/actascihealthsci.v35i1.10471

Gunawardana, D., Wetterer, J.K. 2015. *Wasmannia auropunctata* (little fire ant). CABI Compendium. https://doi.org/10.1079/cabicompendium.56704

Hara, A.H., Cabral, S.K., Niino-Duponte, R., Jacobsen, C.M., Onuma, K. 2011. Bait insecticides and hot water drenches against the little fire ant, *Wasmannia auropunctata* (Hymenoptera: Formicidae), infesting containerised nursery plants. *Florida Entomologist*, **94**: 517-526. https://doi.org/10.1653/024.094.0316

Harris, R., Abbott, K., Barton, K., Berry, J., Don, W., Gunawardana, D., Lester, P., Rees, J., Stanley, M., Sutherland, A., Toft, R., 2005. Invasive ant pest risk assessment project for Biosecurity New Zealand. In: Series of unpublished Landcare Research contract reports to Biosecurity New Zealand, No. BAH/35/2004-1

Holway, D. A., Lach, L., Suarez, A. V., Tsutsui, N. D., Case, T. J. 2002. The Causes and Consequences of Ant Invasions. *Annual Review of Ecology and Systematics*, **33**: 181–233. https://doi.org/10.1146/annurev.ecolsys.33.010802.150444

Jaffe, K., Mauleon, H., Kermarrec, A. 1990. Predatory ants of Diaprepes abbreviatus (Coleoptera: Curculionidae) in citrus groves in Martinique and Guadeloupe, F.W.I. *Florida Entomologist*, **73**: 684–687

Jeanne, R. L. 1979. A latitudinal gradient in rates of ant predation. *Ecology*, **60**: 1211–1224.

Jourdan, H. 1997. Threats on Pacific islands: the spread of the tramp ant *Wasmannia auropunctata* (Hymenoptera: Formicidae). *Pacific Conservation Biology*, **3**: 61-64.

Jourdan, H., Bourguet, E., Mille, C., Gula, R., Theuerkauf, J. 2022. Impact of invasive little fire ants *Wasmannia auropunctata* on rainforest soil fauna: implications for conservation of the endangered flightless kagu of New Caledonia. *Biological Invasions*, **24**: 3675-3680. https://doi.org/10.1007/s10530-022-02882-8

Jourdan, H., Sadlier, R., Bauer, A.M. 2001. Little fire ant invasion (*Wasmannia auropunctata*) as a threat to New Caledonian lizard: evidences from a sclerophyll forest (Hymenoptera: Formicidae). *Sociobiology*, 38: 283-301.

Jucker, C., Rigato, F., Regalin, R. 2008. Exotic ant records from Italy (Hymenoptera, Formicidae). *Bollettino di Zoologia Agraria e di Bachicoltura*, **40**: 99-107.

Kidon, M., Klein, Y., Weinberg, T. 2022. Little fire ant (*Wasmannia auropunctata*) in Israel – from nuisance to life-threatening. *Harefuah*, **161**: 207-209.

Kondo, T., Arcila, A.M., Campos-Patino, Y., Sotelo-Cardona, P. 2018. *Wasmannia auropunctata* (Roger) (Hymenoptera: Formicidae), a small but voracious predator of *Diaphorina citri* (Hemiptera: Liviidae). *Acta Zoologica Mexicana*, **34**: 3412127. https://doi.org/10.21829/azm.2018.3412127

Kulikowski, A.J., II. 2020. Ant-scale mutualism increases scale infestation, decreases folivory, and disrupts biological control in restored tropical forests. *Biotropica*, **52**: 709-716. https://doi.org/10.1111/btp.12786

Kusnezov, N. 1952. El género *Wasmannia* en la Argentina (Hymenoptera, Formicidae). *Acta Zoologica Lilloana*, **10**:173-182.

Lee, C-C., Hsu, P.W., Hsu, F.C., Shih, C.H., Hsiao, Y.C., Yang, C.C.S., Lin, C.C. 2021. First Record of the Invasive little fire ant (*Wasmannia auropunctata*) (Hymenoptera: Formicidae) in Taiwan: Invasion status, colony structure, and potential threats. *Formosan Entomologist*, **41**: 172-181

Lee, D.J., Motoki, M., Vanderwoude, C., Nakamoto, S.T., Leung, P. 2015. Taking the sting out of the little fire ant in Hawaii. *Ecological Economics*, **111**: 100-110. https://doi.org/10.1016/j.ecolecon.2015.01.010

Levins, S. C. and Franks, N. R. 1982. Patterns of nested dispersion in a tropical ground ant community. *Ecology*, **63**: 338–344

Longino, J. T.; Fernández, F. 2007. Taxonomic review of the genus *Wasmannia*. *In* Snelling, R. R., Fisher, B. L., Ward, P. S. (eds.) 2007. Advances in ant systematics (Hymenoptera: Formicidae): homage to E.O. Wilson – 50 years of contributions. Memoirs of the American Entomological Institute, 80: 690 pp.

Lowe S, Browne M, Boudjelas S. 2000. 100 of the world's worst invasive alien species. *Aliens*. **2000**, 1–12.

Lubin, Y.D. 1984. Changes in the native fauna of the Galápagos Islands following invasion by the little red fire ant, *Wasmannia auropunctata*. *Biological Journal of the Linnean Society*, **21**: 229-242.

Majer J, Delabie J. 1999. Impact of tree isolation on arboreal and ground ant communities in cleared pasture in the Atlantic rain forest region of Bahia, Brazil. *Insectes sociaux*, **46**: 281–90.

Mao, M., Chen, S., Ke, Z., Qian, Z., Xu, Y. 2022. Using MaxEnt to predict the potential distribution of the little fire ant (*Wasmannia auropunctata*) in China. *Insects*, **13**: 1008.

Mbenoun Masse, P. S., M. Tindo, M. Kenne, Z. Tadu, R. Mony, and C. Djieto-Lordon. 2017. Impact of the invasive ant *Wasmannia auropunctata* (Formicidae: Myrmicinae) on local ant diversity in southern Cameroon. *African Journal of Ecology*, **55**: 423-432. https://doi.org/10.1111/aje.12366

Meier, R.E. 1994. Coexisting patterns and foraging behavior of introduced and native ants (Hymenoptera Formicidae) in the Galapàgos Islands (Ecuador). *In* Williams, D. F. ed. Exotic ants: biology, impact, and control of introduced species. Boulder, Westview Press. pp. 44–62.

Michaud, J. P., Browning, H. W. 1999. Seasonal abundance of the brown citrus aphid, Toxoptera citricida, (Homoptera: Aphididae) and its natural enemies in Puerto Rico. *Florida Entomologist*, **82**: 424–447.

Mikheyen, A.S., Bresson, S., Conant, P. 2009. Single-queen introductions characterize regional and local invasions by the facultatively clonal little fire ant *Wasmannia auropunctata*. *Molecular Ecology*, **18**: 2937-2944. https://doi.org/10.1111/j.1365-294X.2009.04213.x.

Miyakawa, M.O. & Mikheyen, A.S. 2015. Males are here to stay: fertilization enhances viable egg production by clonal queens of the little fire ant (*Wasmannia auropunctata*). *Science of Nature*, **102**: 15. https://doi.org/10.1007/s00114-015-1265-8

Modlmeier, A.P., Foitzik, S., Scharf, I. 2013. Starvation endurance in the ant *Themnothorax nylanderi* depends on group size, body size and access to larvae. *Physiological Entomology*, **38**: 89-94. https://doi.org/10.1111/phen.12007

Montgomery, M.P., Vanderwoude, C., Lintermans, M., Jasmyn Lynch, A.J. 2022. The little fire ant (Hymenoptera: Formicidae): A global perspective. *Annals of the Entomological Society of America*, **115**: 427-448. https://doi.org/10.1093/aesa/saac016

Motoki, M., Lee, D.J., Vanderwoude, C., Nakamoto, S.T., Leung, P.S. 2013. A bioeconomic model of Little Fire Ant *Wasmannia auropunctata* in Hawaii. Technical Report No. 186. Pacific Cooperative Studies Unit, University of Hawaii, Honolulu, Hawaii. 89 pp.

Nauman, K. 1994. An occurrence of two exotic ant (Formicdae) species in British Columbia. *Journal Entomological Society of British Columbia*, **91**: 69-70.

Ness, J. & Bronstein, J.L. 2004. The effects of invasive ants on prospective ant mutualists. *Biological Invasions*, **6**: 445–461. https://doi.org/10.1023/B:BINV.0000041556.88920.dd

Newson, J., Vandermere, J., Perfecto, I. 2021. Differential effects of ants as biological control of the coffee berry borer in Puerto Rico. *Biological Control*, **160**: 104666. https://doi.org/10.1016/j.biocontrol.2021.104666

Ortiz-Alvarado, Y., Rivera-Marchand, B. 2020. Worker queens? Behavioural flexibility of queens in the little fire ant *Wasmannia auropunctata*. *Frontiers in Ecology and Evolution*, **8**: 241. https://doi.org/10.3389/fevo.2020.00241

Ortiz-Alvarado, Y., Fernández-Casas, R. Ortiz-Alvaracto, C.A., Diaz-Iglesias, E., Rivera-Marchand, B. 2021. Behavioural flexibility in *Wasmannia auropunctata* (Hymenoptera: Formicidae). *Journal of Insect Science*, **21**: 1-16. https://doi.org/10.1093/jisesa/ieab059

Perfecto, I., Hajian-Forooshani, Z., White, A., Vandermeer, J. 2021. Ecological complexity and contingency: Ants and lizards affect biological control of the coffee leaf miner in Puerto Rico. *Agriculture, Ecosystems & Environment*, **305**: 107104. https://doi.org/10.1016/j.agee.2020.107104

Perfecto, I., Vandermeer, J. 1996. Microclimate changes and the indirect loss of ant diversity in a tropical agroecosystem. *Oecologia*, **108**: 577-582.

Ramos, L.S., Marinho, C.G.S., Zanetti, R., Delabie, J.H.C., Schlindwein, E.M.N. 2003. Impact of formicid granulated baits on non-target ants in eucalyptus plantations according to two forms of application. *Neotropical Entomology*, **32**: 231–237.

Rey, O., Estoup, A, Vonshak, M., Loiseau, A., Blanchet, S., Calcaterra, L., Chifflet, L., Rossi, J-P., Kergoat, G.T., Foucaud, J., Orivel, J., Leponce, M., Schultz, T., Facon, B. 2012. Where do adaptive shifts occur during invasion? A multidisciplinary approach to unravelling cold adaptation in a tropical ant species invading the Mediterranean area. *Ecology Letters*, **15**: 1266-1275. https://doi.org/10.1111/j.1461-0248.2012.01849.x

Rey, O., Facon, B., Foucaud, J., Loiseau, A., Estoup, A. 2013. Androgenesis is a maternal trait in the invasive ant *Wasmannia auropunctata*. *Proceedings of the Royal Society B – Biological Sciences*, **280**: 20131181. https://doi.org/10.1098/rspb.2013.1181

Rojas, P. & Fragoso, C. 2021. A regional approach shows differences among invasive ants *Solenopsis geminata* and *Wasmannia auropunctata* (Hymenoptera: Formicidae) within its native range of distribution. *Journal of Insect Science*, **21**: 1-9. https://doi.org/10.1093/jisesa/ieab039

Roque Albelo, L., Causton, C. 1999. El Niño and introduced insects in the Galápagos Islands : different dispersal strategies, similar effects. *Noticias de Galápagos*, **60**: 30-36.

Rosselli, D., Wetterer, J.K. 2017. Stings of the ant *Wasmannia auropunctata* (Hymenoptera: Formicidae) as cause of punctate corneal lesions in humans and other animals. *Journal of Medical Entomology*, **54**: 1783-1785. https://doi.org/10.1093/jme/tjx167

Rosumek F.B. 2017. Natural history of ants: what we (do not) know about trophic and temporal niches of neotropical species. *Sociobiology*, **64** :244–255. https://doi.org/10.13102/sociobiology.v64i3.1623

Samuel, H. 2022. Dreaded 'little fire ant' detected in France for the first time. The Telegraph, 31 October 2022.

Santos, P.F., Fondeca, A.R., Sanches, N.M. 2009. Ants (Hymenoptera: Formicidae) as vectors for bacteria in two hospitals in the municipality of Divinopolis, State of Minas Gerais. *Revista da Sociedade Brasileira de Medicina Tropical*, **42**: 565-569.

Serge, M.M.P., Tindo, M., Dijiéto-Lordon, C., Kenne, M. 2019. Diversity of ant assemblages (Hymenoptera: Formicidae) in an urban environment in Cameroon during and after colonization of the area by *Wasmannia auropunctata*. *European Journal of Entomology*, **116**: 461-467. https://doi.org/10.14411/eje.2019.047

Smith, M.R. 1965. House-infesting ants of the eastern United States. USDA-ARS Technical Bulletin No. 1326. 105pp.

Solomon, S.E., Mikheyev, A.S. 2005. The ant (Hymenoptera: Formicidae) fauna of Cocos Island, Costa Rica. *Florida Entomologist*, **88**: 415-423.

Souza-Campana, D.R., Silva, R.R., Fernandez, T.T., de Morais Silva, O.G., Saad, L.P., de Castro Morini, M.S. 2017. Twigs in the leaf litter as habitats in different vegetation habitats in southeastern Brazil. *Tropical Conservation Science*, **2017**: 10.

Tennant, L.E. 1994. The ecology of *Wasmannia auropunctata* in primary tropical rainforest in Costa Rica and Panama.*In* Williams, D. F. (ed). Exotic ants: biology, impact, and control of introduced species: 332 pp. Westview Press, Boulder, Colorado, USA

Tindo, M., Mbenoun Masse, P.S., Kenne, M., Mony, R., Orivel, J., Fotio, A.D., Kuate, A.F., Djieto-Lordon, C., Fomena, A., Estoup, A., Dejean, A., Foucaud, J. 2012. Current distribution and population dynamics of the little fire ant supercolony in Cameroon. *Insectes Sociaux*, **59**: 175-182.

Torres, J.A., Snelling, R.R., Canals, M. 2001. Seasonal and nocturnal periodicities in ant nuptial flights in the tropics (Hymenoptera: Formicidae). *Sociobiology*, **37**: 601-626

Ulloa-Chacon, P., Cherix, D. 1990. The little fire ant. *Wasmannia auropunctata* (R.) (Hymenoptera: Formicidae). *In* Applied Myrmecology. A World Perspective. Vander Meer. R. , K. Jaffe and A. Cedeno eds. Westview Press. Boulder. San Francisco. and Oxford. pp 281 - 289.

Vandermeer, J., Perfecto, I. 2020. Ecological complexity and contingency: Ants and lizards affect biological control of the coffee leaf miner in Puerto Rico. *Proceedings of the Royal Society B – Biological Sciences*, **287**: 20202214.

Vanderwoude, C. 2014. Managing the impacts of the little fire ants (*Wasmannia auropunctata*) in French Polynesia. Technical Report by the Secretariat of the Pacific Regional Environment Programme for the Government of French Polynesia and Fonds Pacifique. https://doi.org/10.13140/RG.2.1.1932.7609

Vanderwoude, C., Montgomery, M.P., Forester, H., Hensley, E., Adachi, M.K. 2015. The history of little fire ants *Wasmannia auropunctata* Roger in the Hawaian Islands: spread, control, and local eradication. *Proceedings of the Hawaii Entomological Society*, **48**: 39–50.

Vonshak, M., Dayan, T., Foucaud, J., Estoup, A., & Hefetz, A. 2009a. The interplay between genetic and environmental effects on colony insularity in the clonal invasive little fire ant *Wasmannia auropunctata*. *Behavioral Ecology & Sociobiology*, **63**: 1667–1677. https://doi.org/10.1007/s00265-009-0775-9

Vonshak, M., Dayan, T., Hefetz, A. 2012. Interspecific displacement mechanism by the invasive little fire ant *Wasmannia auropunctata*. *Biological Invasions*, **14**: 851-861. https://doi.org/10.1007/s10530-011-0122-8

Vonshak, M., Dayan, T., Ionescu-Hirsh, A., Freidberg, A., Hefetz, A. 2009b. The little fire ant *Wasmannia auropunctata*: a new invasive species in the Middle East and its impact on the local arthropod fauna. *Biological Invasions*, **12**: 1825-1837. https://doi.org/10.1007/s10530-009-9593-2

Walker, K.L. 2006. Impact of the little fire ant *Wasmannia auropunctata*, on native forest ants in Gabon. *Biotropica*, **38**: 666-673. https://doi.org/10.1111/j.1744-7429.2006.00198.x

Walsh, P.D., Henschel, P., Abernethy, K.A., Tutin, E.G., Telfer, P. & Lahm, S.A. 2004. Logging Speeds Little Red Fire Ant Invasion of Africa. *Biotropica*, **36**, 641–646.

Way, M.J. & Khoo, K.C. 1992. Role of ants in pest management. *Annual Review of Entomology*, **37**: 479 -503.

Wetterer, J.K. 1997. Alien ants of the Pacific Islands. *Aliens*, **6**: 3-4.

Wetterer, J.K., Walsh, P.D., White, L.J.T. 1999. *Wasmannia auropunctata* (Roger) (Hymenoptera: Formicidae), a highly destructive tramp ant, in wildlife refuges of Gabon, West Africa. *African Entomology*, **7**: 292–294.

Wetterer, J.K., Porter, S. 2003. The little fire ant, *Wasmannia auropunctata*: Distribution, impact and control. *Sociobiology*, **41**: 1-41.

Williams, M.L. 1993. *Toumeyella lignumvitae*, a New Species of Scale Insect from the Florida Keys (Homoptera: Coccidae). *Florida Entomologist*, **76**: 566-572.

Yitbarex, S., Vandermeer, J.H., Perfecto, I. 2019. From insinator to dominator: foraging switching by an exotic ant. *Diversity and Distributions*, **23**: 820-827. https://doi.org/10.1111/ddi.12568