

Risk assessment template developed under the "Study on Invasive Alien Species – Development of risk assessments to tackle priority species and enhance prevention"
Contract No 090201/2021/856738/ETU/ENV.D2¹

Name of organism: *Brachyponera chinensis* (Emery, 1895)

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Risk Assessment Area: The risk assessment area is the territory of the European Union 27, excluding the EU-outermost regions.

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¹ This template is based on the Great Britain non-native species risk assessment scheme (GBNNRA). A number of amendments have been introduced to ensure compliance with Regulation (EU) 1143/2014 on IAS and relevant legislation, including the Delegated Regulation (EU) 2018/968 of 30 April 2018, supplementing Regulation (EU) No 1143/2014 of the European Parliament and of the Council with regard to risk assessments in relation to invasive alien species (see <https://eur-lex.europa.eu/legal-content/en/TXT/?uri=CELEX%3A32018R0968>).

Contents

SECTION A – Organism Information and Screening	3
SECTION B – Detailed assessment	11
1 PROBABILITY OF INTRODUCTION AND ENTRY	11
2 PROBABILITY OF ESTABLISHMENT	34
3 PROBABILITY OF SPREAD	41
4 MAGNITUDE OF IMPACT	54
RISK SUMMARIES	66
REFERENCES	68
Distribution Summary	72
ANNEX I Scoring of Likelihoods of Events	74
ANNEX II Scoring of Magnitude of Impacts	75
ANNEX III Scoring of Confidence Levels	76
ANNEX IV CBD pathway categorisation scheme	77
ANNEX V Ecosystem services classification (CICES V5.1, simplified) and examples	78
ANNEX VI EU Biogeographic Regions and MSFD Subregions	82
ANNEX VII Delegated Regulation (EU) 2018/968 of 30 April 2018	83
ANNEX VIII Species Distribution Model of <i>Brachyponera chinensis</i>	84

SECTION A – Organism Information and Screening

A1. Identify the organism. Is it clearly a single taxonomic entity and can it be adequately distinguished from other entities of the same rank?

including the following elements:

- the taxonomic family, order and class to which the species belongs;
- the scientific name and author of the species, as well as a list of the most common synonym names;
- names used in commerce (if any)
- a list of the most common subspecies, lower taxa, varieties, breeds or hybrids

As a general rule, one risk assessment should be developed for a single species. However, there may be cases where it may be justified to develop one risk assessment covering more than one species (e.g. species belonging to the same genus with comparable or identical features and impact). It shall be clearly stated if the risk assessment covers more than one species, or if it excludes or only includes certain subspecies, lower taxa, hybrids, varieties or breeds (and if so, which subspecies, lower taxa, hybrids, varieties or breeds). Any such choice must be properly justified.

Response:

Class: Insecta

Order: Hymenoptera

Family: Formicidae

Sub-family: Ponerinae

Genus: *Brachyponera*

Scientific name: *Brachyponera chinensis* (Emery, 1895) valid

Described by Emery (1895) as *Ponera nigrita* subsp. *chinensis*. Combination in *Euponera* (*Brachyponera*), Emery (1909); in *Brachyponera*, Brown (1958); in *Pachycondyla*, in Bolton (1995). *Brachyponera* revived from synonymy (Schmidt and Shattuck 2014). A comprehensive and regularly updated list can be found at www.antcat.org, (Taxonomic history provided by Barry Bolton, 2022; online catalogue: https://www.antwiki.org/wiki/Online_Catalogue_of_the_Ants_of_the_World). The Asian needle ant, *Brachyponera chinensis* (Emery, 1895) was until recently included under the genus *Pachycondyla* (Schmidt and Shattuck 2014).

Common English name: The Asian needle ant, also known as the “giant needle ant”, “oo-hari-ari” in Japan and Asiatische Nadelameise in German.

This assessment covers one species, *Brachyponera chinensis* (Emery, 1895). The taxon has no formal subspecies, lower taxa, varieties, breeds or hybrids.

A2. Provide information on the existence of other species that look very similar [that may be detected in the risk assessment area, either in the environment, in confinement or associated with a pathway of introduction]

Include both native and non-native species that could be confused with the species being assessed, including the following elements:

- other alien species with similar invasive characteristics, to be avoided as substitute species (in this case preparing a risk assessment for more than one species together may be considered);
- other alien species without similar invasive characteristics, potential substitute species;
- native species, potential misidentification and mis-targeting

Response: *Brachyponera chinensis* can be recognized by the following combination of characteristics: length of workers approximately 4.5–5.0 mm (queens 5.0–6.0 mm), dark brownish-black color with orangish-brown appendages, shiny mesopleural region, single waist segment, large conspicuous eyes, single petiolar node, and conspicuous stinger (MacGown 2009).

Brachyponera has more than 20 species in its genus, but only *B. chinensis* is present in Europe at present. Most species are found in Africa, Asia, and Australia with the highest species diversity in Southeast Asia. *Brachyponera chinensis* is part of a species complex which is very hard to distinguish. The identification of *B. chinensis* in its native range is challenging due to the presence of other morphologically similar species such as the cryptic species *Brachyponera nakasujii* (Yashiro et al. 2010). Molecular analysis or expert identification is required.

In the RA area, *B. chinensis* may be confused with species of the genera *Cryptopone* (one species), *Hypoconer* (five species) and *Ponera* (two species). However, they are all smaller than the Asian needle ant, their workers being between 2.5 and 3 mm long. Moreover, they all form small colonies of a few dozen individuals – polygynous colonies of *B. chinensis* can reach thousands of individuals (Zungoli and Benson 2008) – and are all relatively rare in Europe, but can be locally abundant (Lebas et al. 2016). Despite significant differences with the local myrmecofauna, its identification can be challenging and genetic analysis (DNA barcoding) may be performed (Menchetti et al. 2022).

Unlike most invasive ants, *B. chinensis* is a predatory ant and a termite specialist. There is no evidence that *B. chinensis* consumes nectar or hemipteran honeydew, often considered as one of the key factors that explains invasive ants' success. *Brachyponera chinensis* is also distinguished from other invasive ants by the absence of mass recruitment based on trail pheromones to collect food. Indeed, the species use what is called “tandem carrying”, which is one of the most simple recruitment strategies where one worker guides another to the food source (Guénard and Silverman 2011). This recruitment is context dependent and based on the type of food discovered and can be quickly adjusted as food quality changes.

A3. Does a relevant earlier risk assessment exist? Give details of any previous risk assessment, including the final scores and its validity in relation to the risk assessment area.

Response: The Asian needle ant has been assessed as part of the National Biosecurity Plan in Australia for the management of invasive ants (Environment and Invasives Committee 2019). This species has been classified as a high priority invasive species that should be considered for eradication if detected.

However due to the limited overlap in climatic and ecological conditions between Australia and the RA area, this assessment has limited relevance. No other risk assessment has been carried out for *B. chinensis*.

A4. Where is the organism native?

including the following elements:

- an indication of the continent or part of a continent, climatic zone and habitat where the species is naturally occurring
- if applicable, indicate whether the species could naturally spread into the risk assessment area

Response: The Asian needle ant is native and widespread in East Asia and can be quite common in some regions. It is present in Japan, China, Thailand, Vietnam, South and North Korea, Taiwan and Nepal (www.antmap.org, Guénard et al. 2018). However, the identification of *B. chinensis* can be challenging, and past confusion over its discrimination from other species still prevents a full understanding of its distribution in Asia (Guénard et al. 2018). *Brachyponera chinensis* nests in both disturbed sites and natural wooded habitats (Guénard and Dunn 2010; Rice and Silverman 2013). It typically nests in soil in slightly damp areas, below stones, in rotting logs and stumps, or other debris. In urban settings it might also be found under mulch, railroad ties, bricks, or other similar areas (Zungoli and Benson 2008; Park and Moon 2020).

A5. What is the global non-native distribution of the organism outside the risk assessment area?

Response: *Brachyponera chinensis* has been successful in spreading over several climatic zones (north temperate, north subtropical and tropical, www.antmaps.org). In the New world, the species has been established in 16 US states (Guénard et al. 2018). In the Old World, records of *B. chinensis* recently have been reported from four localities bordering the Russian and Georgian coasts of the Black Sea (Guénard et al. 2018).

A6. In which biogeographic region(s) or marine subregion(s) in the risk assessment area has the species been recorded and where is it established? The information needs be given separately for recorded (including casual or transient occurrences) and established occurrences. “Established” means the process of an alien species successfully producing viable offspring with the likelihood of continued survival².

A6a. Recorded: List regions

A6b. Established: List regions

² Convention on Biological Diversity, Decision VI/23

Freshwater / terrestrial biogeographic regions:

- Alpine, Atlantic, Black Sea, Boreal, Continental, Mediterranean, Pannonian, Steppic

Marine regions:

- Baltic Sea, North-east Atlantic Ocean, Mediterranean Sea, Black Sea

Marine subregions:

- Greater North Sea, incl. the Kattegat and the English Channel, Celtic Seas, Bay of Biscay and the Iberian Coast, Western Mediterranean Sea, Adriatic Sea, Ionian Sea, Central Mediterranean Sea, Aegean-Levantine Sea.

Comment on the sources of information on which the response is based and discuss any uncertainty in the response.

For delimitation of EU biogeographical regions please refer to <https://www.eea.europa.eu/data-and-maps/figures/biogeographical-regions-in-europe-2> (see also Annex VI).

For delimitation of EU marine regions and subregions consider the Marine Strategy Framework Directive areas; please refer to <https://www.eea.europa.eu/data-and-maps/data/msfd-regions-and-subregions/technical-document/pdf> (see also Annex VI).

Response (6a): Terrestrial biogeographic regions: Continental and Mediterranean (for details see question A8)

Response (6b): Terrestrial biogeographic regions: Mediterranean (for details see question A8).

A7. In which biogeographic region(s) or marine subregion(s) in the risk assessment area could the species establish in the future under current climate and under foreseeable climate change? The information needs be given separately for current climate and under foreseeable climate change conditions.

A7a. Current climate: List regions

A7b. Future climate: List regions

With regard to EU biogeographic and marine (sub)regions, see above.

With regard to climate change, provide information on

- the applied timeframe (e.g. 2050/2070)
- the applied scenario (e.g. RCP 4.5)
- what aspects of climate change are most likely to affect the risk assessment (e.g. increase in average winter temperature, increase in drought periods)

The assessment does not have to include a full range of simulations on the basis of different climate change scenarios, as long as an assessment with a clear explanation of the assumptions is provided. However, if new, original models are executed for this risk assessment, the following RCP pathways shall be applied: RCP 2.6 (likely range of 0.4-1.6°C global warming increase by 2065)

and RCP 4.5 (likely range of 0.9-2.0°C global warming increase by 2065). Otherwise, the choice of the assessed scenario has to be explained.

Response (7a):

- Alpine, Continental and Mediterranean according to Bertelsmeier et al. (2013). However, given the absence of a comprehensive list of suitable biogeographic areas in the risk assessment area and the low resolution of the world map provided, it is impossible to extract accurate data on species distribution from this publication. The amount of suitable landmass was estimated to be 3% for Europe in 2020.
- Alpine, Black Sea, Continental and Steppic according to a species distribution model (SDM) (see Annex VIII). However, the proportion of suitable grid cells is above 5% only in the Black Sea biogeographical region.

Response (7b):

- Mediterranean, Continental, Alpine, Pannonian and Atlantic in 2080 according to Bertelsmeier et al. (2013) (climatic suitability index above 0.5). The same limitations apply as mentioned in Qu. 7a. By 2080, the suitable landmass is expected to increase by 210% in Europe.
- Alpine, Black Sea, Continental, Mediterranean, Pannonian and Steppic according to SDM (see Annex VIII). The proportion of suitable grid cells increases for each biogeographical region, the Pannonian biogeographical region is the most suitable for *B. chinensis* (RCP 2.6 and 4.5).

Bertelsmeier et al. (2013), using a climate matching model (Maxent) based on present distributions, mapped suitable areas globally for *B. chinensis*. To consider a range of possible future climates, they used downscaled climate data from three GCMs: the CCCMA-GCM2 model; the CSIRO MK2 model; and the HCCPR-HADCM3 model (GIEC 2007). Similarly, they used the two extreme SRES: the optimistic B2a; and the pessimistic A2a scenario.

A number of underlying assumptions and inherent uncertainties are associated with the niche modelling approach and the actual distribution is contingent on many factors such as biotic interactions or other abiotic factors at a regional or global scale. For example, it is important to note that the species can find suitable climatic conditions to establish in urban areas located in unsuitable biogeographical zones.

A8. In which EU Member States has the species been recorded and in which EU Member States has it established? List them with an indication of the timeline of observations. The information needs be given separately for recorded and established occurrences.

A8a. Recorded: List Member States

A8b. Established: List Member States

Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden

The description of the invasion history of the species shall include information on countries invaded and an indication of the timeline of the first observations, establishment and spread.

Response (8a): Germany, Italy

The Asian needle ant has been recently recorded in southern Italy, in the region of Naples (Menchetti et al. 2022). Before that, it was intercepted in Hamburg and reported by Forel (1900) on plants imported from Japan. However, the identity could not be confirmed by Guénard et al. (2018).

Response (8b): Italy

To date, *B. chinensis* may have two established population in the risk assessment area. In 2020, one male was recorded in Naples (Italy) (Menchetti et al. 2022). More recently, an established population was found near Lake Como (Schifani et al. 2024) in Italy.

A9. In which EU Member States could the species establish in the future under current climate and under foreseeable climate change? The information needs be given separately for current climate and under foreseeable climate change conditions.

A9a. Current climate: List Member States

A9b. Future climate: List Member States

With regard to EU Member States, see above.

With regard to climate change, provide information on

- the applied timeframe (e.g. 2050/2070)
- the applied scenario (e.g. RCP 4.5)
- what aspects of climate change are most likely to affect the risk assessment (e.g. increase in average winter temperature, increase in drought periods)

The assessment does not have to include a full range of simulations on the basis of different climate change scenarios, as long as an assessment with a clear explanation of the assumptions is provided. However, if new, original models are executed for this risk assessment, the following RCP pathways shall be applied: RCP 2.6 (likely range of 0.4-1.6°C global warming increase by 2065) and RCP 4.5 (likely range of 0.9-2.0°C global warming increase by 2065). Otherwise, the choice of the assessed scenario has to be explained.

Response (9a):

- Austria, Croatia, France, Italy, Hungary, Slovenia, Spain, according to Bertelsmeier et al. (2013). The same limitations apply as mentioned in Qu. 7a regarding the confidence level in the list of suitable Member States.
- Italy and Slovenia according to the SDM (see Annex VIII).

Response (9b):

- Austria, Croatia, France, Germany, Italy, Hungary, Slovenia, Spain, according to Bertelsmeier et al. (2013) (Projection for 2080). The same limitations apply as mentioned in Qu. 7a regarding the confidence level in the list of suitable Member States.
- Austria, Bulgaria, Croatia, Czech Republic, France, Germany, Hungary, Italy, Poland, Romania, Slovakia, Slovenia and Spain, according to the SDM (see Annex VIII, RCP 2.6 and 4.5). Croatia, Hungary, Romania, and Slovenia have the highest proportion of grid cells suitable for *B. chinensis*, above 50% each.

It is important to note that the species can find suitable climatic conditions to establish in urban areas of EU countries identified as unsuitable. Moreover, its recent dispersal into northern and mountainous areas in the USA (e.g., Rhode Island and Indiana) causes some concern regarding its adaptation to cold temperatures (Waters et al. 2022).

A10. Is the organism known to be invasive (i.e. to threaten or adversely impact upon biodiversity and related ecosystem services) anywhere outside the risk assessment area?

Response: Yes. It is one of the invasive ants that have successfully spread even though its distribution is currently limited to Asia and the USA. It has ecological (Rodriguez-Cabal et al. 2012; Rice and Silverman 2013), and human health impacts (Nelder et al. 2006).

A11. In which biogeographic region(s) or marine subregion(s) in the risk assessment area has the species shown signs of invasiveness? Indicate the area endangered by the organism as detailed as possible.

Freshwater / terrestrial biogeographic regions:

- Alpine, Atlantic, Black Sea, Boreal, Continental, Mediterranean, Pannonian, Steppic

Marine regions:

- Baltic Sea, North-east Atlantic Ocean, Mediterranean Sea, Black Sea

Marine subregions:

Greater North Sea, incl. the Kattegat and the English Channel, Celtic Seas, Bay of Biscay and the Iberian Coast, Western Mediterranean Sea, Adriatic Sea, Ionian Sea, Central Mediterranean Sea, Aegean-Levantine Sea

Response: *Brachyponera chinensis* showed no signs of invasiveness in the risk assessment area yet. Only one individual (a male) and one established population have been detected so far (Menchetti et al. 2022, Schifani et al. 204).

A12. In which EU Member States has the species shown signs of invasiveness? Indicate the area endangered by the organism as detailed as possible.

Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden

Response: None.

A13. Describe any known socio-economic benefits of the organism.

including the following elements:

- Description of known uses for the species, including a list and description of known uses in the risk assessment area and third countries, if relevant.
- Description of social and economic benefits deriving from those uses, including a description of the environmental, social and economic relevance of each of those uses and an indication of associated beneficiaries, quantitatively and/or qualitatively depending on what information is available.

If the information available is not sufficient to provide a description of those benefits for the entire risk assessment area, qualitative data or different case studies from across the risk assessment area or third countries shall be used, if available.

Response: There are no known socio-economic benefits of the species.

SECTION B – Detailed assessment

Important instructions:

- In the case of lack of information the assessors are requested to use a standardized answer: “No information has been found.” In this case, no score and confidence should be given and the standardized “score” is N/A (not applicable).
- With regard to the scoring of the likelihood of events or the magnitude of impacts see Annexes I and II.
- With regard to the confidence levels, see Annex III.
- Highlight the selected response score and confidence level in **bold** but keep the other scores in normal text (so that the selected score is evident in the final document).

1 PROBABILITY OF INTRODUCTION AND ENTRY

Important instructions:

- **Introduction** is the movement of the species into the risk assessment area (it may be either in captive conditions and/or in the environment, depending on the relevant pathways).
- **Entry** is the release/escape/arrival in the environment, i.e. occurrence in the wild
- Introduction and entry may coincide for species entering through pathways such as “corridor” or “unaided”, but it also may differ. If different, please consider all relevant pathways, both for the introduction into the risk assessment area and the entry in the environment.
- For each described pathway, in each of the questions below, ensure that there are separate comments explicitly addressing both the “introduction” and “entry” where applicable and as appropriate. The classification of pathways developed by the Convention of Biological Diversity (CBD) should be used (see Annex IV). For detailed explanations of the CBD pathway classification scheme consult the IUCN/CEH guidance document³ and the provided key to pathways⁴.
- For organisms which are already present (recorded or established) in the risk assessment area, the likelihood of introduction and entry should be scored as “very likely” by default.
- Repeated (independent) introductions and entries at separate locations in the risk assessment area should be considered here (see Qu. 1.7).

Qu. 1.1. List relevant pathways through which the organism could be introduced into the risk assessment area and/or enter into the environment. Where possible give details about the specific origins and end points of the pathways as well as a description of any associated commodities.

³ <https://op.europa.eu/en/publication-detail/-/publication/f8627bbc-1f15-11eb-b57e-01aa75ed71a1>

⁴ <https://circabc.europa.eu/sd/a/0aeba7f1-c8c2-45a1-9ba3-bcb91a9f039d/TSSR-2016-010%20CBD%20pathways%20key%20full%20only.pdf>

For each pathway answer questions 1.2 to 1.8 (copy and paste additional rows at the end of this section as necessary). Please attribute unique identifiers to each question if you consider more than one pathway, e.g. 1.2a, 1.3a, etc. and then 1.2b, 1.3b etc. for the next pathway.

In this context a pathway is the route or mechanism of introduction and/or entry of the species.

The description of commodities with which the introduction of the species is generally associated shall include a list and description of commodities with an indication of associated risks (e.g. the volume of trade; the likelihood of a commodity being contaminated or acting as vector).

If there are no active pathways or potential future pathways this should be stated explicitly here, and there is no need to answer the questions 1.2-1.9.

Pathway name:

- a) Transport-Stowaway (Hitchhikers in or on airplane).
- b) Transport-Stowaway (Hitchhikers in vehicles)
- c) Transport-Stowaway (nests transported in container/bulk, including sea freight, airfreight, train, etc.)
- d) Transport-Contaminant (nursery material and other materials from horticultural trade)
- e) Transport-Contaminant (Transportation of habitat material (soil, vegetation, wood, ...))
- f) Pet trade (online market)

Brachyponera chinensis is considered one of the classic tramp ant species, due to its reliance on human-mediated dispersal and close association with humans (Hölldobler and Wilson 1990). It can hitchhike with many commodities through many pathways. However, only the introduction and entry of queen ants and nests present a risk of establishment. The species was intercepted “on Prunus” at the port of Hamburg (DE) in 1900 (Forel 1900). However, the species identity of the intercepted individuals could not be confirmed by Guénard et al. (2018). Queens may be introduced into the risk assessment area through the increasing online ant trade. As there is no evidence that this has happened, we here consider this pathway as currently not active.

Pathway name: Transport-Stowaway (Hitchhikers in or on airplane).

Qu. 1.2a. Is introduction and/or entry along this pathway intentional (e.g. the organism is imported for trade) or unintentional (e.g. the organism is a contaminant of imported goods)?

RESPONSE	intentional	CONFIDENCE	low
	unintentional		medium
			high

Response: This pathway concerns only newly mated queens. Indeed, it is very unlikely that a complete nest with queens and workers will travel in or on an airplane without being transported in containers or nursery materials.

Qu. 1.3a. How likely is it that large numbers of the organism will be introduced and/or enter into the environment through this pathway from the point(s) of origin over the course of one year?

including the following elements:

- discuss how likely the organism is to get onto the pathway in the first place. Also comment on the volume of movement along this pathway.
- an indication of the propagule pressure (e.g. estimated volume or number of individuals / propagules, or frequency of passage through pathway), including the likelihood of reinvasion after eradication
- if relevant, comment on the likelihood of introduction and/or entry based on propagule pressure (i.e. for some species low propagule pressure (1-2 individuals) could result in subsequent establishment whereas for others high propagule pressure (many thousands of individuals) may not.

RESPONSE	very unlikely unlikely moderately likely likely very likely	CONFIDENCE	low medium high
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Response: No data are available to estimate the role of propagule pressure on the likelihood of introduction, but because *B. chinensis* reproduce through nuptial flights (Yashiro et al. 2010; Guénard et al. 2018), propagule pressure might be moderate. There is little information about the introduction of ants in general via stowaways on airplanes. It must be assumed that more species and higher numbers of specimens are traveling with cargo airplanes, but in comparison with ships, this pathway probably is quantitatively less relevant. The score is moderate (because colonies of *B. chinensis* tend to be smaller than those of other invasive ants (Vargo et al. 2016) and therefore may produce less alates. Confidence is low as no queen has yet been intercepted in Europe. The likelihood of reinvasion after eradication is identical to the likelihood of introduction in the first place.

Qu. 1.4a. How likely is the organism to survive, reproduce, or increase during transport and storage along the pathway (excluding management practices that would kill the organism)?

RESPONSE	very unlikely unlikely moderately likely likely	CONFIDENCE	low medium high
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	very likely		
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Response: Both in their native and introduced ranges queens have independent colony foundation (nuptial flights) (Gotoh and Ito 2008), the queens are likely to be able to survive several tens of days using their own reserves before the first workers emerge (Hölldobler and Wilson 1990). It seems that colonies are founded by a single queen and become secondarily polygyne by adding queens that stay within the natal nest and that the seasonal changes associated with queen number involve queens produced within the natal nest (Vargo et al. 2016). This will increase chances of survival during periods of transport.

Brachyponera chinensis has an inflexible and relatively low ability to tolerate cold temperatures (Warren et al. 2020), which may reduce its survival during journeys in the cargo hold of an aircraft. The minimum temperature tolerance of *Brachyponera chinensis* is 6.3 ± 0.2 °C (mean \pm SE) (Warren et al. 2020). Therefore, it may be a limiting factor along this pathway if the ant is transported in cold conditions. The likelihood of survival will thus decrease with increasing travel duration and cold temperature, but survival is should be possible for journeys over several days. Multiplication and the establishment of a small nest during such an intercontinental flight however is highly unlikely.

Qu. 1.5a. How likely is the organism to survive existing management practices before and during transport and storage along the pathway?

RESPONSE	N/A	CONFIDENCE	low medium high
	very unlikely unlikely moderately likely likely very likely		

Response: N/A. There are no management practices in place against hitchhiking ants or ant queens in or on airplanes.

Qu. 1.6a. How likely is the organism to be introduced into the risk assessment area or entry into the environment undetected?

Please note that “detection” here is considered as any system or event that may actively contribute to record the presence of a species in a way that appropriate management measures could be potentially undertaken by relevant authorities.

RESPONSE	very unlikely unlikely moderately likely	CONFIDENCE	low medium high

	likely very likely		
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Response: Importation via this pathway is not likely to be detected by current official surveillance. Due to their small size, ants are not easy to detect and detection rate thus will be low. At the global scale, the number of introduced ant species in temperate regions is considered to be three and half times higher than the number so far detected (Miravete et al. 2014). Likelihood of detection in the environment is low as well, as there is no targeted or standardized ant monitoring in place in the risk assessment area.

Qu. 1.7a. How isolated or widespread are possible points of introduction and/or entry into the environment in the risk assessment area?

RESPONSE	isolated widespread ubiquitous	CONFIDENCE	low medium high
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Response: Due to the high volumes of air traffic between the native range in East Asia and the introduced range in the USA with the RA area, points of introduction and entry into the environment are widespread in the RA area.

Qu. 1.8a. Estimate the overall likelihood of introduction into the risk assessment area based on this pathway?

RESPONSE	very unlikely unlikely moderately likely likely very likely	CONFIDENCE	low medium high
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Response: The likelihood is noted as moderately likely because the number of queen ants travelling by this route is expected to be moderate, despite the species is widespread in areas that have significant traffic with the RA area. The duration of the transport would not affect the survival of the queen. No specific data are available for *B. chinensis* which constrains the confidence to low.

Pathway name: Transport-Stowaway (Hitchhikers in vehicles).

Qu. 1.2b. Is introduction and/or entry along this pathway intentional (e.g. the organism is imported for trade) or unintentional (e.g. the organism is a contaminant of imported goods)?

RESPONSE	intentional unintentional	CONFIDENCE	low medium high
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Response: This pathway concerns only newly mated queens introduced from Russia and Georgia along the eastern coast of the Black Sea. Indeed, it is very unlikely that a complete nest with queens and workers will travel in vehicles without being transported in goods. It also is very unlikely that the species will be introduced along this pathway from the native range in Asia.

Qu. 1.3b. How likely is it that large numbers of the organism will be introduced and/or enter into the environment through this pathway from the point(s) of origin over the course of one year?

including the following elements:

- discuss how likely the organism is to get onto the pathway in the first place. Also comment on the volume of movement along this pathway.
- an indication of the propagule pressure (e.g. estimated volume or number of individuals / propagules, or frequency of passage through pathway), including the likelihood of reinvasion after eradication
- if relevant, comment on the likelihood of introduction and/or entry based on propagule pressure (i.e. for some species low propagule pressure (1-2 individuals) could result in subsequent establishment whereas for others high propagule pressure (many thousands of individuals) may not.

RESPONSE	very unlikely unlikely moderately likely likely very likely	CONFIDENCE	low medium high
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Response: No data are available to estimate the role of propagule pressure on the likelihood of introduction. But even if *B. chinensis* reproduces through nuptial flights (Yashiro et al. 2010; Guénard et al. 2018), propagule pressure might be low. Indeed, areas from which the species could be introduced in vehicles is currently limited to the few locations around the Black Sea. We did not find documented examples of exotic ants being introduced by land vehicles crossing borders. The likelihood of reinvasion after eradication is identical to the likelihood of introduction in the first place.

Qu. 1.4b. How likely is the organism to survive, reproduce, or increase during transport and storage along the pathway (excluding management practices that would kill the organism)?

RESPONSE	very unlikely unlikely moderately likely likely very likely	CONFIDENCE	low medium high
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Response: As presented in Qu. 14a, the queens are likely to be able to survive several tens of days using their own reserves before the first workers emerge (Hölldobler and Wilson 1990). This will increase chances of survival during periods of transport. The likelihood of survival will thus decrease with increasing travel duration, but survival is possible for journeys over several days. Multiplication and the establishment of a small nest along this pathway is highly unlikely.

Qu. 1.5b. How likely is the organism to survive existing management practices before and during transport and storage along the pathway?

RESPONSE	N/A very unlikely unlikely moderately likely likely very likely	CONFIDENCE	low medium high
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Response: N/A. There are no management practices in place against hitchhiking ants or ant queens in or on vehicles.

Qu. 1.6b. How likely is the organism to be introduced into the risk assessment area or entry into the environment undetected?

Please note that “detection” here is considered as any system or event that may actively contribute to record the presence of a species in a way that appropriate management measures could be potentially undertaken by relevant authorities.

RESPONSE	very unlikely unlikely moderately likely likely	CONFIDENCE	low medium high
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	very likely		
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Response: Importation via this pathway is not likely to be detected. As mentioned in Qu. 1.6a, detection rates for solitary queens or even several queens are low. In general, ants are not easy to detect. Likelihood of detection in the environment is low as well, as there is no targeted or standardized ant monitoring in place in the risk assessment area.

Qu. 1.7b. How isolated or widespread are possible points of introduction and/or entry into the environment in the risk assessment area?

RESPONSE	isolated widespread ubiquitous	CONFIDENCE	low medium high
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Response: Virtually everywhere in the risk assessment area.

Qu. 1.8b. Estimate the overall likelihood of introduction into the risk assessment area based on this pathway?

RESPONSE	very unlikely unlikely moderately likely likely very likely	CONFIDENCE	low medium high
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Response: The likelihood is noted as moderately likely because the number of queen ants travelling in vehicles is expected to be limited, as potential sources of introduction along this pathway are currently restricted to few areas in Russia and Georgia. However, no specific data are available for *B. chinensis* which constrains our confidence to medium.

Pathway name: Transport-Stowaway (nests transported in container/bulk, including sea freight, airfreight, train, etc.)

Qu. 1.2c. Is introduction and/or entry along this pathway intentional (e.g. the organism is imported for trade) or unintentional (e.g. the organism is a contaminant of imported goods)?

RESPONSE	intentional	CONFIDENCE	low
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	unintentional		medium high
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Response: This section includes travelling nests that are not directly associated with the horticultural trade. Virtually any article of commerce can host hitchhiking nests of all sizes and ages, including newly-founded colonies and fully developed colonies (e.g. Suhr et al. 2019). A free volume of 10ml should be sufficient for an incipient colony composed of a queen and a dozen of workers. Ants sold on the commercial market are usually shipped in tubes of a few milliliters.

Qu. 1.3c. How likely is it that large numbers of the organism will be introduced and/or enter into the environment through this pathway from the point(s) of origin over the course of one year?

including the following elements:

- discuss how likely the organism is to get onto the pathway in the first place. Also comment on the volume of movement along this pathway.
- an indication of the propagule pressure (e.g. estimated volume or number of individuals / propagules, or frequency of passage through pathway), including the likelihood of reinvasion after eradication
- if relevant, comment on the likelihood of introduction and/or entry based on propagule pressure (i.e. for some species low propagule pressure (1-2 individuals) could result in subsequent establishment whereas for others high propagule pressure (many thousands of individuals) may not.

RESPONSE	very unlikely unlikely moderately likely likely very likely	CONFIDENCE	low medium high
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Response: There are very limited data on ant nests arriving in Europe. Sea containers and all articles of commerce cited above are considered as one of the main sources of transport for alien ants to Europe (Rabitsch and Blight 2021). In Australia, 16 of the 46 interceptions of *Solenopsis geminata* were in containers including empty ones, and one on Aircraft (Department of Agriculture, Fisheries and Forestry, Canberra cited in Harris et al. 2005). At New Zealand borders, *S. geminata* were intercepted in four empty containers for a total of 54 interception records (Harris et al. 2005). Similarly, interceptions in empty containers or with various non-plant products accounted for 62% of the total interceptions of *Anoplolepis gracilipes* (Abbott et al. 2005) and 25% for *Paratrechina longicornis* in New Zealand (Harris et al. 2005). At Gaoming port (China), interceptions in containers, waste hardware and plastics accounted for 2.1%, 20.4% and 6.6% of the total interceptions, respectively (Yang et al. 2019).

Ant nests might travel along the pathway in large numbers as stowaways in containers or other bulk freight, including soil, fruits and vegetables.

Both multiple queened (polygyne) and single queened (monogyne) colonies occur. Among the 134 queenright nests studied by Gotoh and Ito (2008), 38 had several mated queens and the remaining 96 nests were monogynous. The nesting system seemed to be polydomous: 266 of 400 nests collected by Gotoh and Ito (2008) were queenless. The number of queenless nests increased during the reproductive season. Colony size ranges from less than 100 individuals to many thousand (Murata et al. 2017), and large numbers of ants could be transported with this pathway.

Yashiro et al. (2010) proposed that Gotoh and Ito (2008) conducted their studies on a newly described cryptic species, *B. nakasujii*. It should be noted that Yashiro et al. (2010) did not compare physical specimens collected from their study with specimens identified by Gotoh and Ito (2008) as *B. chinensis*. Therefore, some of the information presented by Gotoh and Ito (2008) could pertain to *B. chinensis*.

The movement of large numbers of workers increases colony survival. However, it is of less concern compared to mated queens as workers do not reproduce (Gotoh and Ito 2008). The likelihood of reinvasion after eradication is identical to the likelihood of introduction in the first place.

Qu. 1.4c. How likely is the organism to survive, reproduce, or increase during transport and storage along the pathway (excluding management practices that would kill the organism)?

RESPONSE	very unlikely unlikely moderately likely likely very likely	CONFIDENCE	low medium high
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Response: The chances of queens surviving transport along this pathway is very likely as workers will feed them. The survival is very likely even for journeys that last several weeks or even months. Despite *B. chinensis* has a specialist diet (termite predator), it seems to diversify its diet in its introduced range preying on other insects (Bednar et al. 2013; Suehiro et al. 2017). Therefore, they are very likely to find food during transport. Groups of active workers with queens are able to survive a few weeks with no food (e.g. *Temnothorax rugatulus*, Rueppell and Kirkman 2005). In the case they do not find food resources they can eat their eggs and larvae. This may also happen in the Asian needle ant.

Brachyponera chinensis exhibits an inflexible and relatively poor ability to tolerate cold temperatures (<6°C) (Warren et al. 2020). Similarly, they suffered from 70% of mortality when exposed at 26°C for six weeks (Rice and Silverman 2013). Therefore, climatic conditions may be a limiting factor along this pathway if shipments are transported under cold or warm conditions. Though the likelihood of survival is high, this will decrease with increasing travel duration. Multiplication of a small nest during intercontinental translocation however is probably unlikely and will depend on the availability of resources.

Qu. 1.5c. How likely is the organism to survive existing management practices before and during transport and storage along the pathway?

RESPONSE	very unlikely unlikely moderately likely likely very likely	CONFIDENCE	low medium high
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Response: To our knowledge, no specific measures are currently undertaken during the transport of commodities into the risk assessment area to prevent ant introductions.

Qu. 1.6c. How likely is the organism to be introduced into the risk assessment area or entry into the environment undetected?

Please note that “detection” here is considered as any system or event that may actively contribute to record the presence of a species in a way that appropriate management measures could be potentially undertaken by relevant authorities.

RESPONSE	very unlikely unlikely moderately likely likely very likely	CONFIDENCE	low medium high
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Response: Many of these commodities are not carefully inspected. Time and human resources currently devoted to detect harmful organisms are unequal among Member States of the EU. As an example, in Member States that inspected at least 500 consignments, the rate of detection of pests in general ranged from 6.9% in Austria and France to 0.0% in Spain and Poland (Eyre et al. 2018). Eyre et al. (2018) estimated that “if this difference in detection rate is the result of differences in the methods and intensity of inspection in different member states then an approximate sevenfold increase in the interception of harmful organisms may be achieved if all states were to achieve detection rates achieved by Austria and France.”

While established nests are usually obvious, small nests are often inconspicuous. Newly-founded nests with a queen and workers could easily arrive undetected. The relatively small size of both queens (5-6 mm) and workers (4-5 mm) makes the detection of this species difficult. A free volume of 10ml should be sufficient for an incipient colony composed of a queen and a dozen workers, making their detection almost impossible. The probability is high but the confidence is scored medium because no direct data are available for *B. chinensis* travelling by this pathway.

Qu. 1.7c. How isolated or widespread are possible points of introduction and/or entry into the environment in the risk assessment area?

RESPONSE	isolated widespread ubiquitous	CONFIDENCE	low medium high
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Response: Due to the high trade volumes between the native range in East Asia and the introduced range in the USA with the RA area, points of introduction and entry into the environment are widespread in the RA area.

Qu. 1.8c. Estimate the overall likelihood of introduction into the risk assessment area and/or entry into the environment based on this pathway?

RESPONSE	very unlikely unlikely moderately likely likely very likely	CONFIDENCE	low medium high
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Response: Given the high numbers and multiple types of containers, commodities and items that can be associated with this pathway, and the high volume of trade between the native and introduced ranges with the RA area, this pathway can be considered as having a high likelihood of introduction. However, no specific data are available for *B. chinensis* which constrains our confidence to medium.

Pathway name: Transport-Contaminant (nursery material and other material from the horticultural trade)

Qu. 1.2d. Is introduction and/or entry along this pathway intentional (e.g. the organism is imported for trade) or unintentional (e.g. the organism is a contaminant of imported goods)?

RESPONSE	intentional unintentional	CONFIDENCE	low medium high
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Response: This applies both to new colonies consisting of a few workers and a queen, and to fully developed nests (with active workers and several queens) transported in nursery stock by the horticultural trade.

Qu. 1.3d. How likely is it that large numbers of the organism will be introduced and/or enter into the environment through this pathway from the point(s) of origin over the course of one year?

including the following elements:

- discuss how likely the organism is to get onto the pathway in the first place. Also comment on the volume of movement along this pathway.
- an indication of the propagule pressure (e.g. estimated volume or number of individuals / propagules, or frequency of passage through pathway), including the likelihood of reinvasion after eradication
- if relevant, comment on the likelihood of introduction and/or entry based on propagule pressure (i.e. for some species low propagule pressure (1-2 individuals) could result in subsequent establishment whereas for others high propagule pressure (many thousands of individuals) may not.

RESPONSE	very unlikely unlikely moderately likely likely very likely	CONFIDENCE	low medium high
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Response: There are very limited data on ant nests arriving through the horticultural trade in Europe. In Germany, *B. chinensis* was intercepted in Hamburg and reported by Forel (1900) on plants imported from Japan. However, the species identity could not be confirmed by Guénard et al. (2018). The species was also intercepted on imported plants in the US (Brown in 1965, cited in Guénard et al. (2018)). Since 1920, 11 interceptions (0.6 % of total interceptions) at ports and airports in US were from nursery material (*Citrus aurantifolia*) imported from Japan (Blight et al., unpublished data).

Ants are not listed as quarantine pests in the EU (Rabitsch & Blight 2021) and, therefore, records rarely appear in the national and international lists of intercepted pests. However, millions of plants arrive in Europe with soil or in pots (with substrates) from infested areas (East and South Asia, and the USA) every year. Although, the soil/substrate is supposed to be sterile, infestation by ants can occur just before or during transport. The European Union (EU) imports a large volume and diversity of plants for planting every year, and the value of imported plants for planting has increased 60% over the past fifteen years (Eschen et al. 2015). For example, in the period 2013-2017, the annual volume of EU imports from the US of live plants (CN code 0602) varied between 3,000 and 5,200 tonnes with value between 11 and 16 million euro.

Like many invasive alien ants, *B. chinensis* is a generalist in its nest location requirements. It nests in the ground in somewhat damp areas, including under stones, in decaying trunks and stumps, or in other

debris (Guénard and Dunn 2010), thus increasing its likelihood of being introduced with the horticultural trade.

As presented above (Qu. 1.3b), polygynous nests can reach high densities increasing the chances of a large number of nests (group composed of workers and one or several queens) to be transported from the native or invaded area. Flower pots are one of the preferred habitats for alien ants in invaded regions (e.g. Suhr et al. 2019), in particular because of their humidity and because they are usually in contact with the ground. Other horticultural material such as mulch, hay and other plant material can also harbour ant nests.

Potted plants and plant materials are often planted or stored in, or close to, highly suitable habitats, such as gardens, parks, road sides, etc. It is expected that the distribution of these media will facilitate occurrences in urban, suburban and agricultural habitats. The likelihood of reinvasion after eradication is identical to the likelihood of introduction in the first place.

Qu. 1.4d. How likely is the organism to survive, reproduce, or increase during transport and storage along the pathway (excluding management practices that would kill the organism)?

RESPONSE	very unlikely unlikely moderately likely likely very likely	CONFIDENCE	low medium high
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Response: This pathway allows a colony to travel in good conditions by providing habitat and food. The survival probability is very high even for journeys that last several weeks or even months. Groups of active workers with queens are able to survive a few weeks with no food (e.g. *Temnothorax rugatulus*, Rueppell and Kirkman 2005). In the case they do not find food resources they can eat their eggs and larvae (Rueppell and Kirkman 2005). This may happen for the Asian needle ant that, despite a diet that can include dead insects (Suehiro et al. 2017), is a termite predator (Bednar et al. 2013).

Brachyponera chinensis exhibits an inflexible and relatively poor ability to tolerate cold temperatures (Warren et al. 2020). Similarly, they suffered from 70% of mortality when exposed at 26°C for six weeks (Rice and Silverman 2013). Temperature may be a limiting factor along this pathway if shipments are transported under cold or warm conditions. However, as plants require specific temperatures, this is likely to be moderated during shipment to accommodate temperatures matching the origin.

Qu. 1.5d. How likely is the organism to survive existing management practices before and during transport and storage along the pathway?

RESPONSE	very unlikely	CONFIDENCE	low
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	unlikely moderately likely likely very likely		medium high
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Response: Horticulture plants and soils/substrates are often chemically treated before shipment but there are no known existing management practices during transport and storage under current regulations. Horticultural plants and soils/substrates can be infested after treatment either before departure or during transport. There is little information available on management during transport or its efficacy, hence the low score for confidence.

Qu. 1.6d. How likely is the organism to be introduced into the risk assessment area or entry into the environment undetected?

Please note that “detection” here is considered as any system or event that may actively contribute to record the presence of a species in a way that appropriate management measures could be potentially undertaken by relevant authorities.

RESPONSE	very unlikely unlikely moderately likely likely very likely	CONFIDENCE	low medium high
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Response: Fully developed nests can be detected, although the workers are of a dark brown-black color which can make them more difficult to detect on the soil of potted plants. However, a small, newly-founded colony of a queen(s) and workers in the soil/substrate can easily arrive undetected.

Qu. 1.7d. How isolated or widespread are possible points of introduction and/or entry into the environment in the risk assessment area?

RESPONSE	isolated widespread ubiquitous	CONFIDENCE	low medium high
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Response: Due to the high plant trade volumes between the native range in East Asia and the introduced range in the USA with the RA area, points of introduction and entry into the environment are ubiquitous in the RA area.

Qu. 1.8d. Estimate the overall likelihood of introduction into the risk assessment area based on this pathway?

RESPONSE	very unlikely unlikely moderately likely likely very likely	CONFIDENCE	low medium high
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Response: Given the high numbers of horticulture items imported into the RA area each year from infested areas, the probability of introduction along this pathway is likely. Trade of plants for horticulture represents an important part of EU imports, increasing chances of alien species introduction and particularly ants. In 2020, the total import value of live trees and other plants accounted for 2 billion euros (www.ec.europa.eu). However, no specific data are available for *B. chinensis* which constrains our confidence to medium.

Pathway name: Transport-Contaminant (Transportation of habitat material (soil, vegetation, wood, ...))

Qu. 1.2e. Is introduction and/or entry along this pathway intentional (e.g. the organism is imported for trade) or unintentional (e.g. the organism is a contaminant of imported goods)?

RESPONSE	intentional unintentional	CONFIDENCE	low medium high
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Response: This concerns both incipient colonies of workers and a queen, and fully developed nests (with active workers and multiple queens) transported in soil, vegetation or wood, provided as habitat material.

Qu. 1.3e. How likely is it that large numbers of the organism will be introduced and/or enter into the environment through this pathway from the point(s) of origin over the course of one year?

including the following elements:

- discuss how likely the organism is to get onto the pathway in the first place. Also comment on the volume of movement along this pathway.

- an indication of the propagule pressure (e.g. estimated volume or number of individuals / propagules, or frequency of passage through pathway), including the likelihood of reinvasion after eradication
- if relevant, comment on the likelihood of introduction and/or entry based on propagule pressure (i.e. for some species low propagule pressure (1-2 individuals) could result in subsequent establishment whereas for others high propagule pressure (many thousands of individuals) may not.

RESPONSE	very unlikely unlikely moderately likely likely very likely	CONFIDENCE	low medium high
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Response: There are very limited data on ant nests arriving in Europe. An established population has recently been identified in northern Italy (Schifani et al. 2024), but there is no information on the nest size or propagule pressure (Menchetti et al. 2022). Nests are likely to be transported if the soil, vegetation or wood of infested sites are moved into Europe. However, the volume of such trade remains unknown, and the likelihood of the introduction of infested habitat from overseas is probably very low.

As presented above (Qu. 1.3b), polygynous nests can reach high densities, which increases the chances of a large number of nests (group composed of workers and one or several queens) being transported from the native or invaded area into the RA area. Habitat materials are often deposited in, or close to, highly suitable habitats, such as gardens, parks, roadsides, etc. It is expected that the distribution of these media will facilitate occurrences in urban, suburban and agricultural habitats. The likelihood of reinvasion after eradication is identical to the likelihood of introduction in the first place.

Qu. 1.4e. How likely is the organism to survive, reproduce, or increase during transport and storage along the pathway (excluding management practices that would kill the organism)?

RESPONSE	very unlikely unlikely moderately likely likely very likely	CONFIDENCE	low medium high
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Response: The chances of queens surviving transport along this pathway is very likely as workers will feed them. The survival is very likely even for journeys that last several weeks or even months. Despite *B. chinensis* having a specialist diet (termite predator), it seems to diversify its diet in its introduced range preying on other insects (Bednar et al. 2013; Suehiro et al. 2017). Therefore, they are likely to find food during transport. Groups of active workers with queens are able to survive a few weeks with no food (e.g. *Temnothorax rugatulus*, Rueppell and Kirkman 2005). If they do not find food resources they can eat their eggs and larvae. This may also happen for the Asian needle ant.

Brachyponera chinensis exhibits an inflexible and relatively poor ability to tolerate cold temperatures (Warren et al. 2020). Similarly, they suffered from 70% of mortality when exposed at 26°C for six weeks (Rice and Silverman 2013). Temperature may be a limiting factor along this pathway if habitat material is transported under cold or warm conditions. Though the likelihood of survival is high, this will decrease with increasing travel duration.

Qu. 1.5e. How likely is the organism to survive existing management practices before and during transport and storage along the pathway?

RESPONSE	very unlikely unlikely moderately likely likely very likely	CONFIDENCE	low medium high
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Response: There is no information available on management during transport or its efficacy along this pathway.

Qu. 1.6e. How likely is the organism to be introduced into the risk assessment area or entry into the environment undetected?

Please note that “detection” here is considered as any system or event that may actively contribute to record the presence of a species in a way that appropriate management measures could be potentially undertaken by relevant authorities.

RESPONSE	very unlikely unlikely moderately likely likely very likely	CONFIDENCE	low medium high
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Response: The probability of detection will be negatively correlated to the volume of soil or vegetation transported. Fully developed nests might be detected despite the workers being small and similar in color to many soils. A newly-founded colony of a queen(s) and workers in the soil/substrate could easily arrive undetected.

Qu. 1.7e. How isolated or widespread are possible points of introduction and/or entry into the environment in the risk assessment area?

RESPONSE	isolated widespread ubiquitous	CONFIDENCE	low medium high
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Response: Due to the high trade volumes between the native range in East Asia and the introduced range in the USA with the RA area, points of introduction and entry into the environment are widespread in the RA area.

Qu. 1.8e. Estimate the overall likelihood of introduction into the risk assessment area and/or entry into the environment based on this pathway?

RESPONSE	very unlikely unlikely moderately likely likely very likely	CONFIDENCE	low medium high
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Response: *Brachyponera chinensis* could be transported effectively along this pathway as the transfer of soil, vegetation, mulch, straw or untreated wood, wood chips are suitable habitat for the species survival. However, the propagule pressure is unknown, and the probability of habitat material transfer from both the native and introduced ranges into the RA area might be low. No specific data are available for *B. chinensis* which constrains our confidence to low.

Pathway name: Pet trade (Online market)

Qu. 1.2f. Is introduction and/or entry along this pathway intentional (e.g. the organism is imported for trade) or unintentional (e.g. the organism is a contaminant of imported goods)?

RESPONSE	intentional unintentional	CONFIDENCE	low medium high
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Response: This concerns incipient colonies of workers and a queen that are sold online.

Qu. 1.3f. How likely is it that large numbers of the organism will be introduced and/or enter into the environment through this pathway from the point(s) of origin over the course of one year?

including the following elements:

- discuss how likely the organism is to get onto the pathway in the first place. Also comment on the volume of movement along this pathway.
- an indication of the propagule pressure (e.g. estimated volume or number of individuals / propagules, or frequency of passage through pathway), including the likelihood of reinvasion after eradication
- if relevant, comment on the likelihood of introduction and/or entry based on propagule pressure (i.e. for some species low propagule pressure (1-2 individuals) could result in subsequent establishment whereas for others high propagule pressure (many thousands of individuals) may not.

RESPONSE	very unlikely unlikely moderately likely likely very likely	CONFIDENCE	low medium high
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Response: There are no data on *B. chinensis* arriving in Europe via this pathway. However, in a recent study, Gippet and Bertelsmeier (2022) show that in the emergent trade of ants as pets which is too recent to be responsible for any invasions yet, invasive alien ants are overrepresented. In total, at least 520 ant species from 95 genera were sold online between 2002 and 2017, representing 3.4% of all ant species and 28% of all ant genera. Among traded ant species, 57 were invasive based on their ecological and economic impacts, including *B. chinensis*.

Qu. 1.4f. How likely is the organism to survive, reproduce, or increase during transport and storage along the pathway (excluding management practices that would kill the organism)?

RESPONSE	very unlikely unlikely moderately likely likely very likely	CONFIDENCE	low medium high
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Response: It is very likely that the queens and workers will survive transport by this route, as online sellers are used to shipping fledgling colonies. The ants are placed in tubes containing water and are usually shipped by air, which reduces the journey time to few days.

Qu. 1.5f. How likely is the organism to survive existing management practices before and during transport and storage along the pathway?

RESPONSE	very unlikely unlikely moderately likely likely very likely	CONFIDENCE	low medium high
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Response: There is no management during transport along this pathway.

Qu. 1.6f. How likely is the organism to be introduced into the risk assessment area or entry into the environment undetected?

Please note that “detection” here is considered as any system or event that may actively contribute to record the presence of a species in a way that appropriate management measures could be potentially undertaken by relevant authorities.

RESPONSE	very unlikely unlikely moderately likely likely very likely	CONFIDENCE	low medium high
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Response: As shipments are rarely inspected, it is unlikely that the species will be detected along this pathway of introduction. However, as no data are available on interceptions along this pathway, the confidence is low.

Qu. 1.7f. How isolated or widespread are possible points of introduction and/or entry into the environment in the risk assessment area?

RESPONSE	isolated widespread ubiquitous	CONFIDENCE	low medium high
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Response: Due the growing demand of ants in Europe (Gippet et al. 2022), points of introduction and/entry are ubiquitous in the risk assessment area.

Qu. 1.8f. Estimate the overall likelihood of introduction into the risk assessment area and/or entry into the environment based on this pathway?

RESPONSE	very unlikely unlikely moderately likely likely very likely	CONFIDENCE	low medium high
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Response: *Brachyponera chinensis* has been found on the online ant market, but not in Europe. However, as this is an emerging market, its introduction via this route is likely in the future, but the degree of confidence is low.

Qu. 1.9. Estimate the overall likelihood of introduction into the risk assessment area or entry into the environment based on all pathways and specify if different in relevant biogeographical regions in current conditions.

Provide a thorough assessment of the risk of introduction in relevant biogeographical regions in current conditions: providing insight in to the risk of introduction into the risk assessment area.

RESPONSE	very unlikely unlikely moderately likely likely very likely	CONFIDENCE	low medium high
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Response: The species has been already recorded/intercepted in Europe (Italy and Germany) and it is very likely that this will happen again, specifically with contaminated potted plants in the horticultural trade and/or as stowaway with container/bulk imports in sea or air freight. This is especially true as the infested areas are the main sources of imports into Europe (USA and East Asia). The points of introductions and entry into the environment are widespread and with equal likelihood of introduction and entry in the RA area.

Qu. 1.10. Estimate the overall likelihood of introduction into the risk assessment area or entry into the environment based on all pathways in foreseeable climate change conditions?

Thorough assessment of the risk of introduction in relevant biogeographical regions in foreseeable climate change conditions: explaining how foreseeable climate change conditions will influence this risk.

With regard to climate change, provide information on

- the applied timeframe (e.g. 2050/2070)
- the applied scenario (e.g. RCP 4.5)
- what aspects of climate change are most likely to affect the likelihood of introduction (e.g. change in trade or user preferences)

The thorough assessment does not have to include a full range of simulations on the basis of different climate change scenarios, as long as an assessment of likely introduction within a medium timeframe scenario (e.g. 30-50 years) with a clear explanation of the assumptions is provided. However, if new, original models are executed for this risk assessment, the following RCP pathways shall be applied: RCP 2.6 (likely range of 0.4-1.6°C global warming increase by 2065) and RCP 4.5 (likely range of 0.9-2.0°C global warming increase by 2065). Otherwise, the choice of the assessed scenario has to be explained.

RESPONSE	very unlikely unlikely moderately likely likely very likely	CONFIDENCE	low medium high
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Response: Climate change does not change the risk of introduction or likelihood of entry based on the mentioned active pathways.

2 PROBABILITY OF ESTABLISHMENT

Important instructions:

- For organisms which are already established in parts of the risk assessment area or have previously been eradicated, the likelihood of establishment should be scored as “very likely” by default.
- Discuss the risk also for those parts of the risk assessment area, where the species is not yet established.

Qu. 2.1. How likely is it that the organism will be able to establish in the risk assessment area based on similarity of climatic and abiotic conditions in its distribution elsewhere in the world?

RESPONSE	very unlikely unlikely moderately likely likely very likely	CONFIDENCE	low medium high
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Response: It is very likely that the Asian needle ant is able to establish colonies in the risk assessment area. However, our confidence level is medium as no colonies have yet been detected.

Bertelsmeier et al. (2013) found that around 3% of the European continent is climatically suitable for the species under current conditions. They also found suitable areas at northern latitudes, whereas Warren et al. (2020) demonstrated an absence of thermal adaptation to cold temperature below 6°C. The SDM found that mainly the Black Sea biogeographical region is at risk of species establishment, but also the Alpine, Continental and Steppic (Annex VIII). However, its recent dispersal into northern and mountainous areas in the USA (e.g., Rhode Island and Indiana) causes some concern regarding its adaptation to cold temperatures (Waters et al. 2022).

Urbanisation is another key factor that determines the success of invasive ants' establishment (Holway et al. 2002). *Brachyponera chinensis* is highly competitive in such habitats (Rice and Silverman 2013), and there is little doubt that it will find suitable urban areas, even in northern latitudes, to establish colonies. Moreover, unlike many alien ant species, *B. chinensis* has the ability to invade natural areas (Guénard and Dunn 2010), which increases its chances of establishment in the RA area.

Qu. 2.2. How widespread are habitats or species necessary for the survival, development and multiplication of the organism in the risk assessment area? Consider if the organism specifically requires another species to complete its life cycle.

RESPONSE	very isolated	CONFIDENCE	low
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	isolated moderately widespread widespread ubiquitous		medium high
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Response: *Brachyponera chinensis* has the capacity to invade natural and urban areas indiscriminately. Therefore, virtually all habitats present in climatically suitable areas can be invaded. The species originates from temperate regions and has invaded the east coast of the US, from the South to the North (www.antmaps.org) (tropical, temperate climate). Thermal tolerance experiments showed that the species survival decreases to below 50% when exposed to temperatures below 6°C and above 25°C (Rice and Silverman 2013; Warren et al. 2020).

Brachyponera chinensis does not require another species for establishment but has a specialist diet, that includes termites. However, as termites are present in parts of the RA area, particularly termite species of the genus *Reticulitermes*, this should not be a limiting factor for its establishment at least in southern Europe where termites are abundant. Moreover, it seems to be able to adjust its diet to a higher degree of generalist predation (Suehiro et al. 2017).

Qu. 2.3. How likely is it that establishment will occur despite competition from existing species in the risk assessment area?

RESPONSE	very unlikely unlikely moderately likely likely very likely	CONFIDENCE	low medium high
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Response: *Brachyponera chinensis* is an ecologically successful dominant ant both in disturbed and protected ecosystems in areas to which it has been introduced. Native populations seem already to possess some of the key characteristics shared by many invasive alien ants in introduced ranges, such as stable polygyny, weak inter-nest aggression (supercolony) and acceptance of non-nestmates (Murata et al. 2017). *Brachyponera chinensis* appears to be highly competitive compared with native and invasive alien ant species. This is confirmed by the systematic reduction of local ant species richness in invaded areas (Guénard and Dunn 2010; Bednar et al. 2013; Warren et al. 2015). In recent years, *B. chinensis* is becoming the most widespread invasive alien ant in the US, beyond the infamous Fire ant, *Solenopsis invicta*.

In several suitable areas it will have to face competition with two invasive alien ant species, the Argentine ant *Linepithema humile* and *Tapinoma magnum*. These species are highly competitive (Blight et al. 2010; Blight et al. 2014) and confrontations will be asymmetric as they both already form supercolonies of many hundred thousand individuals. However, *B. chinensis* was superior to the Argentine ant in an urban environment especially when the latter is at its climatic limit. The Argentine ant has been present for more than 100 years in the RA area but is restricted to the Mediterranean coast

from Portugal to Italy through Spain and France (www.antmap.org). *Tapinoma magnum* is a more recent invasive alien ant species, that is known from Mediterranean, Continental, Atlantic and Alpine biogeographic regions (www.antmap.org). It seems to have a broader climatic tolerance than *B. chinensis* (Bujan et al. 2021). Therefore, *Tapinoma magnum* may have a competitive advantage over *B. chinensis* when present in the risk assessment area. Nonetheless, where these competitive species are not present, establishment may easily occur.

Qu. 2.4. How likely is it that establishment will occur despite predators, parasites or pathogens already present in the risk assessment area?

RESPONSE	very unlikely unlikely moderately likely likely very likely	CONFIDENCE	low medium high
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Response: No species of the genus *Brachyponera* are native to Europe; no specialist natural enemies of *Brachyponera* are known to occur in Europe. Thus, establishment in Europe is only likely to be hindered by other ant species and possibly generalist predators that may prey on individual queens during nuptial flights.

Qu. 2.5. How likely is the organism to establish despite existing management practices in the risk assessment area? Explain if existing management practices could facilitate establishment.

RESPONSE	very unlikely unlikely moderately likely likely very likely	CONFIDENCE	low medium high
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Response: There have been no management practices applied in the risk assessment area that could hinder or facilitate establishment.

Qu. 2.6. How likely is it that biological properties of the organism would allow it to survive eradication campaigns in the risk assessment area?

RESPONSE	very unlikely	CONFIDENCE	low
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	unlikely moderately likely likely very likely		medium high
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Response: As for other invasive alien ants (Hoffmann et al. 2016), the eradication of *B. chinensis* outdoors would be difficult at a large scale, especially when populations reach high densities of nests and individuals within those nests. Only killing of the queens will eradicate the population, which requires the use of toxins with a delayed action to reach queens that are protected inside the nest.

Qu. 2.7. How likely are the biological characteristics of the organism to facilitate its establishment in the risk assessment area?

including the following elements:

- a list and description of the reproduction mechanisms of the species in relation to the environmental conditions in the risk assessment area
- an indication of the propagule pressure of the species (e.g. number of gametes, seeds, eggs or propagules, number of reproductive cycles per year) of each of those reproduction mechanisms in relation to the environmental conditions in the risk assessment area.
- If relevant, comment on the likelihood of establishment based on propagule pressure (i.e. for some species low propagule pressure (1-2 individuals) could result in establishment whereas for others high propagule pressure (many thousands of individuals) may not.
- If relevant, comment on the adaptability of the organism to facilitate its establishment and if low genetic diversity in the founder population would have an influence on establishment.

RESPONSE	very unlikely unlikely moderately likely likely very likely	CONFIDENCE	low medium high
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Response: Because *B. chinensis* reproduces through nuptial flights (a single queen founds independently a new colony), one inseminated queen is virtually enough to establish a new colony and population. It seems that colonies are founded by a single queen and become secondarily polygyne by adding queens that stay within the natal nest; queen numbers change over the season and this is probably associated with queen production in the nest (Gotoh and Ito 2008; Vargo et al. 2016).

As a pre-adapted trait, the Asian needle ant does not suffer inbreeding, allowing it to cope with genetic depletion following a genetic bottleneck (Eyer et al. 2018). Indeed, inbreeding is not a consequence of the founder effect following introduction, but is due to mating between sister queens and their brothers that pre-exist in native populations. This increases its chances of establishment in the RA area.

Brachyponera chinensis forms polygynous and polydomus colonies. The polygynous form can more easily establish because the higher number of queens increases reproduction potential, especially in the

critical early stages of establishment. However, nests seem to be less populous than in other invasive alien ants. In its native range, the maximum number of queens per nest is 20 (collected in early May) and the average number of workers per nest is 31.8 (range 1 to 276) (Gotoh and Ito 2008). During winter through to early May, the average number of workers per nest was 241 +/- 211 but it decreases to 20 +/- 16 per nest during the reproductive season in June.

Sexuals are produced over few months and the seasonal change in the queens reproductive condition indicates that queens die or are expelled from the nests during the production of alate (winged) males and queens in June (Gotoh and Ito 2008). This has also been shown in the Argentine ant *Linepithema humile* (Keller et al. 1989).

The division of labour, i.e. the existence of a reproductive caste, enabled ants to become ecologically dominant invertebrates in terrestrial habitats, with a high success rate of reproduction and dispersal. For example in the case of the Argentine ant, *Linepithema humile*, it was shown that as few as 10 workers and a queen are sufficient for a colony to grow quickly (Hee et al. 2000; Luque et al. 2013).

Brachyponera chinensis has a specialist diet, which includes termites, which could limit its establishment compared to other invasive ants. However, as termites are present in some parts of the RA (Southern Europe), particularly termite species of the genus *Reticulitermes*, this should not be a significant limiting factor for its establishment. This is illustrated by its success in the USA where it is now the second most widespread invasive species.

Qu. 2.8. If the organism does not establish, then how likely is it that casual populations will continue to occur?

Consider, for example, a species which cannot reproduce in the risk assessment area, because of unsuitable climatic conditions or host plants, but is present because of recurring introduction, entry and release events. This may also apply for long-living organisms.

RESPONSE	very unlikely unlikely moderately likely likely very likely	CONFIDENCE	low medium high
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Response: Although we could not find any data on *Brachyponera chinensis* interception in the RA area since Forel (1900), the recent detection of an established population in Italy (Schifani et al. 2024) and along the Black Sea coast (Guénard et al. 2018) suggest the possibility of temporary, casual populations and a non-negligible rate of propagule pressure.

Qu. 2.9. Estimate the overall likelihood of establishment in the risk assessment area under current climatic conditions. In addition, details of the likelihood of establishment in relevant biogeographical regions under current climatic conditions should be provided.

Thorough assessment of the risk of establishment in relevant biogeographical regions in current conditions: providing insight in the risk of establishment in (new areas in) the risk assessment area.

RESPONSE	very unlikely unlikely moderately likely likely very likely	CONFIDENCE	low medium high
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Response: If we consider suitable areas in the risk assessment area, the probability of establishment is very likely with a high confidence. The recent detection of a population in Italy (Schifani et al. 2024) confirms the presence of the species in the RA area.

However, if we consider the whole risk assessment area, the likelihood decreases as the predicted suitable area is restricted. Bertelsmeier et al. (2013) estimated that the suitable area covers only 3% of Europe. The proportion of suitable areas predicted by our SDM (Annex VIII) is higher, but still restricted (5% of the grid cells in the Black Sea region).

Qu. 2.10. Estimate the overall likelihood of establishment in the risk assessment area under foreseeable climate change conditions. In addition, details of the likelihood of establishment in relevant biogeographical regions under foreseeable climate change conditions should be provided.

Thorough assessment of the risk of establishment in relevant biogeographical regions in foreseeable climate change conditions: explaining how foreseeable climate change conditions will influence this risk.

With regard to climate change, provide information on

- the applied timeframe (e.g. 2050/2070)
- the applied scenario (e.g. RCP 4.5)
- what aspects of climate change are most likely to affect the likelihood of establishment (e.g. increase in average winter temperature, increase in drought periods)

The thorough assessment does not have to include a full range of simulations on the basis of different climate change scenarios, as long as an assessment of likely establishment within a medium timeframe scenario (e.g. 30-50 years) with a clear explanation of the assumptions is provided. However, if new, original models are executed for this risk assessment, the following RCP pathways shall be applied: RCP 2.6 (likely range of 0.4-1.6°C global warming increase by 2065) and RCP 4.5 (likely range of 0.9-2.0°C global warming increase by 2065). Otherwise, the choice of the assessed scenario has to be explained.

RESPONSE	very unlikely unlikely moderately likely likely very likely	CONFIDENCE	low medium high
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Response: Under foreseeable climate change, the global area suitable for *B. chinensis* will increase significantly in the future (Bertelsmeier et al. 2013). Bertelsmeier et al. (2013) predicted a 210% increase in suitable land mass in Europe by 2080 and the SDM (see Annex VIII) predicts an overall increase in the proportion of grid cells for each biogeographic region, with the Pannonian biogeographic region the most suitable for *B. chinensis*.

3 PROBABILITY OF SPREAD

Important instructions:

- Spread is defined as the expansion of the geographical distribution of an alien species within the risk assessment area.
- Repeated releases at separate locations do not represent continuous spread and should be considered in the probability of introduction and entry section (Qu. 1.7).

Qu. 3.1. How important is the expected spread of this organism within the risk assessment area by natural means? (List and comment on each of the mechanisms for natural spread.)

including the following elements:

- a list and description of the natural spread mechanisms of the species in relation to the environmental conditions in the risk assessment area.
- an indication of the rate of spread discussed in relation to the species biology and the environmental conditions in the risk assessment area.

The description of spread patterns here refers to the CBD pathway category “Unaided (Natural Spread)”. It should include elements of the species life history and behavioural traits able to explain its ability to spread, including: reproduction or growth strategy, dispersal capacity, longevity, dietary requirements, environmental and climatic requirements, specialist or generalist characteristics.

RESPONSE	minimal minor moderate major massive	CONFIDENCE	low medium high
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Response: No data could be found on the natural dispersal distance of *B. chinensis*. New colonies are founded by winged females, capable of flying long distances, greater than budding. This allows in general new colonization a long distance from the source population (Holway et al. 2002). However, such a strategy does not allow a rapid spread compared to flying alien species. For example, newly mated queens of the ant *Solenopsis geminata* seek areas within 2 km of the mother colony, which is one of the highest dispersal distances observed in ants. As winged females are only produced once a year, it can be estimated that the maximum annual dispersal distance does not (or rarely) exceed 2 km.

The question is scored “minor” because it is very likely to spread more slowly by natural means than by human assistance.

Qu. 3.2a. List and describe relevant pathways of spread other than "unaided". For each pathway answer questions 3.3 to 3.9 (copy and paste additional rows at the end of this section as necessary). Please attribute unique identifiers to each question if you consider more than one pathway, e.g. 3.3a, 3.4a, etc. and then 3.3b, 3.4b etc. for the next pathway.

including the following elements:

- a list and description of pathways of spread with an indication of their importance and associated risks (e.g. the likelihood of spread in the risk assessment area, based on these pathways; likelihood of survival, or reproduction, or increase during transport and storage; ability and likelihood of transfer from the pathway to a suitable habitat or host) in relation to the environmental conditions in the risk assessment area.
- an indication of the rate of spread for each pathway discussed in relation to the species biology and the environmental conditions in the risk assessment area.
- All relevant pathways of spread (except “Unaided (Natural Spread)”, which is assessed in Qu. 3.1) should be considered. The classification of pathways developed by the Convention of Biological Diversity shall be used (see Annex IV).

Pathway name:

- a) Transport-Contaminant (Contaminant nursery material)
- b) Transport-Stowaway (Container/bulk, including road transport, sea freight, airfreight, train, etc.)
- c) Transportation of habitat material (soil, vegetation, wood, ...)

Pathway: Transport-Contaminant (Contaminant nursery material)

Qu. 3.3a. Is spread along this pathway intentional (e.g. the organism is deliberately transported from one place to another) or unintentional (e.g. the organism is a contaminant of translocated goods within the risk assessment area)?

RESPONSE	intentional	CONFIDENCE	low
	unintentional		medium high

Response: There is unlikely to be any intentional spread along this pathway.

Qu. 3.4a. How likely is it that a number of individuals sufficient to originate a viable population will spread along this pathway from the point(s) of origin over the course of one year?

including the following elements:

- an indication of the propagule pressure (e.g. estimated volume or number of specimens, or frequency of passage through pathway), including the likelihood of reinvasion after eradication
- if appropriate, indicate the rate of spread along this pathway
- if appropriate, include an explanation of the relevance of the number of individuals for spread with regard to the biology of species (e.g. some species may not necessarily rely on large numbers of individuals).

RESPONSE	very unlikely unlikely moderately likely likely very likely	CONFIDENCE	low medium high
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Response: Within Europe, movements of potted plants are unrestricted. Soil/substrate in potted plants is a favourite medium for nesting (see introduction and entry sections above). Thus, newly founded nests or parts of fully developed nests could easily be moved. Other horticultural material such as mulch, hay and other plant material can also harbour ant nests.

Polygynous nests include many queens and may contain thousands of workers (Zungoli and Benson 2008). Ant nests might get onto the pathway in large numbers as contaminants of horticultural materials including soil. The peculiar, almost unique, reproductive caste system of these eusocial insects can facilitate the development of viable colonies. For example, in the case of the Argentine ant, *Linepithema humile*, it was shown that as few as 10 workers and a queen are sufficient to originate a colony (Hee et al. 2000; Luque et al. 2013). The likelihood of reinvasion after eradication is identical to the likelihood of introduction in the first place.

Qu. 3.5a. How likely is the organism to survive, reproduce, or increase during transport and storage along the pathway (excluding management practices that would kill the organism)?

RESPONSE	very unlikely unlikely moderately likely likely very likely	CONFIDENCE	low medium high
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Response: A newly founded nest or parts of fully developed nests are able to survive transport and storage. The interception of individuals in Germany on plants imported from Japan (Forel 1900) and the recent expansion within the US (Guénard et al. 2018), illustrate its capacity to travel over long distances. Colonies of the ant *Temnothorax rugatulus* can survive for several months without food resources (Rueppell and Kirkman 2005). Likelihood of survival is high, but nevertheless will decrease with increasing travel duration. Multiplication of a colony (production of sexuals and reproduction) during spread within the EU cannot be ruled out, but is rather unlikely as most transports last few days.

Qu. 3.6a. How likely is the organism to survive existing management practices during spread?

RESPONSE	very unlikely unlikely	CONFIDENCE	low medium
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	moderately likely likely very likely		high
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Response: Horticultural plants and products and soils/substrates are not systematically treated before translocation within the EU (directive 2000/29/CE) (see management annex for treatments before introduction into Europe).

Qu. 3.7a. How likely is the organism to spread in the risk assessment area undetected?

Please note that “detection” here is considered as any system or event that may actively contribute to record the presence of a species in a way that appropriate management measures could be potentially undertaken by relevant authorities.

RESPONSE	very unlikely unlikely moderately likely likely very likely	CONFIDENCE	low medium high
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Response: Fully developed nests could be quite visible even though workers are relatively small (<5mm). In contrast, newly-founded nests with few queen(s) and workers can easily travel undetected in soil or other horticultural products.

Qu. 3.8a. How likely is the organism to be able to transfer from the pathway to a suitable habitat or host during spread?

RESPONSE	very unlikely unlikely moderately likely likely very likely	CONFIDENCE	low medium high
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Response: Potted plants and plant materials are often planted or stored in, or close to, highly suitable habitats, such as gardens, parks, road sides, etc. It is expected that the proximity of these media to suitable habitats will facilitate occurrences in urban, suburban and agricultural habitats. As a predator that prefers to prey on termites, its likelihood of establishment would be high in southern areas and lower in the northern part of the EU where termites are less abundant.

Qu. 3.9a. Estimate the overall potential rate of spread based on this pathway in relation to the environmental conditions in the risk assessment area. (please provide quantitative data where possible).

RESPONSE	very slowly slowly moderately rapidly very rapidly	CONFIDENCE	low medium high
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Response: We consider this pathway as the most likely pathway of spread of *B. chinensis* within Europe. The rate of spread will depend on the internal volume of trade within Europe. After a 50-year latent phase that saw *B. chinensis* invade six US states, 50 years later, it has been recorded in 11 new states (Guénard et al. 2018). The mechanisms that caused *B. chinensis* to suddenly reach high abundance are unclear, though diet diversification has been proposed recently as a potential result of ecological change compared with native ant populations (Suehiro et al. 2017). At a distributional range of over 965,000 km² (Guénard et al. 2018a), *B. chinensis* is now one the most widespread alien ant species within the US; compared with *S. invicta* that has spread across an area of over 1.3 million km² in the US (www.antmap.org). For comparison, accidental transportation by humans has resulted in rates of spread of 10.50 km/yr in the case of *S. invicta* into uninvaded areas of the USA (Ross and Trager 1990).

Pathway: Transport-Stowaway (Container/bulk, including road transport, sea freight, airfreight, train, etc.)

Qu. 3.3b. Is spread along this pathway intentional (e.g. the organism is deliberately transported from one place to another) or unintentional (e.g. the organism is a contaminant of translocated goods within the risk assessment area)?

RESPONSE	intentional unintentional	CONFIDENCE	low medium high
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Response: Virtually any article of commerce can host hitchhiking solitary queens, or nests of all sizes and ages, including newly-founded and fully developed nests. A free volume of 10 ml should be sufficient for an incipient colony composed of a queen and a dozen of workers. There are very many transported items (e.g. vehicles (incl. used car parts), machinery, building material, agricultural equipment packaging materials, bark, used electric equipment, non-agricultural soil, sand, gravel) that are suitable to carry nests and are grouped here together.

Qu. 3.4b. How likely is it that a number of individuals sufficient to originate a viable population will spread along this pathway from the point(s) of origin over the course of one year?

including the following elements:

- an indication of the propagule pressure (e.g. estimated volume or number of specimens, or frequency of passage through pathway), including the likelihood of reinvasion after eradication
- if appropriate, indicate the rate of spread along this pathway
- if appropriate, include an explanation of the relevance of the number of individuals for spread with regard to the biology of species (e.g. some species may not necessarily rely on large numbers of individuals).

RESPONSE	very unlikely unlikely moderately likely likely very likely	CONFIDENCE	low medium high
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Response: There are very limited data on ant nests translocated within the EU. Polygynous nests include many queens and may contain thousands of workers (Zungoli and Benson 2008). Ant nests might get onto transported items in large numbers as stowaways. For the Argentine ant, *Linepithema humile*, it was shown that as few as 10 workers and a queen are sufficient for a colony to grow quickly (Hee et al. 2000; Luque et al. 2013). The likelihood of reinvasion after eradication is identical to the likelihood of spread in the first place.

Qu. 3.5b. How likely is the organism to survive, reproduce, or increase during transport and storage along the pathway (excluding management practices that would kill the organism)?

RESPONSE	very unlikely unlikely moderately likely likely very likely	CONFIDENCE	low medium high
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Response: The likelihood of colony survival is high, but will decrease with increasing travel duration. Post introduction distances and hence transport periods are likely to be relatively short. Multiplication of a colony during spread within the EU cannot be ruled out, but is rather unlikely.

Qu. 3.6b. How likely is the organism to survive existing management practices during spread?

RESPONSE	very unlikely unlikely moderately likely likely very likely	CONFIDENCE	low medium high
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Response: Most potential commodities that can carry ants or nests are not managed to limit ant spread.

Qu. 3.7b. How likely is the organism to spread in the risk assessment area undetected?

Please note that “detection” here is considered as any system or event that may actively contribute to record the presence of a species in a way that appropriate management measures could be potentially undertaken by relevant authorities.

RESPONSE	very unlikely unlikely moderately likely likely very likely	CONFIDENCE	low medium high
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Response: Fully developed nests could be quite visible even though workers are relatively small (<5mm). In contrast, newly-founded nests with few queen(s) and workers can easily travel undetected in soil or other horticultural products.

Qu. 3.8b. How likely is the organism to be able to transfer from the pathway to a suitable habitat or host during spread?

RESPONSE	very unlikely unlikely moderately likely likely very likely	CONFIDENCE	low medium high
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Response: Several of the potential commodities and items in which nests can hide can be transported to suitable outdoor habitats since the ant particularly likes disturbed soils (Guénard and Dunn 2010; Rice and Silverman 2013), which are found everywhere, especially in urban, semi-urban and agricultural habitats.

Qu. 3.9b. Estimate the overall potential rate of spread based on this pathway in relation to the environmental conditions in the risk assessment area. (please provide quantitative data where possible).

RESPONSE	very slowly slowly moderately rapidly very rapidly	CONFIDENCE	low medium high
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Response: Given the high numbers and types of commodities and items that can be associated with *B. chinensis*, this species has the potential to spread rapidly in the RA area through this pathway. The rate of spread will depend on the internal volume of trade within Europe.

After a 50-year latent phase that saw *B. chinensis* invade six US states, 50 years later, it has been recorded in 11 new states (Guénard et al. 2018). The mechanisms that caused *B. chinensis* to suddenly reach high abundance are unclear, though diet diversification has been proposed recently as a potential result of ecological change compared with native ant populations (Suehiro et al. 2017). At a distributional range of over 965,000 km² (Guénard et al. 2018a), *B. chinensis* is now one the most widespread invasive ant species within the US; compared with *S. invicta* that has spread across an area of over 1.3 million km² in the US (www.antmap.org). For comparison, accidental transportation by humans has resulted in rates of spread of 10.50 km/yr in the case of *S. invicta* into uninvaded areas of the USA (Ross and Trager 1990).

Pathway: Transportation of habitat material (soil, vegetation, wood, ...)

Qu. 3.3c. Is spread along this pathway intentional (e.g. the organism is deliberately transported from one place to another) or unintentional (e.g. the organism is a contaminant of translocated goods within the risk assessment area)?

RESPONSE	intentional unintentional	CONFIDENCE	low medium high
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Response: There should be no intentional spread of this species along this pathway.

Qu. 3.4c. How likely is it that a number of individuals sufficient to originate a viable population will spread along this pathway from the point(s) of origin over the course of one year?

including the following elements:

- an indication of the propagule pressure (e.g. estimated volume or number of specimens, or frequency of passage through pathway), including the likelihood of reinvasion after eradication
- if appropriate, indicate the rate of spread along this pathway
- if appropriate, include an explanation of the relevance of the number of individuals for spread with regard to the biology of species (e.g. some species may not necessarily rely on large numbers of individuals).

RESPONSE	very unlikely unlikely moderately likely likely very likely	CONFIDENCE	low medium high
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Response: Within Europe, movements of habitat (e.g. soil, vegetation and wood) are unrestricted. Soil/substrate is a favourite medium for nesting as the species can nest in the soil, leaf litter or logs. Thus, newly founded nests or parts of fully developed nests could easily be moved. Other habitat material such as vegetation, can also harbour ant nests.

Polygynous nests include many queens and may contain thousands of workers. Ant nests might get onto the pathway in large numbers as contaminants of habitat material.

The peculiar reproductive caste system of these eusocial insects can facilitate the development of viable colonies. For example, in the case of the Argentine ant, *Linepithema humile*, it was shown that as few as 10 workers and a queen are sufficient to originate a colony (Hee et al. 2000; Luque et al. 2013). The likelihood of reinvasion after eradication is identical to the likelihood of introduction in the first place.

Qu. 3.5c. How likely is the organism to survive, reproduce, or increase during transport and storage along the pathway (excluding management practices that would kill the organism)?

RESPONSE	very unlikely unlikely moderately likely likely very likely	CONFIDENCE	low medium high
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Response: A newly founded nest or parts of fully developed nests are able to survive transport and storage. The interception of individuals in Germany on plants imported from Japan (Forel 1900) and the recent expansion within the US (Guénard et al. 2018), illustrate its capacity to travel over long distance, much longer than expected within the RA. Colonies of the ant *Temnothorax rugatulus* can survive for several months without food resources (Rueppell and Kirkman 2005).

Likelihood of survival is high, but nevertheless will decrease with increasing travel duration even if this pathway might concern only transfer over short distances (within member states). Multiplication of a colony (production of sexuals and reproduction) during spread within the EU cannot be ruled out, but is rather unlikely.

Qu. 3.6c. How likely is the organism to survive existing management practices during spread?

RESPONSE	very unlikely unlikely moderately likely likely very likely	CONFIDENCE	low medium high
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Response: There is no specific regulation along this pathway as invasive ants are not listed as pests.

Qu. 3.7c. How likely is the organism to spread in the risk assessment area undetected?

Please note that “detection” here is considered as any system or event that may actively contribute to record the presence of a species in a way that appropriate management measures could be potentially undertaken by relevant authorities.

RESPONSE	very unlikely unlikely moderately likely likely very likely	CONFIDENCE	low medium high
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Response: Both fully developed nests and newly-founded nests with few queen(s) and workers can easily travel undetected in soil, vegetation or wood as this pathway can involve large volumes of habitat material.

Qu. 3.8c. How likely is the organism to be able to transfer from the pathway to a suitable habitat or host during spread?

RESPONSE	very unlikely unlikely moderately likely likely	CONFIDENCE	low medium high
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	very likely		
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Response: Habitat materials are often deposited in, or close to, highly suitable habitats, such as gardens, parks, roadsides, etc. It is expected that the distribution of these media will facilitate occurrences in urban, suburban and agricultural habitats.

Qu. 3.9c. Estimate the overall potential rate of spread based on this pathway in relation to the environmental conditions in the risk assessment area. (please provide quantitative data where possible).

RESPONSE		CONFIDENCE	
	very slowly		low
	slowly		medium
	moderately		high
	rapidly		
	very rapidly		

Response: We consider this pathway as a likely pathway of spread of *B. chinensis* within Europe. However, the transfer of habitat materials may occur mainly over short distances within a country which will limit the rate of spread within the risk assessment area.

After a 50-year latent phase that saw *B. chinensis* invade six US states, 50 years later it has been recorded in 11 new states (Guénard et al. 2018). The mechanisms that caused *B. chinensis* to suddenly reach high abundance are unclear, though diet diversification has been proposed recently as a potential result of ecological change compared with native ant populations (Suehiro et al. 2017). At a distributional range of over 965,000 km² (Guénard et al. 2018a), *B. chinensis* is now one the most widespread invasive ant species within the US; compared with *S. invicta*, that has spread across an area of over 1.3 million km² in the US (www.antmap.org). For comparison, accidental transportation by humans has resulted in rates of spread of 10.50 km/yr in the case of *S. invicta* into uninvaded areas of the USA (Ross and Trager 1990).

Qu. 3.10. Within the risk assessment area, how difficult would it be to contain the organism in relation to these pathways of spread?

RESPONSE		CONFIDENCE	
	very easy		low
	easy		medium
	with some difficulty		high
	difficult		
	very difficult		

Response: It will be very difficult to physically contain the species. Its spread will be constrained by climate, habitat suitability and competition from other invasive species. If *B. chinensis* become established in a European region, quarantine measures could be put in place to restrict the risk of medium to long-distance spread, e.g. through nursery stock, as in USA for *S. invicta*. The species has not been contained in the US.

Qu. 3.11. Estimate the overall potential rate of spread in relevant biogeographical regions under current conditions for this organism in the risk assessment area (indicate any key issues and provide quantitative data where possible).

Thorough assessment of the risk of spread in relevant biogeographical regions in current conditions, providing insight in the risk of spread into (new areas in) the risk assessment area.

RESPONSE	very slowly slowly moderately rapidly very rapidly	CONFIDENCE	low medium high
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Response: Despite the relatively low ecoclimatic suitability in Europe under current conditions, we can estimate that it will spread unaided (via nuptial flights) or aided to all potentially infested biogeographical regions. However, the rate of natural spread is uncertain as no data are yet available. There are still doubts about the behavior of mated queens (founding a solitary colony or returning to the nest). It seems that colonies are founded by a single queen and become secondarily polygynous by adding queens that stay within the natal nest (Gotoh and Ito 2008; Vargo et al. 2016) or by merging nests after overwintering (Murata et al. 2017).

Its spread will occur mainly through human transport but its distribution will be indirectly constrained by climate, habitat suitability, presence of termites and competition from other dominant ants (alien and native). The rate of spread will also depend on the internal volume of trade within Europe. The example of the invasion of the US, with a lag time of several decades before sudden acceleration, illustrates the complexity of the mechanisms involved in the invasion process.

The species shows low thermal adaptation to cold temperatures which may confine its distribution to southern Europe.

Qu. 3.12. Estimate the overall potential rate of spread in relevant biogeographical regions in foreseeable climate change conditions (provide quantitative data where possible).

Thorough assessment of the risk of spread in relevant biogeographical regions in foreseeable climate change conditions: explaining how foreseeable climate change conditions will influence this risk, specifically if rates of spread are likely slowed down or accelerated.

RESPONSE	very slowly	CONFIDENCE	low
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	slowly moderately rapidly very rapidly		medium high
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Response: Climate change will not significantly increase the potential or speed of spread directly, even if it is expected to increase the distribution range (Bertelsmeier et al. 2013) (Fig. 1b). Beckmann et al. (2022) found an increase in suitable areas under foreseeable climate change in the Alpine, Atlantic, Black Sea, Continental, Mediterranean and Steppic regions (Fig. 2b). However, as the species has a low capacity to adapt to cold temperatures, climate change could facilitate population growth and therefore increase the potential for spread.

4 MAGNITUDE OF IMPACT

Important instructions:

- Questions 4.1-4.5 relate to biodiversity and ecosystem impacts, 4.6-4.8 to impacts on ecosystem services, 4.9-4.13 to economic impact, 4.14-4.15 to social and human health impact, and 4.16-4.18 to other impacts. These impacts can be interlinked, for example, a disease may cause impacts on biodiversity and/or ecosystem functioning that leads to impacts on ecosystem services and finally economic impacts. In such cases the assessor should try to note the different impacts where most appropriate, cross-referencing between questions when needed.
- Each set of questions starts with the impact elsewhere in the world, then considers impacts in the risk assessment area (=EU excluding outermost regions) separating known impacts to date (i.e. past and current impacts) from potential future impacts (including foreseeable climate change).
- Only negative impacts are considered in this section (socio-economic benefits are considered in Qu. A.7)
- In absence of specific studies or other direct evidences this should be clearly stated by using the standard answer “No information has been found on the issue”. This is necessary to avoid confusion between “no information found” and “no impact found”. In this case, no score and confidence should be given and the standardized “score” is N/A (not applicable). Note that in principle, even if no information is available for the risk assessment area, this does not apply to Qu. 4.2 and 4.3, because the information on impact can be inferred from regions outside the risk assessment area. If no information is available from regions outside the risk assessment area either, then this should be discussed explicitly.

Biodiversity and ecosystem impacts

Qu. 4.1. How important is the impact of the organism on biodiversity at all levels of organisation caused by the organism in its non-native range excluding the risk assessment area?

including the following elements:

- Biodiversity means the variability among living organisms from all sources, including terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems
- impacted chemical, physical or structural characteristics and functioning of ecosystems

RESPONSE		CONFIDENCE	
	minimal		low
	minor		medium
	moderate		high
	major		
	massive		

Response: Despite being introduced and established in the US for more than 100 years, few data are available on *B. chinensis* impacts on biodiversity. No loss of native species has yet been reported, and impacts are not clearly irreversible. The score may change to major in the future if further evidence of

impacts is provided. As for other invasive alien ants, the severity of impact is most likely related to the population densities achieved.

Environmental impacts caused by the ant in the invaded range excluding the risk assessment area are detailed below:

- Impacts on fauna

The invasion of *B. chinensis* is consistently followed by a reduction in abundance and density of native ants (Guenard and Dunn 2010). The species most at risk in the US are the keystone seed-dispersing ants in the genus *Aphaenogaster* (Warren et al. 2015). Results suggest that *B. chinensis* shares ecological niche requirements (temperature, moisture and coarse woody material as nesting habitat) with *Aphaenogaster* species, severely diminishing the abundance of these native ants. Merchlinsky et al. (2023) found that *B. chinensis* somewhat inhibited native ant communities with negative impacts. They concluded that it may pose a greater threat to native ant communities than *Solenopsis invicta* in a warmer world (Merchlinsky et al. 2023).

No information has been found on impacts on other groups of animals.

- Impacts on plants and plant communities

The apparent ability of the Asian needle ant to displace keystone seed-dispersing ants is also of concern for native plants. Many plants’ seeds have a nutritious structure attached called an elaiosome, which attracts certain ants. These ant species carry the seeds away from the mother plant, ensuring proper dispersal of the plant species. In invaded forest areas in the US, substantial decreases in seed dispersal have been observed (Rodriguez-Cabal et al. 2012; Warren et al. 2015; Warren et al. 2023). Thus, *B. chinensis* could have dramatic, long-term negative effects on the plant species composition of the forest understory. Warren et al. (2015) found that a common forest understory herb to be more aggregated within the invasion. Rodriguez-Cabal et al. (2012) indicated that “The number of *Aphaenogaster rudis* workers was 96% lower in invaded than in intact plots, and the number of seeds removed was 70% lower in these plots. Finally, in invaded plots the abundance of *Hexastylis arifolia*, a locally abundant myrmecochorous plant, was 50% lower than in plots where *B. chinensis* was absent”.

Unlike most alien ant species, *B. chinensis* is not attracted to plants by their carbohydrate-rich resources or by honeydew-producing herbivores.

Qu. 4.2. How important is the current known impact of the organism on biodiversity at all levels of organisation (e.g. decline in native species, changes in native species communities, hybridisation) in the risk assessment area (include any past impact in your response)?

Discuss impacts that are currently occurring or are likely occurring or have occurred in the past in the risk assessment area. Where there is no direct evidence of impact in the risk assessment area (for example no studies have been conducted), evidence from outside of the risk assessment area can be used to infer impacts within the risk assessment area.

RESPONSE	N/A	CONFIDENCE	low
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	minimal minor moderate major massive		medium high
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Response: The species has not yet established in Europe and no information on impacts in the risk assessment area is available.

Qu. 4.3. How important is the potential future impact of the organism on biodiversity at all levels of organisation likely to be in the risk assessment area?

See comment above. The potential future impact shall be assessed only for the risk assessment area. A potential increase in the distribution range due to climate change does not *per se* justify a higher impact score.

RESPONSE	minimal minor moderate major massive	CONFIDENCE	low medium high
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Response: It is likely that, if *B. chinensis* establishes and spreads in the predicted suitable areas in the risk assessment area, the impacts on native biodiversity, in particular ants and selected plants, will be at least similar to what has been already described in the US (see Qu. 4.1).

Qu. 4.4. How important is decline in conservation value with regard to European and national nature conservation legislation caused by the organism currently in the risk assessment area?

including the following elements:

- native species impacted, including red list species, endemic species and species listed in the Birds and Habitats directives
- protected sites impacted, in particular Natura 2000
- habitats impacted, in particular habitats listed in the Habitats Directive, or red list habitats
- the ecological status of water bodies according to the Water Framework Directive and environmental status of the marine environment according to the Marine Strategy Framework Directive

RESPONSE	N/A minimal minor moderate major	CONFIDENCE	low medium high
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	massive		
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Response: The species has not yet established in Europe and no information on impacts in the risk assessment area is available.

Qu. 4.5. How important is decline in conservation value with regard to European and national nature conservation legislation caused by the organism likely to be in the future in the risk assessment area?

- See guidance to Qu. 4.3. and 4.4.

RESPONSE	minimal minor moderate major massive	CONFIDENCE	low medium high
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Response: *Brachyponera chinensis* can inhabit a wide range of natural habitats and is a threat to native ants. It does not functionally replace the species it displaces, leading to changes in the plant community (Rodriguez-Cabal et al. 2012). In the risk assessment area, it will preferentially invade the Mediterranean biogeographic region which has a high conservation value in the risk assessment area (Medail and Quezel 1999).

Therefore, many natural habitats of high conservation value, and their status, in suitable areas would be threatened by the ant. Some of them could be N2000 habitats (e.g. 9340-Forests with *Quercus ilex* and *Quercus rotundifolia*; or 9330-Forests with *Quercus suber* in the Mediterranean region) or national protected areas.

Ecosystem Services impacts

Qu. 4.6. How important is the impact of the organism on provisioning, regulating, and cultural services in its non-native range excluding the risk assessment area?

- For a list of services use the CICES classification V5.1 provided in Annex V.
- Impacts on ecosystem services build on the observed impacts on biodiversity (habitat, species, genetic, functional) but focus exclusively on reflecting these changes in relation to their links with socio-economic well-being.
- Quantitative data should be provided whenever available and references duly reported.

RESPONSE	minimal minor moderate major	CONFIDENCE	low medium high
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	massive		
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Response:

- Regulation & Maintenance: Seed dispersal

Brachyponera chinensis interferes with seed dispersal activities of native ant species and therefore reduces the distribution of viable seeds (Rodriguez-Cabal et al. 2012). They leave the seeds exposed on the soil surface. These exposed seeds are not protected from fire or seed predators, and likely have less access to nutrients than do buried seeds or seeds deposited in ant nests. This has led to a change in the spatial structure of the plant community (Warren et al. 2015). There is, however, no evidence how and if reduced seed dispersal has any effect on ecosystem services and socio-economic well-being.

- Cultural: Physical interactions with natural environment

Brachyponera chinensis is a social nuisance in infested areas due to its painful sting (Nelder et al. 2006). Colonies are common around urban areas and can be considered locally as urban pests in the native and alien range (Rice and Silverman 2013; Park and Moon 2020). It might disrupt outdoor activities that have a greater risk of contact with ants (e.g., picnics, gardening), such as does *S. invicta* in the US (Shearer et al. 2020). Ant control would be necessary within a heavily infested area to allow such activities to continue.

Qu. 4.7. How important is the impact of the organism on provisioning, regulating, and cultural services currently in the different biogeographic regions or marine sub-regions where the species has established in the risk assessment area (include any past impact in your response)?

- See guidance to Qu. 4.6.

RESPONSE	N/A	CONFIDENCE	low medium high
	minimal minor moderate major massive		

Response: The species has not yet established in Europe and no information on impacts in the risk assessment area is available.

Qu. 4.8. How important is the impact of the organism on provisioning, regulating, and cultural services likely to be in the different biogeographic regions or marine sub-regions where the species can establish in the risk assessment area in the future?

- See guidance to Qu. 4.6.

RESPONSE	minimal minor moderate major massive	CONFIDENCE	low medium high
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Response: It is likely that, if *B. chinensis* establishes and spreads in the predicted suitable areas in the risk assessment area, especially in the Mediterranean biogeographical region, the impact on ecosystem services may be major due to its effects on seed dispersal and its painful sting. There is, however, no evidence how and if reduced seed dispersal has any effect on ecosystem services and socio-economic well-being. Moreover, its extent is very difficult to estimate considering the uncertainty related to habitat and climatic suitability.

Economic impacts

Qu. 4.9. How great is the overall economic cost caused by the organism within its current area of distribution (excluding the risk assessment area), including both costs of / loss due to damage and the cost of current management.

- Where economic costs of / loss due to the organism have been quantified for a species anywhere in the world these should be reported here. The assessment of the potential costs of / loss due to damage shall describe those costs quantitatively and/or qualitatively depending on what information is available. Cost of / loss due to damage within different economic sectors can be a direct or indirect consequence of the earlier-noted impacts on ecosystem services. In such case, please provide an indication of the interlinkage. As far as possible, it would be useful to separate costs of / loss due to the organism from costs of current management.

RESPONSE	minimal minor moderate major massive	CONFIDENCE	low medium high
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Response: No quantitative or qualitative information has been found on the issue. Neither Rice et al. (2012) or Buczkowski (2016) mentioned the costs associated with the management technique tested.

In a recent review of the economic costs of invasive ants, Angulo et al. (2022) reported costs of invasive ants compiled in the InvaCost database. Economic costs, reported since 1930 for 12 ant species in 27 countries, totalled US\$ 51.93 billion. More than 80% of total costs were associated with only two species, *Solenopsis invicta* and *Wasmannia auropunctata*. Overall, damage costs amounted to 92% of the total cost, mainly impacting the agriculture, public and social welfare sectors. Management costs were primarily post-invasion management (US\$ 1.79 billion), with much lower amounts dedicated to

prevention (US\$ 235.63 million). Besides the taxonomic bias, cost information was lacking for an average of 78% of the invaded countries.

These data give an idea of the cost associated with invasive alien ants in general. However, it is currently clear that *B. chinensis* generates fewer costs than *S. invicta* and *W. auropunctata*. Unlike these two species, *B. chinensis* does not appear to be an agricultural pest. Indeed, it does not tend sap sucking insects, but its painful sting can make it a real nuisance in any infested area. There may also be costs associated with the care of people injured by the bite and finally substantial costs associated with the management of the species.

Qu. 4.10. How great is the economic cost of / loss due to damage (excluding costs of management) of the organism currently in the risk assessment area (include any past costs in your response)?

- Where economic costs of / loss due to the organism have been quantified for a species anywhere in the EU these should be reported here. Assessment of the potential costs of damage on human health, safety, and the economy, including the cost of non-action. A full economic assessment at EU scale might not be possible, but qualitative data or different case studies from across the EU (or third countries if relevant) may provide useful information to inform decision making. In absence of specific studies or other direct evidences this should be clearly stated by using the standard answer “No information has been found on the issue”. This is necessary to avoid confusion between “no information found” and “no impact found”. In this case, no score and confidence should be given and the standardized “score” is N/A (not applicable). Cost of / loss due to damage within different economic sectors can be a direct or indirect consequence of the earlier-noted impacts on ecosystem services. In such case, please provide an indication of the interlinkage.

RESPONSE	N/A	CONFIDENCE	
	minimal		low
	minor		medium
	moderate		high
	major		
	massive		

Response: No information has been found on the issue.

Qu. 4.11. How great is the economic cost of / loss due to damage (excluding costs of management) of the organism likely to be in the future in the risk assessment area?

- See guidance to Qu. 4.10.

RESPONSE		CONFIDENCE	
	minimal		low
	minor		medium
	moderate		high

	major massive		
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Response: As no information has been found on the current economic costs of the species, it is difficult to predict future costs. It is likely that, if *B. chinensis* establishes and spread in the predicted suitable areas within the RA area, it will have economic costs that might be locally moderate to major regarding at least its health impacts. Economic damages are sector-specific and vary with the size and extent of the infestation.

The extent and strength of costs which depend on the densities of ants, are very difficult to estimate considering the uncertainty related to habitat/climatic suitability. According to Motoki et al. (2013), for *Wasmannia auropunctata*, the economic damage in sector I at time t is:

$$D_{i,t} = c_i^{damage} \cdot \frac{N_{i,t}^{final^2}}{N_i^{max}}$$

Here C_i^{damage} is the average economic damage of an infested site in sector I, $N_{i,t}^{final}$ is the number of infested sites in sector I at the end of time t; N_i^{max} is the number of sites in sector I that are susceptible to *W. auropunctata*. Thus, when sector I becomes fully infested, $N_{i,t}^{final} = N_i^{max}$ and annual damage is $C_i^{damage} N_i^{max}$ (Motoki et al 2013). This model has been developed for *W. auropunctata* but can be applied to other ants.

Qu. 4.12. How great are the economic costs / losses associated with managing this organism currently in the risk assessment area (include any past costs in your response)?

- In absence of specific studies or other direct evidences this should be clearly stated by using the standard answer “No information has been found on the issue”. This is necessary to avoid confusion between “no information found” and “no impact found”. In this case, no score and confidence should be given and the standardized “score” is N/A (not applicable).

RESPONSE	N/A minimal minor moderate major massive	CONFIDENCE	low medium high
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Response: No information has been found on the issue.

Qu. 4.13. How great are the economic costs / losses associated with managing this organism likely to be in the future in the risk assessment area?

- See guidance to Qu. 4.12.

RESPONSE	N/A	CONFIDENCE	
	minimal		low
	minor		medium
	moderate		high
	major		
	massive		

Response: No information has been found on the issue.

Social and human health impacts

Qu. 4.14. How important is social, human health or other impact (not directly included in any earlier categories) caused by the organism for the risk assessment area and for third countries, if relevant (e.g. with similar eco-climatic conditions).

The description of the known impact and the assessment of potential future impact on human health, safety and the economy, shall, if relevant, include information on

- illnesses, allergies or other affections to humans that may derive directly or indirectly from a species;
- damages provoked directly or indirectly by a species with consequences for the safety of people, property or infrastructure;
- direct or indirect disruption of, or other consequences for, an economic or social activity due to the presence of a species.

Social and human health impacts can be a direct or indirect consequence of the earlier-noted impacts on ecosystem services. In such case, please provide an indication of the interlinkage.

RESPONSE		CONFIDENCE	
	minimal		low
	minor		medium
	moderate		high
	major		
	massive		

Response: *Brachyponera chinensis* may be a social nuisance in infested areas. Colonies are common around urban areas. This ant has a painful sting that may cause injury to humans. The sting may produce an immediate, intense pain. It can result in anaphylactic shock, an acute allergic response (Cho et al. 2002; Leath et al. 2006; Nelder et al. 2006; Lee et al. 2009).

Stings are often reported to result in intense pain at the site of the sting that comes and goes over the course of several hours. Redness of the skin and mild to severe urticaria (hives) are reported as symptoms. In a study in the native range of the Asian needle ant, 2.1 percent of people stung exhibited anaphylaxis (Cho et al. 2002). While anaphylaxis has been reported in the US (Nelder et al. 2006), the

percentage of people who have developed hypersensitivity to Asian needle ant stings is unknown. The first report of anaphylaxis case to *B. chinensis* in the US was in 2006 (Leath et al. 2006). People who are hypersensitive to other stinging insects might be at increased risk of anaphylaxis.

Qu. 4.15. How important is social, human health or other impact (not directly included in any earlier categories) caused by the organism in the future for the risk assessment area.

- In absence of specific studies or other direct evidences this should be clearly stated by using the standard answer “No information has been found on the issue”. This is necessary to avoid confusion between “no information found” and “no impact found”. In this case, no score and confidence should be given and the standardized “score” is N/A (not applicable).

RESPONSE	minimal minor moderate major massive	CONFIDENCE	low medium high
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Response: It is likely that, if *B. chinensis* establishes and spreads in the RA area, the social impact, including health impact, may be moderate to potentially locally major, and similar to that observed in presently invaded areas elsewhere as in the USA.

Other impacts

Qu. 4.16. How important is the organism in facilitating other damaging organisms (e.g. diseases) as food source, a host, a symbiont or a vector etc.?

RESPONSE	minimal minor moderate major massive	CONFIDENCE	low medium high
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Response: *Brachyponera chinensis* is not known for facilitating other damaging organisms. Ants have been observed carrying pathogens, however up to date no transmission to humans or food contaminations have been recorded (Alharbi et al. 2019).

Qu. 4.17. How important might other impacts not already covered by previous questions be resulting from introduction of the organism?

RESPONSE	N/A minimal minor moderate major massive	CONFIDENCE	low medium high
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Response: No information has been found on the issue.

Qu. 4.18. How important are the expected impacts of the organism despite any natural control by other organisms, such as predators, parasites or pathogens that may already be present in the risk assessment area?

RESPONSE	minimal minor moderate major massive	CONFIDENCE	low medium high
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Response: There are no specialist natural enemies of *Brachyponera chinensis* in Europe because there is no native species of the genus *Brachyponera*. Thus, only generalist natural enemies of ants may affect the ant and these are highly unlikely to regulate (control) populations.

Qu. 4.19. Estimate the overall impact in the risk assessment area under current climate conditions. In addition, details of overall impact in relevant biogeographical regions should be provided.

Thorough assessment of the overall impact on biodiversity and ecosystem services, with impacts on economy as well as social and human health as aggravating factors, in current conditions.

RESPONSE	minimal minor moderate major massive	CONFIDENCE	low medium high
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Response: It is likely that, if *B. chinensis* establishes and spreads in the Alpine, Black Sea, Continental, Mediterranean, Pannonian, and Steppic regions, the overall impacts may be locally moderate to major, and at a minimum similar to that observed in currently invaded areas elsewhere. Compared to other invasive ants, *B. chinensis* has not yet been extensively studied for its impacts, which limits the strength of our conclusions.

Qu. 4.20. Estimate the overall impact in the risk assessment area in foreseeable climate change conditions. In addition, details of overall impact in relevant biogeographical regions should be provided.

Thorough assessment of the overall impact on biodiversity and ecosystem services, with impacts on economy as well as social and human health as aggravating factors, under future conditions.

- See also guidance to Qu. 4.3.

RESPONSE	minimal minor moderate major massive	CONFIDENCE	low medium high
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Response: It is assumed that in foreseeable climate change the likelihood of impact increases, however, the extent of the impacts is very difficult to estimate considering the uncertainty related to habitat/climatic suitability. Merchlinsky et al. (2023) studied, using an experimental approach, the effects of soil warming on *B. chinensis* impacts. They concluded that it may pose a greater threat to native ant communities than *Solenopsis invicta* in a warmer world.

RISK SUMMARIES			
	RESPONSE	CONFIDENCE	COMMENT
Summarise Introduction and Entry*	very unlikely unlikely moderately likely likely very likely	low medium high	The species has been already recorded/intercepted in Europe (Italy and Germany) and it is very likely that this will happen again, specifically with contaminated soil in the horticultural trade and/or as stowaway with container/bulk imports in sea or air freight. This is especially true as the areas where the species occurs are the main sources of imports into Europe (USA and East Asia). The points of introduction and entry into the environment are widespread in the RA area. Climate change is not affecting the risk of introduction or likelihood of entry based on the mentioned active pathways.
Summarise Establishment*	very unlikely unlikely moderately likely likely very likely	low medium high	The recent detection of an established population in Italy confirms the presence of the species in the RA area. Based on climatic similarity, probability of establishment is very likely with medium confidence in the Alpine, Black Sea, Continental and Mediterranean biogeographical regions, although the suitable area within each region is restricted. Under foreseeable climate change, the suitable area will increase significantly in the future.
Summarise Spread*	very slowly slowly moderately rapidly very rapidly	low medium high	Spread of the ant will occur mainly through human transport, but its distribution will be constrained by climate, habitat suitability and competition from other dominant ants (invasive and native). The rate of human assisted spread within the risk assessment area will depend on the internal volume of trade. Natural spread of the ant is

			probably slow. Climate change will not significantly increase the likelihood or magnitude of spread, even if it is expected to increase the distribution range in the risk assessment area.
Summarise Impact*	minimal minor moderate major massive	low medium high	It is likely that, if <i>B. chinensis</i> spreads in the risk assessment area, the impacts on biodiversity and ecosystem services and human health may be locally moderate to major, and very likely similar to that observed in currently invaded areas elsewhere. Compared to other invasive ants, <i>B. chinensis</i> has not been extensively researched for its impacts, which limits the strength of our conclusions. Climate change will not increase the impact score, but impacts will increase with the projected increase in distribution range.
Conclusion of the risk assessment (overall risk)	low moderate high	low medium high	Whereas the species has been introduced to other regions for more than 100 years, it has only recently caught more attention, especially with its recent expansion in the United States and its introduction and establishment in Russia and the Black Sea. There is evidence that it can enter the risk assessment area, probably through a wide variety of pathways, and it is very likely that it is able to establish. However, impacts in the risk assessment area are uncertain, and considered moderate outside the risk assessment area. It is expected that climate change will increase the distribution range and impact in the risk assessment area.

*in current climate conditions and in foreseeable future climate conditions

REFERENCES

- Abbott K, Harris R, Lester P. 2005. Invasive ant risk assessment: *Anoplolepis gracilipes*, Landcare Research contract report for Biosecurity New Zealand, Ministry of Agriculture and Forestry, Wellington, New Zealand.
- Alharbi JS, Alawadhi Q, Leather SR. 2019. Monomorium ant is a carrier for pathogenic and potentially pathogenic bacteria. BMC Res. Notes. doi:10.1186/s13104-019-4266-4.
- Angulo Elena, Hoffmann Benjamin D, Ballesteros-Mejia L, Taheri Ahmed, Balzani P, Bang Alok, Renault David, Cordonnier M, Bellard C, Diagne C, et al. 2022 Apr 25. Economic costs of invasive alien ants worldwide. Biol. Invasions 2022:1–20. doi:10.1007/S10530-022-02791-W. [accessed 2022 Jun 7]. <https://link.springer.com/article/10.1007/s10530-022-02791-w>.
- Bednar DM, Shik JZ, Silverman J. 2013. Prey handling performance facilitates competitive dominance of an invasive over native keystone ant. Behav. Ecol. 24:1312–1319. doi:10.1093/beheco/art069.
- Bertelsmeier C, Guénard B, Courchamp F. 2013. Climate Change May Boost the Invasion of the Asian Needle Ant. PLoS One 8:e75438. doi:10.1371/JOURNAL.PONE.0075438. [accessed 2022 May 25]. <https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0075438>.
- Blight O, Orgeas J, Torre F, Provost E. 2014. Competitive dominance in the organisation of Mediterranean ant communities. Ecol. Entomol. doi:10.1111/een.12137.
- Blight O, Provost E, Renucci M, Tirard A, Orgeas J. 2010. A native ant armed to limit the spread of the Argentine ant. Biol. Invasions 12:3785–3793.
- Buczowski G. 2016. The Trojan horse approach for managing invasive ants: a study with Asian needle ants, *Pachycondyla chinensis*. Biol. Invasions 18:507–515. doi:10.1007/s10530-015-1023-z.
- Bolton B. 1995. A new general catalogue of the ants of the world. Cambridge, Mass.: Harvard University Press, 504 pp.
- Brown WL Jr. 1958. A review of the ants of New Zealand. Acta Hymenopterologica 1:1-50.
- Bujan J, Charavel E, Bates OK, Gippet JMW, Darras H, Lebas C, Bertelsmeier C. 2021. Increased acclimation ability accompanies a thermal niche shift of a recent invasion. J. Anim. Ecol. 90:483–491. doi:10.1111/1365-2656.13381. [accessed 2022 Jun 4]. <https://onlinelibrary.wiley.com/doi/full/10.1111/1365-2656.13381>.
- Cho YS, Lee YM, Lee CK, Yoo B, Park HS, Moon HB. 2002. Prevalence of *Pachycondyla chinensis* venom allergy in an ant-infested area in Korea. J. Allergy Clin. Immunol. 110:54–57. doi:10.1067/mai.2002.124890.
- Emer C. 1895. Viaggio di Leonardo Fea in Birmania e regioni vicine. LXIII. Formiche di Birmania del Tenasserim e dei Monti Carin raccolte da L. Fea. Parte II. Annali del Museo Civico di Storia Naturale 34[(2)14]:450-483.
- Emery C. 1909. Beiträge zur Monographie der Formiciden des paläarktischen Faunengebietes. (Hym.) Teil VIII. Deutsche Entomologische Zeitschrift 1909:355-376.
- Eschen R, Roques A, Santini A. 2015. Taxonomic dissimilarity in patterns of interception and establishment of alien arthropods, nematodes and pathogens affecting woody plants in Europe. Divers. Distrib. 21:36–45. doi:10.1111/ddi.12267.
- Eyer PA, Matsuura K, Vargo EL, Kobayashi K, Yashiro T, Suehiro W, Himuro C, Yokoi T, Guénard B, Dunn RR, et al. 2018. Inbreeding tolerance as a pre-adapted trait for invasion success in the invasive ant *Brachyponera chinensis*. Mol. Ecol. 27:4711–4724. doi:10.1111/mec.14910.
- Eyre D, Macarthur R, Haack RA, Lu Y, Krehan H. 2018. Variation in Inspection Efficacy by Member States of Wood Packaging Material Entering the European Union. J. Econ. Entomol. 111:707–715. doi:10.1093/jee/tox357.

- Forel, A. 1900. Fourmis du Japon. Nids en toile. *Strongylognathus huberi* et voisins. Fourmilière triple. *Cyphomyrmex wheeleri*. Fourmis importées. *Mitteilungen der Schweizerischen Entomologischen Gesellschaft*, 10, 267–287.
- GIEC. 2007. Climate Change 2007: Synthesis report. An assessment of the Intergovernmental panel on Climate Change.
- Gippet JMW and Bertelsmeier C. 2021. Invasiveness is linked to greater commercial success in the global pet trade. *PNAS* 118, doi:10.1073/pnas.2016337118.
- Gippet JMW, Sherpa Z, Bertelsmeier C. 2022. Reliability of social media data in monitoring the global pet trade in ants. *Conserv. Biol.*, doi: 10.1111/cobi.14041.
- Gotoh A, Ito F. 2008. Seasonal cycle of colony structure in the Ponerine ant *Pachycondyla chinensis* in western Japan (Hymenoptera, Formicidae). *Insectes Soc.* 55:98–104. doi:10.1007/s00040-007-0977-y.
- Guénard B, Dunn RR. 2010. A New(Old), Invasive Ant in the Hardwood Forests of Eastern North America and Its Potentially Widespread Impacts. *PLoS One* 5:11614. doi:10.1371/journal.pone.0011614.
- Guénard B, Silverman J. 2011. Tandem carrying, a new foraging strategy in ants: description, function, and adaptive significance relative to other described foraging strategies. *Naturwissenschaften* 2011 988 98:651–659. doi:10.1007/S00114-011-0814-Z. [accessed 2022 Jun 7]. <https://link.springer.com/article/10.1007/s00114-011-0814-z>.
- Guénard B, Wetterer JK, Macgown JA. 2018. Global and Temporal Spread of a Taxonomically Challenging Invasive ant, *Brachyponera chinensis* (Hymenoptera: Formicidae). *Florida Entomol.* 101:649–656. doi:10.1653/024.101.0402.
- 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. 41 pp.
- Hee JJ, Holway D a., Suarez A V., Case TJ. 2000. Role of propagule size in the success of incipient colonies of the invasive Argentine ant. *Conserv. Biol.* 14:559–563. doi:10.1046/j.1523-1739.2000.99040.x.
- Hijmans RJ, Cameron SE, Parra JL, Jones PG, Jarvis A. 2005. Very high resolution interpolated climate surfaces for global land areas. *International Journal of Climatology*, 25, 1965–1978.
- Hoffmann BD, Luque GM, Bellard C, Holmes ND, Donlan CJ. 2016. Improving invasive ant eradication as a conservation tool: A review. *Biol. Conserv.* 198:37–49. doi:10.1016/j.biocon.2016.03.036.
- Hölldobler B, Wilson EO. 1990. *The Ants*. Harvard University Press, pp
- Holway DA, Lach L, Suarez A V., Tsutsui ND, Case TJ. 2002. The causes and consequences of ant invasions. *Annu. Rev. Ecol. Syst.* 33:181–233. doi:10.1146/annurev.ecolsys.33.010802.150444.
- Keller L, Passera L, Suzzoni J -P. 1989. Queen execution in the Argentine ant, *Iridomyrmex humilis*. *Physiol. Entomol.* 14:157–163. doi:10.1111/J.1365-3032.1989.TB00947.X. [accessed 2022 Jun 4]. <https://onlinelibrary.wiley.com/doi/full/10.1111/j.1365-3032.1989.tb00947.x>.
- Leath TM, Grier TJ, Jacobson RS, Fontana-Penn ME. 2006. Anaphylaxis to *Pachycondyla Chinensis*. *J. Allergy Clin. Immunol.* 117:S129. doi:10.1016/J.JACI.2005.12.517. [accessed 2022 Jun 7]. <http://www.jacionline.org/article/S0091674905032392/fulltext>.
- Lebas C, Galkowski C, Blatrix R, Wegnez P. 2016. Fourmis d'Europe occidentale.
- Lee EK, Jeong KY, Lyu DP, Lee YW, Sohn JH, Lim KJ, Hong CS, Park JW. 2009. Characterization of the major allergens of *Pachycondyla chinensis* in ant sting anaphylaxis patients. *Clin. Exp. Allergy* 39:602–607. doi:10.1111/J.1365-2222.2008.03181.X. [accessed 2022 Jun 7]. <https://onlinelibrary.wiley.com/doi/full/10.1111/j.1365-2222.2008.03181.x>.

- Luque GM, Giraud T, Courchamp F. 2013. Allee effects in ants. *J. Anim. Ecol.* 82:956–965. doi:10.1111/1365-2656.12091.
- MacGown JA. 2009. The Asian Needle Ant, *Pachycondyla chinensis* (Emery) (Hymenoptera: Formicidae), reported from Alabama. *Midsouth Entomol.* 2(2):88–89.
- Medail F, Quezel P. 1999. Biodiversity hotspots in the Mediterranean Basin: Setting global conservation priorities. *Conserv. Biol.* doi:10.1046/j.1523-1739.1999.98467.x.
- Menchetti M, Schifani E, Gentile V, Vila R. 2022. The worrying arrival of the invasive Asian needle ant *Brachyponera chinensis* in Europe (Hymenoptera: Formicidae). *Zootaxa* 5115:146–150. doi:10.11646/zootaxa.5115.1.10.
- Merchilinsky A, Frankson PT, Gitzen R, Lepczyk CA, Mohan JE, Warren RJ. 2023. Warming promotes non-native invasive ants while inhibiting native ant communities. *Ecol. Entomol.* doi.org/10.1111/een.13256.
- Mikheyev AS, Bresson S, Conant P. 2009. Single-queen introductions characterize regional and local invasions by the facultatively clonal little fire ant *Wasmannia auropunctata*. *Mol Ecol* 18:2937–2944. doi: 10.1111/j.1365-294X.2009.04213.x
- Miravete V, Roura-Pascual N, Dunn RR, Gomez C. 2014; How many and which ant species are being accidentally moved around the world? *Biol. Lett.* 10: 20140518.
- Motoki M, Lee DJ, Vanderwoude C, Nakamoto ST and Leung PS. 2013. A bioeconomic model of Little Fire Ant *Wasmannia auropunctata* in Hawaii. Technical Report No. 186. Pacific Cooperative Studies Unit, University of Hawai'i, Honolulu, Hawai'i. 89 pp.
- Murata N, Tsuji K, Kikuchi T. 2017. Social structure and nestmate discrimination in two species of brachyponera ants distributed in Japan. *Entomol. Sci.* 20:86–95. doi:10.1111/ens.12232.
- National Invasive Ant Biosecurity Plan Australian Government, Canberra. Available at: www.environment.gov.au/biodiversity/threatened/publications/tap/invasive-ants)
- Nelder MP, Paysen ES, Zungoli PA, Benson EP. 2006. Emergence of the introduced ant *Pachycondyla chinensis* (Formicidae: Ponerinae) as a public health threat in the southeastern United States. *J. Med. Entomol.* 43:1094–1098. doi:10.1603/0022-2585(2006)43[1094:EOTIAP]2.0.CO;2.
- Park SH, Moon TY. 2020. Structure of ant assemblages on street trees in urban Busan, Korea. *Entomol. Res.* 50:131–137. doi:10.1111/1748-5967.12415.
- Rabitsch W, Blight O. 2021. The threat posed by alien ants to EU agriculture and the potential for phytosanitary measures to prevent importation. Technical note prepared by IUCN for the European Commission.
- Rice ES, Shik JZ, Silverman J. 2012. Effect of Scattered and discrete hydramethylnon bait placement on the Asian needle ant. *J. Econ. Entomol.* 105:1751–1757. doi:10.1603/EC12207.
- Rice ES, Silverman J. 2013. Propagule Pressure and Climate Contribute to the Displacement of *Linepithema humile* by *Pachycondyla chinensis*. *PLoS One* 8. doi:10.1371/JOURNAL.PONE.0056281.
- Rodriguez-Cabal M, Stuble KL, Guénard B, Dunn RR, Sanders NJ. 2012. Disruption of ant-seed dispersal mutualisms by the invasive Asian needle ant (*Pachycondyla chinensis*). *Biol. Invasions* 14:557–565. doi:10.1007/s10530-011-0097-5.
- Ross KG, Trager JC. 1990. Systematics and population genetics of fire ants (*Solenopsis saevissima* complex) from Argentina. *Evolution* (N. Y.). 44:2113–2134. doi:10.2307/2409620.
- Rueppell O, Kirkman RW. 2005. Extraordinary starvation resistance in *Temnothorax rugatulus* (Hymenoptera, Formicidae) colonies: Demography and adaptive behavior. *Insectes Soc.* 52:282–290. doi:10.1007/S00040-005-0804-2. [accessed 2022 May 27].

<https://pubmed.ncbi.nlm.nih.gov/18521192/>.

- Schifani E, Grunicke D, Montechiarini A, Pradera C, Vila R, Menchetti M. 2024. Alien ants spreading through Europe: *Brachyponera chinensis* and *Nylanderia vividula* in Italy. Biodiversity Data Journal 12:e123502. <https://doi.org/10.3897/BDJ.12.e123502>
- Schmidt CA, Shattuck SO. 2014. The higher classification of the ant subfamily Ponerinae (Hymenoptera: Formicidae), with a review of Ponerine ecology and behavior.
- Shearer M, Dabbs A, Snipes Z, Bertagnolli V, Weaver J. Educators' Guide to Managing Red Imported Fire Ants (*Solenopsis invicta*) in School or Community Vegetable Gardens. Clemson (SC): Clemson Cooperative Extension, Land-Grant Press by Clemson Extension; 2020 Feb. LGP 1034. <https://lgpress.clemson.edu/publication/educators-guide-to-managing-red-imported-fire-ants-solenopsis-invicta-in-school-or-community-vegetable-gardens/>.
- Suehiro W, Hyodo F, Tanaka HO, Himuro C, Yokoi T, Dobata S, Guénard B, Dunn RR, Vargo EL, Tsuji K, et al. 2017. Radiocarbon analysis reveals expanded diet breadth associates with the invasion of a predatory ant. Sci. Rep. 7:1–10. doi:10.1038/s41598-017-15105-1.
- Suhr EL, O'Dowd DJ, Suarez AV, Cassey P, Wittmann TA, Ross JV, Cope RC. 2019. Ant interceptions reveal roles of transport and commodity in identifying biosecurity risk pathways into Australia. NeoBiota 53: 1-24.
- Vargo EL, Tsuji K, Matsuura K. 2016. Comparative genetic and ecological studies of the Asian needle ant, *Brachyponera chinensis*, in native and introduced ranges. In: NCUE/IFA. Albuquerque: New York City Health Department.
- Warren RJ, Frankson PT, Mohan JE. 2023. Global change drivers synergize with the negative impacts of non-native invasive ants on native seed-dispersing ants. Biol. Inv., vol. 25(3), 773-786. doi: 10.1007/s10530-022-02943-y
- Warren RJ, Candeias M, Lafferty A, Chick LD. 2020. Regional-scale environmental resistance to non-native ant invasion. Biol. Invasions 22:813–825. doi:10.1007/s10530-019-02133-3.
- Warren RJ, McMillan A, King JR, Chick L, Bradford MA. 2015. Forest invader replaces predation but not dispersal services by a keystone species. Biol. Invasions 17:3153–3162. doi:10.1007/s10530-015-0942-z.
- Waters JS, Keough NW, Burt J, Eckel JD, Hutchinson T, Ewanchuk J, Rock M, Markert JA, Axen HJ, Gregg D. 2022. Survey of ants (Hymenoptera, Formicidae) in the city of Providence (Rhode Island, United States) and a new northern-most record for *Brachyponera chinensis* (Emery, 1895). Check list, vol.18(6), 1347-1368.
- Yang X, Ning D, Ni M, Hassan B, Wu J, Xu Y. 2019. Interception of exotic ants and survey of the ant fauna at Gaoming Port, China. Asian Myrmecology 11: 1-11.
- Yashiro T, Matsuura K, Guénard B, Terayama M, Dunn RR. 2010. On the evolution of the species complex *Pachycondyla chinensis* (Hymenoptera: Formicidae: Ponerinae), including the origin of its invasive form and description of a new species. Zootaxa:39–50. doi:10.11646/zootaxa.2685.1.3.
- Zungoli PA, Benson EP. 2008. Seasonal occurrence of swarming activity and worker abundance of *Pachycondyla Chinensis*. Proc. Sixth Int. Conf. Urban Pests, 13-16 April 2008:51–57.

Distribution Summary

Please answer as follows:

- Yes if recorded, established or invasive
- if not recorded, established or invasive
- ? Unknown; data deficient

The columns refer to the answers to Questions A5 to A12 under Section A.

For data on marine species at the Member State level, delete Member States that have no marine borders.

In all other cases, provide answers for all columns.

Member States

	Recorded	Established (currently)	Possible establishment (under current climate)	Possible establishment (under foreseeable climate)	Invasive (currently)
Austria	–	–	–	Yes	–
Belgium	–	–	–	–	–
Bulgaria	–	–	–	Yes	–
Croatia	–	–	–	Yes	–
Cyprus	–	–	–	Yes	–
Czech Republic	–	–	–	–	–
Denmark	–	–	–	–	–
Estonia	–	–	–	–	–
Finland	–	–	–	–	–
France	–	–	–	Yes	–
Germany	Yes	–	–	Yes	–
Greece	–	–	–	–	–
Hungary	–	–	–	Yes	–
Ireland	–	–	–	–	–
Italy	Yes	Yes	Yes	Yes	?
Latvia	–	–	–	–	–
Lithuania	–	–	–	–	–
Luxembourg	–	–	–	–	–
Malta	–	–	–	–	–
Netherlands	–	–	–	–	–
Poland	–	–	–	Yes	–
Portugal	–	–	–	–	–
Romania	–	–	–	Yes	–
Slovakia	–	–	–	Yes	–
Slovenia	–	–	Yes	Yes	–
Spain	–	–	–	Yes	–
Sweden	–	–	–	–	–

Biogeographical regions of the risk assessment area

	Recorded	Established (currently)	Possible establishment (under current climate)	Possible establishment (under foreseeable climate)	Invasive (currently)
Alpine	–	–	Yes	Yes	–
Atlantic	–	–	–	–	–
Black Sea	–	–	Yes	Yes	–
Boreal	–	–	–	–	–
Continental	Yes	–	Yes	Yes	–
Mediterranean	Yes	Yes	Yes	Yes	?
Pannonian	–	–	–	Yes	–
Steppic	–	–	Yes	Yes	–

ANNEX I Scoring of Likelihoods of Events

(taken from UK Non-native Organism Risk Assessment Scheme User Manual, Version 3.3, 28.02.2005)

Score	Description	Frequency
Very unlikely	This sort of event is theoretically possible, but is never known to have occurred and is not expected to occur	1 in 10,000 years
Unlikely	This sort of event has occurred somewhere at least once in the last millenium	1 in 1,000 years
Moderately likely	This sort of event has occurred somewhere at least once in the last century	1 in 100 years
Likely	This sort of event has happened on several occasions elsewhere, or on at least once in the last decade	1 in 10 years
Very likely	This sort of event happens continually and would be expected to occur	Once a year

ANNEX II Scoring of Magnitude of Impacts

(modified from UK Non-native Organism Risk Assessment Scheme User Manual, Version 3.3, 28.02.2005)

Score	Biodiversity and ecosystem impact	Ecosystem Services impact	Economic impact (Monetary loss and response costs per year)	Social and human health impact, and other impacts
	<i>Question 4.1-5</i>	<i>Question 4.6-8</i>	<i>Question 4.9-13</i>	<i>Question 4.14-18</i>
Minimal	Local, short-term population decline, no significant ecosystem impact	No services affected ⁵	Up to 10,000 Euro	No social disruption. Local, mild, short-term reversible effects to individuals.
Minor	Local, short-term population loss, Localized reversible ecosystem impact	Local and temporary, reversible effects to one or few services	10,000-100,000 Euro	Significant concern expressed at local level. Mild short-term reversible effects to identifiable groups, localised.
Moderate	Local to regional long-term population decline/loss, Measureable reversible long-term damage to ecosystem, little spread, no extinction	Measureable, temporary, local and reversible effects on one or several services	100,000-1,000,000 Euro	Temporary changes to normal activities at local level. Minor irreversible effects and/or larger numbers covered by reversible effects, localised.
Major	Long-term irreversible ecosystem change, spreading beyond local area, population loss or extinction of single species	Local and irreversible or widespread and reversible effects on one / several services	1,000,000-10,000,000 Euro	Some permanent change of activity locally, concern expressed over wider area. Significant irreversible effects locally or reversible effects over large area.
Massive	Long-term irreversible ecosystem change, widespread, population loss or extinction of several species	Widespread and irreversible effects on one / several services	Above 10,000,000 Euro	Long-term social change, significant loss of employment, migration from affected area. Widespread, severe, long-term, irreversible health effects.

⁵ Not to be confused with “no impact”.

ANNEX III Scoring of Confidence Levels

(modified from Bacher et al. 2017)

Each answer provided in the risk assessment must include an assessment of the level of confidence attached to that answer, reflecting the possibility that information needed for the answer is not available or is insufficient or available but conflicting.

The responses in the risk assessment should clearly support the choice of the confidence level.

Confidence level	Description
Low	There is no direct observational evidence to support the assessment, e.g. only inferred data have been used as supporting evidence <i>and/or</i> Impacts are recorded at a spatial scale which is unlikely to be relevant to the assessment area <i>and/or</i> Evidence is poor and difficult to interpret, e.g. because it is strongly ambiguous <i>and/or</i> The information sources are considered to be of low quality or contain information that is unreliable.
Medium	There is some direct observational evidence to support the assessment, but some information is inferred <i>and/or</i> Impacts are recorded at a small spatial scale, but rescaling of the data to relevant scales of the assessment area is considered reliable, or to embrace little uncertainty <i>and/or</i> The interpretation of the data is to some extent ambiguous or contradictory.
High	There is direct relevant observational evidence to support the assessment (including causality) <i>and</i> Impacts are recorded at a comparable scale <i>and/or</i> There are reliable/good quality data sources on impacts of the taxa <i>and</i> The interpretation of data/information is straightforward <i>and/or</i> Data/information are not controversial or contradictory.

ANNEX IV CBD pathway categorisation scheme

Overview of CBD pathway categorisation scheme showing how the 44 pathways relate to the six main pathway categories. All of the pathways can be broadly classified into 1) those that involve intentional transport (blue), 2) those in which the taxa are unintentionally transported (green) and 3) those where taxa moved between regions without direct transportation by humans and/or via artificial corridors (orange and yellow). **Note that the pathways in the category “Escape from confinement” can be considered intentional for the introduction into the risk assessment area and unintentional for the entry into the environment.**



ANNEX V Ecosystem services classification (CICES V5.1, simplified) and examples

For the purposes of this risk assessment, please feel free to use what seems as the most appropriate category / level / combination of impact (Section – Division – Group), reflecting information available.

Section	Division	Group	Examples (i.e. relevant CICES “classes”)
Provisioning	Biomass	Cultivated <i>terrestrial</i> plants	<p>Cultivated terrestrial plants (including fungi, algae) grown for <u>nutritional purposes</u>; <u>Fibres and other materials</u> from cultivated plants, fungi, algae and bacteria for direct use or processing (excluding genetic materials); Cultivated plants (including fungi, algae) grown as a <u>source of energy</u></p> <p><i>Example: negative impacts of non-native organisms to crops, orchards, timber etc.</i></p>
		Cultivated <i>aquatic</i> plants	<p>Plants cultivated by in- situ aquaculture grown for <u>nutritional purposes</u>; <u>Fibres and other materials</u> from in-situ aquaculture for direct use or processing (excluding genetic materials); Plants cultivated by in- situ aquaculture grown as an <u>energy source</u>.</p> <p><i>Example: negative impacts of non-native organisms to aquatic plants cultivated for nutrition, gardening etc. purposes.</i></p>
		Reared animals	<p>Animals reared for <u>nutritional purposes</u>; <u>Fibres and other materials</u> from reared animals for direct use or processing (excluding genetic materials); Animals reared to provide <u>energy</u> (including mechanical)</p> <p><i>Example: negative impacts of non-native organisms to livestock</i></p>
		Reared <i>aquatic</i> animals	<p>Animals reared by in-situ aquaculture for <u>nutritional purposes</u>; <u>Fibres and other materials</u> from animals grown by in-situ aquaculture for direct use or processing (excluding genetic materials); Animals reared by in-situ aquaculture as an <u>energy source</u></p> <p><i>Example: negative impacts of non-native organisms to fish farming</i></p>
		Wild plants (terrestrial and aquatic)	<p>Wild plants (terrestrial and aquatic, including fungi, algae) used for <u>nutrition</u>; <u>Fibres and other materials</u> from wild plants for direct use or processing (excluding genetic materials); Wild plants (terrestrial and aquatic, including fungi, algae) used as a <u>source of energy</u></p> <p><i>Example: reduction in the availability of wild plants (e.g. wild berries, ornamentals) due to non-native organisms (competition, spread of disease etc.)</i></p>
		Wild animals (terrestrial and aquatic)	<p>Wild animals (terrestrial and aquatic) used for <u>nutritional purposes</u>; <u>Fibres and other materials</u> from wild animals for direct use or processing (excluding genetic materials); Wild animals (terrestrial and aquatic) used as a <u>source of energy</u></p>

			<i>Example: reduction in the availability of wild animals (e.g. fish stocks, game) due to non-native organisms (competition, predations, spread of disease etc.)</i>
	Genetic material from all biota	Genetic material from plants, algae or fungi	<u>Seeds, spores and other plant materials</u> collected for maintaining or establishing a population; Higher and lower plants (whole organisms) used to <u>breed new strains or varieties</u> ; Individual genes extracted from higher and lower plants for the <u>design and construction of new biological entities</u> <i>Example: negative impacts of non-native organisms due to interbreeding</i>
		Genetic material from animals	Animal material collected for the purposes of maintaining or establishing a population; Wild animals (whole organisms) used to breed new strains or varieties; Individual genes extracted from organisms for the design and construction of new biological entities <i>Example: negative impacts of non-native organisms due to interbreeding</i>
	Water⁶	Surface water used for nutrition, materials or energy	Surface water for <u>drinking</u> ; Surface water used as a material (<u>non-drinking purposes</u>); Freshwater surface water, coastal and marine water used as an <u>energy source</u> <i>Example: loss of access to surface water due to spread of non-native organisms</i>
		Ground water for used for nutrition, materials or energy	Ground (and subsurface) water for <u>drinking</u> ; Ground water (and subsurface) used as a material (<u>non-drinking purposes</u>); Ground water (and subsurface) used as an <u>energy source</u> <i>Example: reduced availability of ground water due to spread of non-native organisms and associated increase of ground water consumption by vegetation.</i>
	Regulation & Maintenance	Transformation of biochemical or physical inputs to ecosystems	Mediation of wastes or toxic substances of anthropogenic origin by living processes <u>Bio-remediation</u> by micro-organisms, algae, plants, and animals; <u>Filtration/sequestration/storage/accumulation</u> by micro-organisms, algae, plants, and animals <i>Example: changes caused by non-native organisms to ecosystem functioning and ability to filtrate etc. waste or toxics</i>
			Mediation of nuisances of anthropogenic origin <u>Smell reduction; noise attenuation; visual screening</u> (e.g. by means of green infrastructure) <i>Example: changes caused by non-native organisms to ecosystem structure, leading to reduced ability to mediate nuisances.</i>
		Regulation of physical, chemical, biological conditions	Baseline flows and extreme event regulation Control of <u>erosion</u> rates; Buffering and attenuation of <u>mass movement</u> ; <u>Hydrological cycle and water flow regulation</u> (Including flood control, and coastal protection); <u>Wind</u> protection; <u>Fire</u> protection

⁶ Note: in the CICES classification provisioning of water is considered as an abiotic service whereas the rest of ecosystem services listed here are considered biotic.

			Example: changes caused by non-native organisms to ecosystem functioning or structure leading to, for example, destabilisation of soil, increased risk or intensity of wild fires etc.
		Lifecycle maintenance , habitat and gene pool protection	Pollination (or 'gamete' dispersal in a marine context); <u>Seed dispersal</u> ; Maintaining <u>nursery populations and habitats</u> (Including gene pool protection) Example: changes caused by non-native organisms to the abundance and/or distribution of wild pollinators; changes to the availability / quality of nursery habitats for fisheries
		Pest and disease control	Pest control; Disease control Example: changes caused by non-native organisms to the abundance and/or distribution of pests
		Soil quality regulation	<u>Weathering processes</u> and their effect on soil quality; <u>Decomposition and fixing processes</u> and their effect on soil quality Example: changes caused by non-native organisms to vegetation structure and/or soil fauna leading to reduced soil quality
		Water conditions	Regulation of the <u>chemical condition</u> of freshwaters by living processes; Regulation of the chemical condition of salt waters by living processes Example: changes caused by non-native organisms to buffer strips along water courses that remove nutrients in runoff and/or fish communities that regulate the resilience and resistance of water bodies to eutrophication
		Atmospheric composition and conditions	Regulation of <u>chemical composition</u> of atmosphere and oceans; Regulation of <u>temperature and humidity</u> , including ventilation and transpiration Example: changes caused by non-native organisms to ecosystems' ability to sequester carbon and/or evaporative cooling (e.g. by urban trees)
Cultural	Direct, in-situ and outdoor interactions with living systems that depend on presence in the environmental setting	Physical and experiential interactions with natural environment	Characteristics of living systems that enable activities promoting health, recuperation or enjoyment through <u>active or immersive interactions</u> ; Characteristics of living systems that enable activities promoting health, recuperation or enjoyment through <u>passive or observational interactions</u> Example: changes caused by non-native organisms to the qualities of ecosystems (structure, species composition etc.) that make it attractive for recreation, wild life watching etc.
		Intellectual and representative interactions with natural environment	Characteristics of living systems that enable <u>scientific investigation</u> or the creation of traditional ecological knowledge; Characteristics of living systems that enable <u>education and training</u> ; Characteristics of living systems that are resonant in terms of <u>culture or heritage</u> ; Characteristics of living systems that enable <u>aesthetic experiences</u>

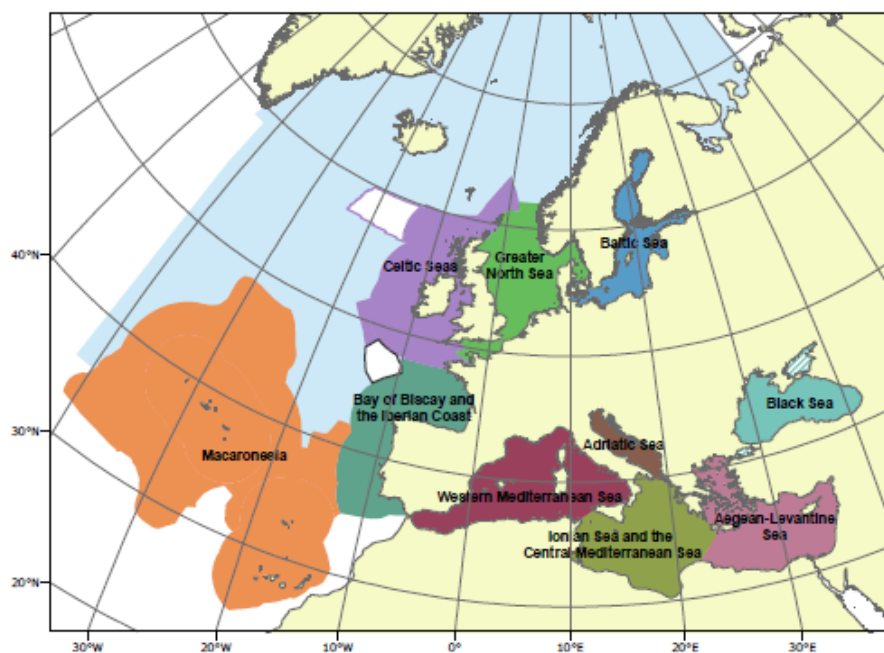
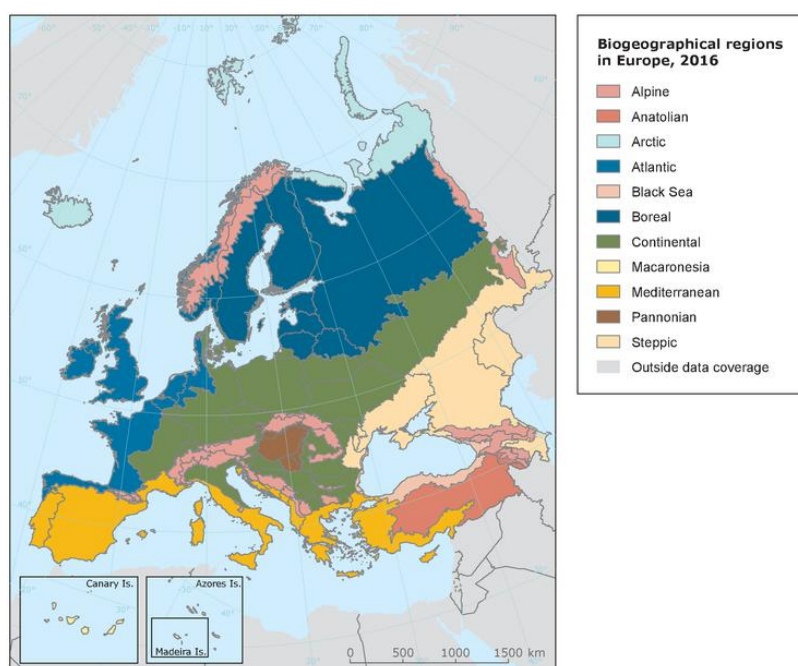
			<p><i>Example: changes caused by non-native organisms to the qualities of ecosystems (structure, species composition etc.) that have cultural importance</i></p>
	<p>Indirect, remote, often indoor interactions with living systems that do not require presence in the environmental setting</p>	<p>Spiritual, symbolic and other interactions with natural environment</p>	<p>Elements of living systems that have <u>symbolic meaning</u>; Elements of living systems that have <u>sacred or religious meaning</u>; Elements of living systems used for <u>entertainment or representation</u></p> <p><i>Example: changes caused by non-native organisms to the qualities of ecosystems (structure, species composition etc.) that have sacred or religious meaning</i></p>
		<p>Other biotic characteristics that have a non-use value</p>	<p>Characteristics or features of living systems that have an <u>existence value</u>; Characteristics or features of living systems that have an <u>option or bequest value</u></p> <p><i>Example: changes caused by non-native organisms to ecosystems designated as wilderness areas, habitats of endangered species etc.</i></p>

ANNEX VI EU Biogeographic Regions and MSFD Subregions

See <https://www.eea.europa.eu/data-and-maps/figures/biogeographical-regions-in-europe-2> ,
http://ec.europa.eu/environment/nature/natura2000/biogeog_regions/

and

<https://www.eea.europa.eu/data-and-maps/data/msfd-regions-and-subregions-1/technical-document/pdf>



ANNEX VII Delegated Regulation (EU) 2018/968 of 30 April 2018

see <https://eur-lex.europa.eu/legal-content/en/TXT/?uri=CELEX%3A32018R0968>

ANNEX VIII Species Distribution Model of *Brachyponera chinensis*

By Björn Beckmann, UKCEH

To estimate the effect of climate change on the potential distribution, we obtained future climate conditions modelled for the 2070s under the Representative Concentration Scenarios (RCP) 2.6 and 4.5 (Annex VIII). These represent low and medium emissions scenarios, respectively. Climate data were selected from the 'Bioclim' variables contained within the WorldClim database (Hijmans et al., 2005), originally at 5 arcminute resolution (0.083 x 0.083 degrees of longitude/latitude) and aggregated to a 0.25 x 0.25 degree grid for use in the model.

Based on the biology of *Brachyponera chinensis*, the following climate variables were used in the modelling:

- Minimum temperature of the coldest month (Bio6)
- Mean temperature of the warmest quarter (Bio10)
- Precipitation of the warmest quarter (Bio18)

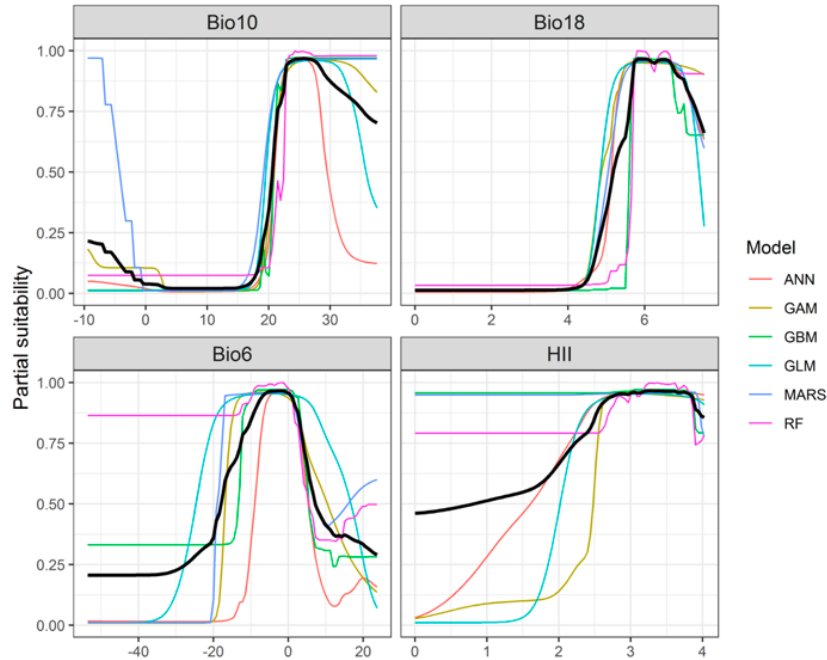
The above variables were obtained as averages of outputs of eight Global Climate Models (BCC-CSM1-1, CCSM4, GISS-E2-R, HadGEM2-AO, IPSL-CM5A-LR, MIROC-ESM, MRI-CGCM3, NorESM1-M), downscaled and calibrated against the WorldClim baseline (http://www.worldclim.org/cmip5_5m). The following habitat layers were used: Human influence index (HII): As many non-native invasive species associate with anthropogenically disturbed habitats, we used the Global Human Influence Index Dataset of the Last of the Wild Project (Wildlife Conservation Society - WCS & Center for International Earth Science Information Network - CIESIN - Columbia University, 2005), which is developed from nine global data layers covering human population pressure (population density), human land use and infrastructure (built-up areas, nighttime lights, land use/land cover) and human access (coastlines, roads, railroads, navigable rivers). The index ranges between 0 and 1 and was $\ln+1$ transformed for the model to improve normality. Projections were classified into suitable and unsuitable regions using a "lowest presence threshold", setting the cut-off as the lowest value at which 98% of all presence records are classified correctly under the current climate (here 0.43).

The ensemble model suggested that suitability for *Brachyponera chinensis* was most strongly determined by Precipitation of the warmest quarter (Bio18), accounting for 36.6% of variation explained, followed by Mean temperature of the warmest quarter (Bio10) (33.5%), Minimum temperature of the coldest month (Bio6) (20.2%) and Human influence index (HII) (9.7%) (Table 1, Figure 1).

Table 1. Summary of the cross-validation predictive performance (AUC, Kappa, TSS) and variable importance of the fitted model algorithms and the ensemble (AUC-weighted average of the best performing algorithms). Results are the average from models fitted to 10 different background samples of the data.

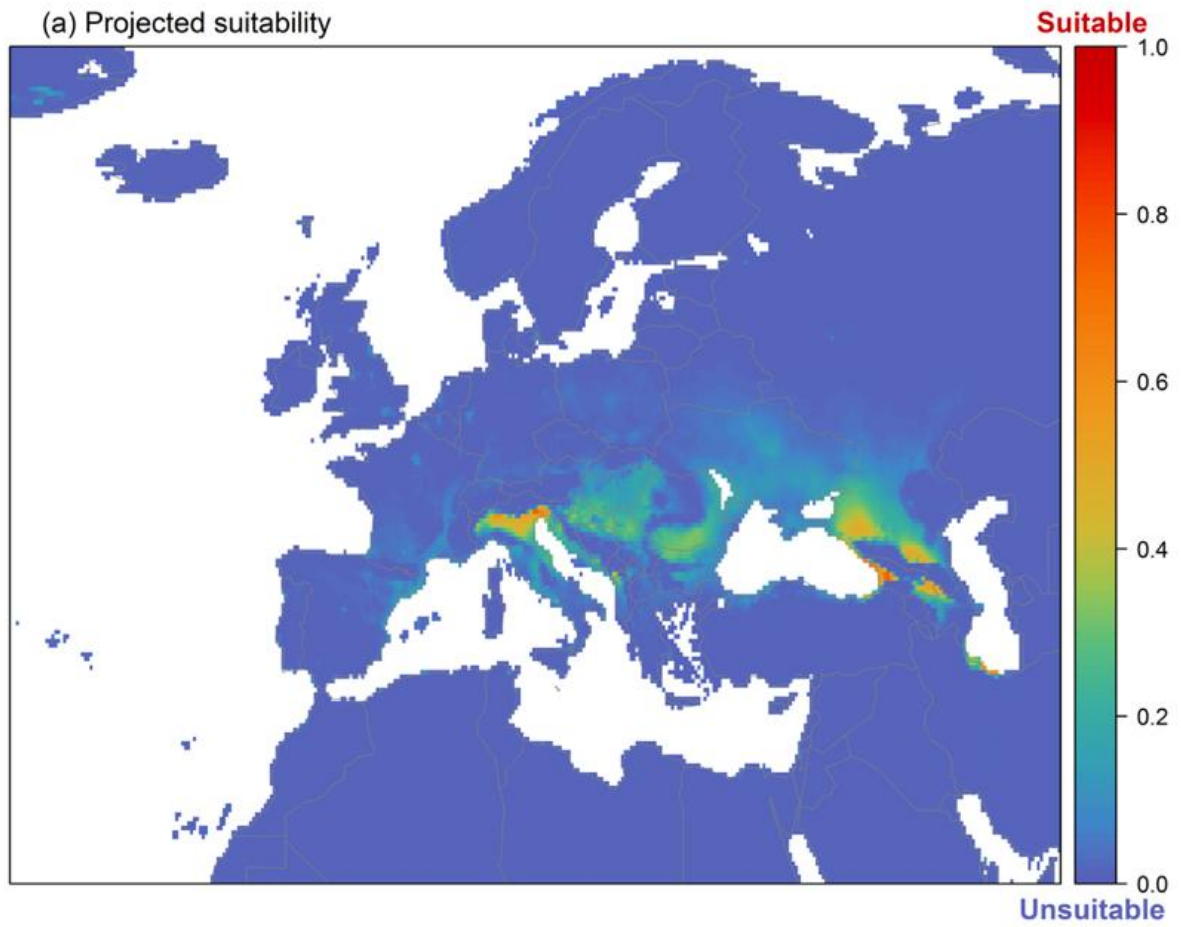
Algorithm	AUC	Kappa	TSS	Used in the ensemble	Variable importance (%)			
					Precipitation of the warmest quarter (Bio18)	Mean temperature of the warmest quarter (Bio10)	Minimum temperature of the coldest month (Bio6)	Human influence index (HII)
GLM	0.974	0.728	0.896	yes	29	35	17	20
GAM	0.972	0.734	0.898	yes	26	31	22	20
GBM	0.974	0.715	0.903	yes	50	33	16	1
ANN	0.975	0.729	0.902	yes	27	32	30	11
MARS	0.970	0.726	0.900	yes	37	35	28	0
RF	0.970	0.698	0.910	yes	50	35	9	6
Maxent	0.967	0.707	0.885	no	38	39	18	5
Ensemble	0.976	0.717	0.905		37	33	20	10

Figure 3. Partial response plots from the fitted models. Thin coloured lines show responses from the algorithms in the ensemble, while the thick black line is their ensemble. In each plot, other model variables are held at their median value in the training data. Some of the divergence among algorithms is because of their different treatment of interactions among variables.



(a) Projected current suitability for *Brachyponera chinensis* establishment in Europe and the Mediterranean region. Values > 0.43 are suitable for the species, with 98% of global presence records above this threshold. Values below 0.43 indicate lower relative suitability. (b) Projected suitability for

Brachyponera chinensis establishment in Europe and the Mediterranean region in the 2070s under climate change scenario RCP2.6.



(b) Projected suitability

