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The prioritisation of a short list of alien plants for risk analysis within the framework of the Regulation (EU) No. 1143/2014

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Abstract

Thirty-seven alien plant species, pre-identified by horizon scanning exercises were prioritised for pest risk analysis (PRA) using a modified version of the EPPO Prioritisation Process designed to be compliant with the EU Regulation 1143/2014. In Stage 1, species were categorised into one of four lists – a Residual List, EU List of Minor Concern, EU Observation List and the EU List of Invasive Alien Plants. Only those species included in the latter proceeded to the risk management stage where their priority for PRA was assessed. Due to medium or high spread potential coupled with high impacts twenty-two species were included in the EU List of Invasive Alien Plants and proceeded to Stage 2. Four species (*Ambrosia trifida*, *Egeria densa*, *Fallopia baldschuanica* and *Oxalis pes-caprae*) were assigned to the EU Observation List due to moderate or low impacts. *Albizia lebbeck*, *Clematis terniflora*, *Euonymus japonicus*, *Lonicera morrowii*, *Prunus campanulata* and *Rubus rosifolius* were assigned to the residual list due to a current lack of information on impacts. Similarly, *Cornus sericea* and *Hydrilla verticillata* were assigned to the Residual List due to unclear taxonomy and uncertainty in native status, respectively. *Chromolaena odorata*, *Cryptostegia grandiflora* and *Sphagneticola trilobata* were assigned to the Residual List as it is unlikely they will establish in the Union under current climatic conditions. In the risk management stage, *Euonymus fortunei*, *Ligustrum sinense* and *Lonicera maackii* were considered a low priority for PRA as they do not exhibit invasive tendencies despite being widely cultivated in the EU over several decades. Nineteen species were identified as having a high priority for a PRA (*Acacia dealbata*, *Ambrosia confertiflora*, *Andropogon virginicus*, *Cardiospermum grandiflorum*, *Celastrus orbiculatus*, *Cinnamomum camphora*, *Cortaderia jubata*, *Ehrharta calycina*, *Gymnocoronis spilanthoides*, *Hakea sericea*, *Humulus scandens*, *Hygrophila polysperma*, *Lespedeza cuneata*, *Lygodium japonicum*, *Pennisetum setaceum*, *Prosopis juliflora*, *Sapium sebiferum*, *Pistia stratiotes* and *Salvinia molesta*).

Keywords
Biodiversity, ecosystem services, Europe, impact, non-native, risk management

Introduction

Trade liberalisation and rapid globalisation have led to the increased spread of invasive alien species (IAS) around the world (van Kleunnen et al. 2015). IAS (plants, animals, fungi or micro-organisms) are recognised as one of the greatest threats to biological diversity by inflicting irreversible damage to the ecosystems they invade (Wilcove et al. 1998). In Europe, there are an estimated 12,000 alien species with 10-15 % considered invasive and it is these species that cost the EU around €12-billion per year (European Commission 2014, Kettunen et al. 2008).

Established invasive alien plant species are one of the largest groups of IAS both in terms of species numbers and the area they occupy (Sheppard et al. 2006). There are an estimated 3,749 naturalised alien plant species in Europe of which 1,780 are alien to Europe, with the remaining being native to parts of Europe (Pyšek et al. 2009). When alien plants invade regions, they can outcompete native plant species through direct (Daehler 2003) or indirect competition (Murrell et al. 2011). Impacts, because of habitat modification and displacement of native plant species can cascade to higher trophic levels impacting at an ecosystem scale (Tanner et al. 2013, Daniel et al. 2003, Levine et al. 2003). Although impacts on ecosystem services are less studied, examples show negative effects on provisioning (Kasulo 2000, Eagle et al. 2007), regulating (Chittka and Schürkens 2001, Prater et al. 2006) and cultural services (Chilton et al. 2002, McFarland et al. 2004).

To mitigate the threat of IAS to the European Union (EU), the European Commission adopted the EU Regulation (No. 1143/2014) 'on the prevention and management of the introduction and spread of invasive alien species' which came into force on the 1st January 2015 (EU 2014, Genovesi et al. 2015, Tollington et al. 2015). The EU Regulation, hereafter referred to as the IAS Regulation, aims to primarily address the negative impact of IAS on biodiversity and ecosystem services, while impacts on human health and the economy are considered as aggravating factors. The

IAS Regulation is centred around three main themes (1) prevention, (2) early warning and rapid response, and (3) management. The IAS Regulation will restrict the use, trade and transport of certain IAS and will be underpinned by a list of IAS of Union concern. At present the Union List contains 37 IAS, of which 14 species are invasive alien plants (European Commission 2016).

The IAS of Union concern will be subject to stringent enforcements including a ban on sale and preventative actions such as a ban on import (see Genovesi et al. 2015). Member States will be obliged to prevent the spread and conduct eradication and management measures for species on the list and already present in Member States (EU 2014). In theory, such measures would go a long way to mitigating entry and impacts of invasive, or potentially invasive alien plants in the EU, especially when considering two thirds of established alien plant species have been introduced intentionally for horticulture or agricultural purposes (Keller et al. 2011).

The IAS Regulation places an emphasis on prevention as opposed to cure, and as such the focus should be on species with a limited regional distribution within the Union, and species that are currently absent but pose a potential threat in the future. Many European countries and regional organisations have produced species lists and conducted horizon scanning studies which have identified priority species (Gallardo et al. 2015, Roy et al. 2015). However, for a species to be included in the list of Union concern a risk assessment is required to technically and objectively evaluate scientific and economic evidence to determine the level of risk associated with a species. It should be noted that the European and Mediterranean Plant Protection Organization (EPPO) always combines risk assessment with risk management, resulting in a risk analysis and hereafter referred to as a pest risk analysis (PRA).

A PRA can be a time-consuming process requiring significant finances and high levels of species specific expertise. When presented with a large pool of invasive, or potentially invasive alien plants, prioritizing species for PRA is an essential prerequisite to focus limited resources. High priority species would be those that have the highest negative impact and can be prevented from entering, or cost effectively managed in the European Union (Kumschick et al. 2012, Branquart et al. 2016).

Several schemes have been developed for different countries or regions to prioritise alien plants (Austria-Germany: Essl et al. 2011, Belgium: D'hondt et al. 2014, central Europe: Weber and Gut 2004). The scheme by Brunel et al. (2010) was designed to assess alien plants under the Plant Health Regulation. However, in the context of the IAS Regulation, more emphasis is required on impacts on biodiversity and ecosystem services. Due to this shift in the regulatory process of invasive alien plants, a new prioritisation scheme was designed to ensure that species prioritisation was compliant with the IAS Regulation (Branquart et al. 2016). What the new prioritisation process allows is to (1) prioritise species based on their impacts and spread, (2) to exclude species unsuited for PRA due to a lack of scientific information and (3), include the effectiveness of potential risk management measures for a given species in the prioritisation process. Thus, the prioritisation process deals with both risk assessment and risk management (i.e. risk analysis).

The objective of this study was to produce a list of alien plant species that comply with the definitions and criteria of Article 4 of the IAS Regulation, i.e. alien species that would be capable of causing major detrimental impacts on biodiversity and associated ecosystem services after establishment and spread within the EU territory, and to determine which of these have the highest priority for PRA at the European level.

Method

In March 2016, a three-day workshop was held at EPPO in Paris (FR), with the purpose of prioritising a list of invasive alien plants for PRA as part of a LIFE funded project 'Mitigating the threat of invasive alien plants in the EU through pest risk analysis to support the EU Regulation 1143/2014' (LIFE15 PRE FR 001) (see, www.IAP-risk.eu). Eight experts from the EPPO Panel on Invasive Alien Plants, the NERC Centre for Ecology and Hydrology and the EPPO Secretariat attended the workshop.

Species selected for prioritisation

We appreciate that there are numerous alien plants which could be proposed as candidates for prioritisation, however, due to limited time and financial resources we focused on species that had already been preselected by horizon scanning from two sources. Species were taken from the EPPO List of Invasive Alien Plants (see www.eppo.int) and a recent horizon scanning exercise by Roy et al. (2015).

The EPPO List of Invasive Alien Plants included a total of 15 plant species identified as having a high priority for a PRA whereas Roy et al. (2015) identified a total of 24 plant species which present a high or very high risk to the EU within the next ten years. Of the 24 species identified in Roy et al. (2015), two species (*Alternanthera philoxeroides* (Mart.) Griseb. and *Microstegium vimineum* (Trin.)) had recently been risk analysed (see www.eppo.int) and were excluded from further assessment. Therefore, 22 species from Roy et al. (2015) and 15 species from the EPPO List of Invasive Alien Plants were combined to produce a list of 37 species for prioritisation. Further prioritisation of these 37 species was required based on the requirements of the IAS Regulation. In the case of the species from the EPPO list, these species were selected using the original EPPO prioritisation Scheme (Brunel et al., 2010), where the focus for selection was based on the criteria of the Plant Health Regulation. The species from Roy et al. (2015) included species where scientific data (e.g. impacts, establishment etc.) was lacking, and in addition, European Union outermost regions (e.g. Azores, Canary Islands and Madeira) were included as areas at risk though the IAS Regulation excludes these regions. Lastly, when Roy et al. (2015) prioritised their species risk management criteria were not considered. We suggest that risk management is a vital consideration when prioritizing species for the IAS Regulation to select species where preventative actions are feasible (see Article 4.3 (e) and Article 4.6).

EPPO prioritisation process compliant with the IAS Regulation

The prioritisation scheme used for this study was an amended version of the EPPO prioritisation process for Invasive Alien Plants (Brunel et al. 2010, EPPO standard PM5/6), specifically adapted within the remit of the LIFE project to be fully compliant with the IAS Regulation. A full description of the process is given in Branquart et al. (2016) and depicted in figure (1). The prioritisation process was designed to meet the requirements of Article 4 (IAS Regulation) where the highest priority for performing a PRA at the European level is given to species that satisfy the following criteria: (i) they are alien to the territory of the EU excluding the outermost regions, (ii) they are capable of establishing a viable population and spreading rapidly in the environment in the EU (excluding the outermost regions), (iii) they are capable of causing major detrimental impacts to biodiversity and the associated ecosystem services, (iv) actions can be taken to effectively prevent, minimise or mitigate their adverse impact, which involves that they are moved from country to country primarily by human activities and they still have a significant area suitable for further spread within the EU (EU 2014).

The first stage of the process, the preliminary risk assessment stage, categorises each species into one of four lists (Residual List, EU List of Minor Concern, EU Observation List and the EU List of Invasive Alien Plants) by addressing pre-determined criteria (questions). To proceed to any of the three EU lists, each species needs to meet the requirements of questions A1, A2, A3, A5 and A6, i.e. a positive (yes) answer is required. If a negative (no) answer is recorded, the species is included in the Residual List of species that do not qualify. Reasons a species (including subspecies, varieties, hybrids and cultigens, hereafter collectively called species) may be included in the Residual list include uncertainty in taxonomy and nomenclatural (question A1. Fig. 1), or a lack of current scientific information (question A3. Fig.1). Only those species included in the EU List of Invasive Alien Plants (those species which have the highest potential spread capacity and high negative impacts on biodiversity or ecosystem services) proceed to the risk management stage.

Within the second stage, the preliminary risk management stage, priority for a PRA at the EU level is evaluated based on the feasibility and cost-effectiveness of mitigating impacts with management measures and/or preventative actions. The output of stage two is to define the species into one of two categories:

(1) the plant species is included in a List of Priority Invasive Alien Plants for performing an EU level PRA,
(2) the plant species is included in a List of Invasive Alien Plants that are not considered as a priority to conduct a EU level PRA.

Gathering of species information

Scientific information was collected for each species prior to the workshop. Each expert collected detailed scientific information on each species from a number of predeter-

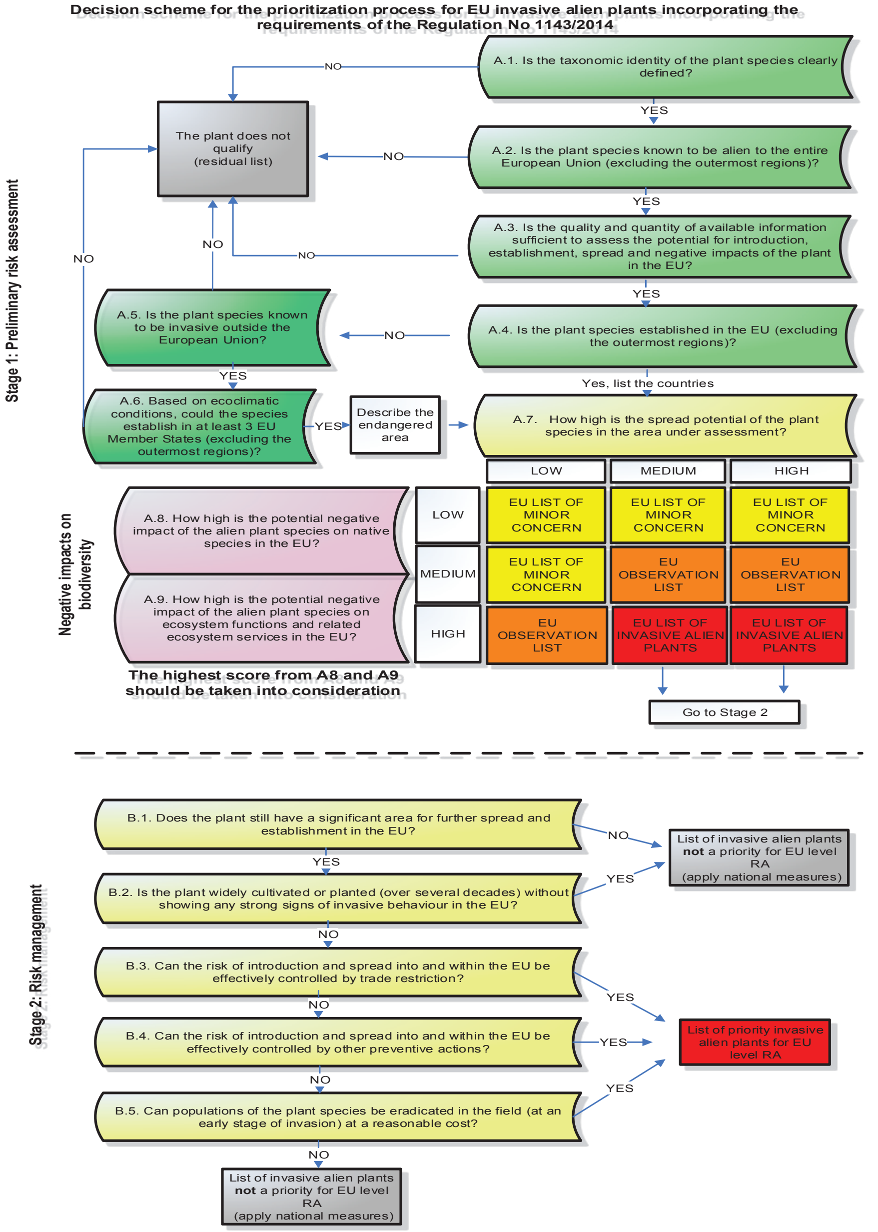

Figure 1. Decision scheme for the EU prioritisation process for alien plants (Taken from Branquart et al. 2016).

species occurrence were developed. A key criterion in evaluating the risk of a species to the EU is to assess if the species can establish under current climatic conditions. This is especially important for species which are currently absent from the region but have been highlighted as a risk through horizon scanning exercises.

Table 1. Key information sources. Information resources utilised when collecting information on the species.

Scientific area	Relating to question in EU P. process	Key resources
Stage 1		
Taxonomic identity	A1	The Plant List (http://www.theplantlist.org/)
Geographical origin	A2	ARS Grin Taxonomy (http://www.ars-grin.gov/)
Global occurrence	A4	GBIF (http://www.gbif.org), EPPO Global Database (https://gd.eppo.int/), CABI ISC (http://www.cabi.org/isc/), Q-Bank (http://www.q-bank.eu/)
Global invasive behavior	A5	Scientific literature, reports, expert opinion
Spread potential & areas threatened	A6, A7	Scientific literature, reports, expert opinion
Impacts	A8, A9	Scientific literature, reports, expert opinion
Stage 2		
Current occurrence within the EU	B1	GBIF (http://www.gbif.org), EPPO Global Database (https://gd.eppo.int/), CABI ISC (http://www.cabi.org/isc/), Q-Bank (http://www.q-bank.eu/)
Invasive behavior in the EU	B2	Scientific literature, reports, expert opinion
Trade status	B3	Numerous internet suppliers (e.g. https://www.rhs.org.uk/; http://www.ebay.com/; https://www.amazon.com/)
Phytosanitary measures	B4, B5	Scientific literature, reports, expert opinion

mined resources, including online databases scientific publications (internet searches and Web of Science), grey literature and relevant books and personal communications (see Table 1). For each species, where possible, the primary data sources were reviewed.

Quality and quantity of information for each species was evaluated under the main headings set out in Table 1. Quantitative data from scientific publications (scientific papers and reports) was considered superior to unreferenced information gathered from online databases. However, during the prioritisation assessment, all information was included and where unreferenced information was considered important, a concerted effort was taken to substantiate any reports. Each species was prioritised using compiled information where each question was answered in chronological order (see Figure 1). A consensus was reached between the experts based on available information and expert opinion.

Uncertainty scores were assigned to questions A7 (spread) and A8–A9 (impacts) following the criteria set out in Branquart et al. (2016). Uncertainty scores increase where the species is absent from the EU or information on a species was conflicting.

Modelling the potential occurrence of species

To support question A6, ‘based on ecoclimatic conditions, could the species establish in at least 3 EU Member States (excluding the outermost regions)’, maps of potential

However, modelling the potential distributions of alien species presents challenges, including the non-equilibrium nature of the distribution, presence of casual records representing failed introductions and spatial biases in recording effort (Václavik and Meentemeyer 2012). Substantial effort is usually required to develop accurate models that account for these effects, prohibiting the use of such models for rapid multi-species PRA prioritisation exercises. Therefore, we adopted a simple but precautionary approach based on delimiting a 'climate envelope' of each species that can be projected onto a map of Europe.

To delimit climate envelopes, we used the 19 standard bioclimatic variables gridded at 10 arcminute resolution (0.167 × 0.167 decimal degrees) from WorldClim (Hijmans et al. 2005). 'Climate space' was summarised by taking the first two axes of a principal components analysis (PCA) on centred and scaled bioclimatic variables, with log-transformed precipitation variables. These axes captured 77.5 % of the variation in climate. For each species, georeferenced occurrence data was obtained from the Global Biodiversity Information facility (GBIF: www.gbif.org). Data points were filtered according to expert opinion (Figure 2A). The species occurrences were then plotted in climate space, by extracting the PCA axis scores for occurrence locations (Figure 2B). To delimit a climate envelope for each species, bivariate density kernels were fitted to the occurrences in climate space using the kernelUD function of R package adehabitat with automatic selection of the smoothing parameter (Calenge 2006). From these models, 95 % kernel density polygons were extracted for each species. These bound the region of climate space containing 95 % of the smoothed occurrence density of each species. Finally, the climate envelopes were projected onto the EU by identifying the grid cells whose PCA axis scores fell inside the species' climate envelope (Figure 2C). The resulting maps were critically appraised by the working group panel, using their expert knowledge to consider the accuracy of the estimates and the potential for non-climatic factors such as habitat availability to limit establishment.

We emphasise that this method does not provide a definitive estimate of the potential for further species establishment, but rather a way of rapidly assessing if a species is worthy of further consideration in full PRA. We also note that the 95 % density kernels may be overly generous and exceed the climatic tolerances of the species. However, while a lower percentage threshold could have been used to constrict the envelopes, a precautionary approach is desirable for our purpose, given that invasive species may not have fully filled their climate niche space and because many species can invade outside of their native climatic niche (Bocsi et al. 2016).

Results

The 37 alien plant species prioritised in this study include representatives from 23 families where Asteraceae (5 species) and Poaceae (4 species) are most represented (Table 1). In total, the list contained 6 aquatics and 31 terrestrial species. Terrestrial

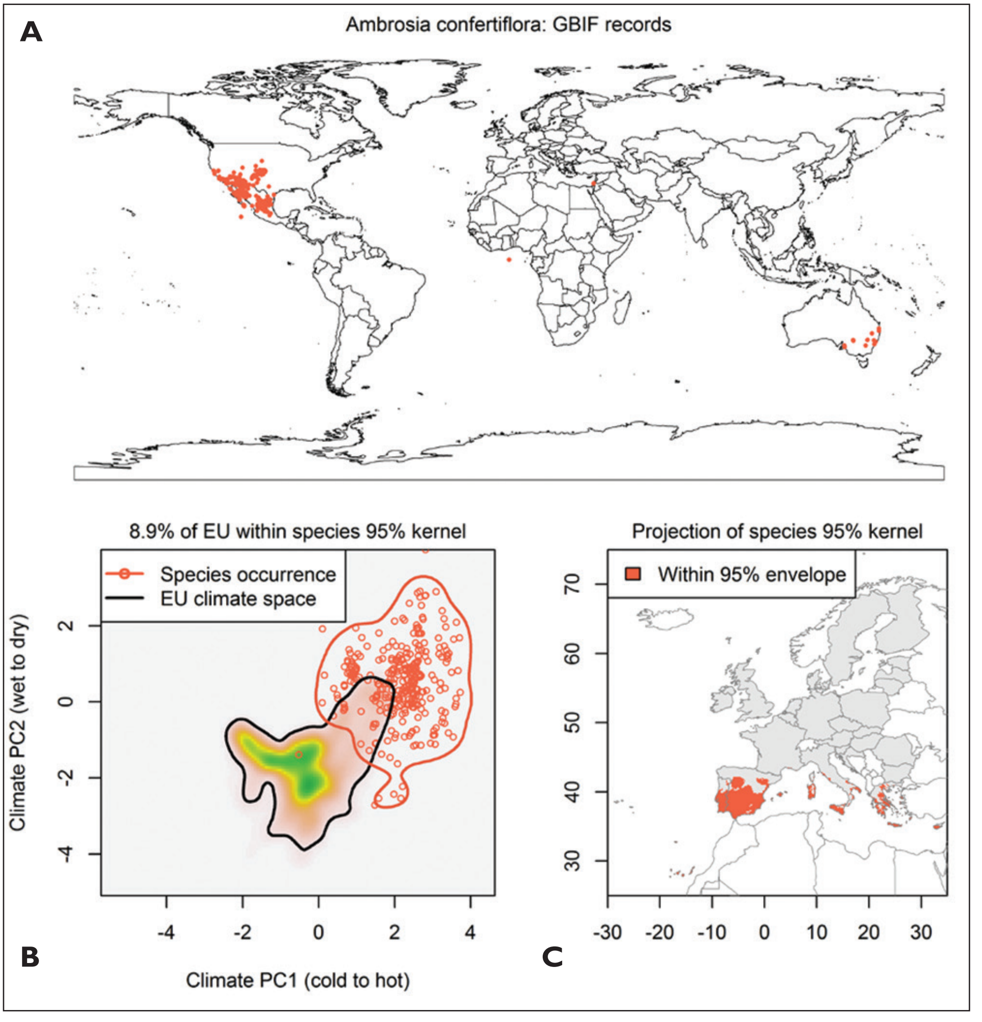

Figure 2. An example of the distribution maps and potential occurrence in Europe – *Ambrosia confertiflora*. **A** Global occurrence locations were obtained from the Global Biodiversity Information Facility **B** The global climate was summarised as two principal components analysis (PCA) axes on the 19 WorldClim layers (Hijmans et al. 2005). Species occurrences were plotted in this climate space and a bivariate normal kernel density model (Calenge 2006) was used to estimate 'climate envelopes' at different percentiles **C** These envelopes were then projected onto geographic space in the EU. Shading indicates these percentiles, with smaller numbers indicating higher density of occurrences.

species included 4 perennial grasses, 10 vines, 6 tree species, 7 woody shrubs and 4 perennial herbs. Almost half of the species (43 %) were native to Asia, followed by South America (18 %), North America (13 %), Africa (8 %), Australia (5 %) and pan-global species (8 %).

Stage 1 (risk assessment)

The first stage of the prioritisation process categorised 22 plant species in the EU List of Invasive Alien Plants, 4 plant species in the EU Observational List and 11 species in the Residual List (Table 2). None of the species were assigned to the List of Minor Concern. All species assigned to the EU List of Invasive Alien Plants fulfilled the criteria set out in questions A1 to A3; indicating a clear taxonomy, alien to the EU and the quality of information was sufficient to assess traits and impacts.

Cornus sericea L. did not fulfil the criteria of the first question in the prioritisation process 'Is the taxonomic identity of the plant species clearly established' as naturalised plants belong to a complex of hybrids of *C. sericea* and *C. alba* (Q-Bank 2016) and thus was included in the Residual List. Similarly, *Hydrilla verticillata* (L.f.) Royle was included in the Residual List as there is evidence the species is native in the EU (Ireland, Poland and the Baltic states; Cook and Lüönd 1982). *Albizia lebbeck* (L.) Benth., *Clematis terniflora* DC., *Euonymus japonicus* Thunb., *Lonicera morrowii* A. Gray, *Prunus campanulata* Maxim. and *Rubus rosifolius* SM. were assigned to Residual List as the quality of information for each was insufficient, potentially impeding a consise PRA.

Of the 29-species assessed under question A4 (is the plant species established in the EU excluding the outermost regions?), 68 % are recorded as established (Table 2). However, this includes 12 species where a clear established population could be debated, and for these species questions A5 and A6 were answered for completeness. All species were invasive in at least one geographical region in the world (excluding the EU), though 50 % of the species are recorded as invasive in two geographical regions, 13 % in three geographical regions and one species *Pistia stratiotes* L. is recorded as invasive in four regions.

Three species, *Chromolaena odorata* (L.) King & H.E.Robins, *Cryptostegia grandiflora* R.Br. and *Sphagneticola trilobata* (L.) Pruski were assigned to the Residual List due to uncertainty in potential for establishment (A.6). Species occurrence maps overlaid in EU climate space indicated establishment at 0.1 %, 0.3 % and 0.2 %, respectively.

The majority of species evaluated in question A7 (88 %) were assigned a high score for spread potential, indicating the species is highly fecund and propagules can spread over distances of 500 to 1,000 m from the parent plant (Table 3). Except for the aquatic species, all species are vigorous seed producers with evidence that propagules are carried by wind, water or wildlife (see Table 3).

For impact (A8: impacts on native plant species, A9: impacts on ecosystem functions and related ecosystem services), the highest of the two scores from A8 and A9 was used in the assessment. A high impact score, coupled with a medium or high spread potential, categorised the species in the EU List of Invasive Alien Plants whereas a medium impact score, coupled with a medium or high spread potential, listed the species in the EU Observation List. It is interesting to note that 84 % of species assessed in question A8 scored high compared to only 19 % scoring high for impacts on ecosystem functions and related ecosystem services. The low percentages for the latter may reflect the current lack of data on such impacts compared to direct impacts on native

Table 2. Results from the prioritisation exercise (Stage 1: risk assessment). The first stage of the prioritisation process categorised twenty-two plant species in the European List of Invasive Alien Plants (List IAP), 4 plant species in the European Observational List (Obs List) and 11 species were rejected from the process (Residual List) as they did not fulfil the criteria of specific questions. Area abbreviations follow: Aus: Australia, N. Am: North America, Afr: Africa, S.Am: South America, Oce: Oceanic. Country abbreviations correspond to ISO codes. The symbol (ǂ) represents some uncertainty in the establishment of a species in the EU and thus questions A5 and A6 are completed for these species. Under A6, the percentage corresponds to the estimate area of the EU within the species 95% Kernel. Under questions A8 and A9, uncertainty is represented by (L) low, (M) medium or (H) high.

Species	A.1. Clear taxonomy	A.2. Alien in the EU	A.3. Quality of information sufficient	A.4. Established in the EU	A.5. Invasive outside the EU	A.6. Establishment in the EU	A.7. Spread	A.8. Impact on native plant species	A.9. Impact on ecosystem functions and services	Conclusion of stage 1
Acacia dealbata (Fabaceae)	Yes	Yes (Aus)	High	Yes (ES, FR, IT)			Medium	High (M): forms dense stands displaces native species (Lorenzo et al. 2012)	Medium (L): Nitrogen cycle modifications (Weber 2003)	List IAP
Albizia lebbeck (Fabaceae)	Yes	Yes (Asia)	Low (STOP)	----	----	----	----	----	----	Residual List
Ambrosia confertiflora (Asteraceae)	Yes	Yes (N.Am)	Medium/ High	No	Yes (C.Asia, Oce)	Yes (8.80%)	High	High (M): forms dense stands displaces native species (EPPO 2014a)	Medium (H): Ecosystem modifier (EPPO 2014a)	List IAP
Ambrosia trifida (Asteraceae)	Yes	Yes (N.Am)	Medium/ High	Yesǂ (ES, NL, RO, PL, FR, IT)	Yes (Asia)	Yes (90%)	High	Medium (L): allelopathic and competes with native spp. for nutrients/light (EPPO 2014b)	Low (M): No recorded impacts	Obs List
Andropogon virginicus (Poaceae)	Yes	Yes (N.Am)	High	Yesǂ (FR)	Yes (Asia, N.Am, Oce)	Yes (70.10%)	High	High (H): Allelopathic impacts (Stone 1985)	Medium (H): Promotes fire (Stone 1985)	List IAP
Cardiospermum grandiflorum (Sapindaceae)	Yes	Yes (Afr, S. Am)	Medium	Yesǂ (IT)	Yes (Afr)	Yes (5.10%)	High	High (M): Smothers native spp. (McKay et al. 2010)	Medium (M): Habitat transformer ((Henderson 2001)	List IAP

Species	A.1. Clear taxonomy	A.2. Alien in the EU	A.3. Quality of information sufficient	A.4. Established in the EU	A.5. Invasive outside the EU	A.6. Establishment in the EU	A.7. Spread	A.8. Impact on native plant species	A.9. Impact on ecosystem functions and services	Conclusion of stage 1
Celastrus orbiculatus (Celastraceae)	Yes	Yes (Asia)	High	Yes‡ (GB)	Yes (N.Am, Oce)	Yes (77%)	High	High (H): Suppression native spp. (Fike and Niering 1999)	Medium (H): Negatively affects aesthetics (CABI 2016)	List IAP
Chromolaena odorata (Asteraceae)	Yes	Yes (S.Am)	High	No	Yes (Afr, N.Am, Oce)	No (STOP)	----	----	----	Residual List
Cinnamomum camphora (Lauraceae)	Yes	Yes (Asia)	High	Casual (FR)	Yes (N.Am, Oce)	Yes (35.10%)	High	High (H): Forms monocultures/ Allelopathic impacts (Firth 1979)	Medium (H): Ecosystem modifier (CABI 2016)	List IAP
Clematis terniflora (Ranunculaceae)	Yes	Yes (Asia)	Low (STOP)	----	----	----	----	----	----	Residual List
Cornus sericea (Cornaceae)	No (STOP)	----	----	----	----	----	----	----	----	Residual List
Cortaderia jubata (Poaceae)	Yes	Yes (S. Am)	High	No	Yes (N.Am, Oce)	Yes (55.80%)	High	High (M): Strongly competes for resources (Lambrinos 2000)	High (M): Alters trophic levels/reduces aesthetics (Bossard et al. 2000)	List IAP
Cryptostegia grandiflora (Apocynaceae)	Yes	Yes (Afr)	High	No	Yes (Oce, S.Am)	No (STOP)	----	----	----	Residual List
Egeria densa (Hydrocharitaceae)	Yes	Yes (S. Am)	High	Yes (FR, BE, IT, NL, UK)			High	Medium (H): Displaces native spp. (CABI 2016)	Medium (H): Reduces recreation activities (CABI 2016)	Obs List
Ehrharta calycina (Poaceae)	Yes	Yes (S. Afr)	High	Yes‡ (ES, PT)	Yes (N.Am)	Yes (15.30%)	High	High (M): Outcompetes native plant spp. (Bossard et al. 2000)	Medium (M): Alter fire regimes (Fisher et al. 2006)	List IAP

Species	A.1. Clear taxonomy	A.2. Alien in the EU	A.3. Quality of information sufficient	A.4. Established in the EU	A.5. Invasive outside the EU	A.6. Establishment in the EU	A.7. Spread	A.8. Impact on native plant species	A.9. Impact on ecosystem functions and services	Conclusion of stage 1
Euonymus fortunei (Celastraceae)	Yes	Yes (Asia)	High	Yes‡ (LV)	Yes (N.Am)	Yes (70.10%)	High	High (M): Outcompetes native plant spp. (Bauer and Reynolds 2016)	Medium (H): Ecosystem modifier (Bauer and Reynolds 2016)	List IAP
Euonymus japonicus (Celastraceae)	Yes	Yes (Asia)	Low (STOP)	----	----	----	----	----	----	Residual List
Fallopia baldschuanica (Polygonaceae)	Yes	Yes (Asia)	High	Yes (widespread)			Medium	Medium (M): Smoothers native spp. (EPPO 2012a)	Medium (M): Ecosystem modifier (EPPO 2012a)	Obs List
Gymnocoronis spilanthoides (Asteraceae)	Yes	Yes (N. Am, S.Am.)	High	Yes‡ (HU, IT)	Yes (Asia, Oce)	Yes (14.20%)	High	High (M): forms dense monocultures/ displaces native species (CAB, 2016)	Medium (M): Reduces recreation activities (Weeds CRC 2008, EPPO 2012b)	List IAP
Hakea sericea (Proteaceae)	Yes	Yes (Aus)	Medium	Yes (FR, ES, PT)			High	High (H): Alter composition of native communities (Richardson et al. 1989)	Medium (M): Reduces recreation activities (CABI 2016)	List IAP
Humulus scandens (Cannabaceae)	Yes	Yes (Asia)	High	Yes (FR, IT, HU)			High	High (M): Dense stands outcompete native spp. (EPPO 2007a)	Medium (M): Ecosystem modifier (EPPO 2007a)	List IAP
Hydrilla verticillata (Hydrocharitaceae)	Yes	No (STOP)	----	----	----	----	----	----	----	Residual List

Species	A.1. Clear taxonomy	A.2. Alien in the EU	A.3. Quality of information sufficient	A.4. Established in the EU	A.5. Invasive outside the EU	A.6. Establishment in the EU	A.7. Spread	A.8. Impact on native plant species	A.9. Impact on ecosystem functions and services	Conclusion of stage 1
Hygrophila polysperma (Acanthaceae)	Yes	Yes (Asia)	High	Yes‡ (DE)	Yes (N.Am)	Yes (75.20%)	High	High (H): Dense mats outcompete native plant spp. (Cuda and Sutton 2000)	High (M): Reduces recreation activities (CABI 2016) and blocks drainage systems (Cuda and Sutton 2000)	List IAP
Lespedeza cuneata (Fabaceae)	Yes	Yes (Aus, Asia)	Medium	No	Yes (N.Am, Afr)	Yes (49.10%)	High	High (M): Outcompetes native species/ allelopathic (Coykendall 2011)	Medium (H): Ecosystem modifier (NWCA 2016)	List IAP
Ligustrum sinense (Oleaceae)	Yes	Yes (Asia)	High	Yes‡ (IT, PT, GB)			High	High (M): Reduces abundance and species richness of native plant spp. (Wilcox and Beck 2007)	Medium (H): Ecosystem modifier (Merriam and Feil 2002)	List IAP
Lonicera maackii (Caprifoliaceae)	Yes	Yes (Asia)	Medium	No	Yes (N.Am)	Yes (72.60%)	High	High (M): Reduces plant species richness (Gould and Gorchov 2000; Collier et al. 2002)	Low (H): No recorded impacts	List IAP
Lonicera morrowii (Caprifoliaceae)	Yes	Yes (Asia)	Low (STOP)	----	----	----	----	----	----	Residual List
Lygodium japonicum (Lygodiaceae)	Yes	Yes (Asia)	Medium	No	Yes (N.Am, Oce)	Yes (26.50%)	High	High (H): Dense monocultures outcompete native spp. (Leichty et al. 2011)	Medium (H): Ecosystem modifier (CABI 2016)	List IAP

Species	A.1. Clear taxonomy	A.2. Alien in the EU	A.3. Quality of information sufficient	A.4. Established in the EU	A.5. Invasive outside the EU	A.6. Establishment in the EU	A.7. Spread	A.8. Impact on native plant species	A.9. Impact on ecosystem functions and services	Conclusion of stage 1
Oxalis pes-caprae (Oxalidaceae)	Yes	Yes (Afr)	High	Yes (FR, IT, PT, ES, GB, MT)			Medium	Medium (M): Outcompetes native plant spp. (Petsikos et al. 2007)	Medium (M): Ecosystem modifier (Petsikos et al. 2007)	Obs List
Pennisetum setaceum (Poaceae)	Yes	Yes (Afr, Asia)	High	Yes (IT, PT, ES)			High	High (H): Disrupts primary succession and competes with native species for resources (Cordell and Sandquist 2008)	Low (H): No recorded impacts	List IAP
Pistia stratiotes (Araceae)	Yes	Yes (S.Am)	High	Yes‡ (DE, ES, IT, SI)	Yes (Afr, Asia, N.Am, Oce)	Yes (69.40%)	High	High (M): forms dense mats displaces native species (Hussner 2014; Cilliers et al. (1996)	Medium (H): Reduces recreation activities (Chamier et al. 2012)	List IAP
Prosopis juliflora (Mimosoideae)	Yes	Yes (C.Am, S. Am)	High	No	Yes (Asia, Afr, Oce)	Yes (7.10%)	High	High (M): Outcompetes native plant spp. (Kaur et al. 2012)	High (H): Degrades land/ negative social effect (Choge et al. 2002)	List IAP
Prunus campanulata (Rosaceae)	Yes	Yes (Asia)	Low (STOP)	----	----	----	----	----	----	Residual List
Rubus rosifolius (Rosaceae)	Yes	Yes (Asia)	Low (STOP)	----	----	----	----	----	----	Residual List

Species	A.1. Clear taxonomy	A.2. Alien in the EU	A.3. Quality of information sufficient	A.4. Established in the EU	A.5. Invasive outside the EU	A.6. Establishment in the EU	A.7. Spread	A.8. Impact on native plant species	A.9. Impact on ecosystem functions and services	Conclusion of stage 1
Salvinia molesta (Salviniaceae)	Yes	Yes (S.Am)	High	Yes‡ (IT, PT)	Yes (Afr, N.Am, Oce)	Yes (62.80%)	High	High (M): forms dense monocultures/ displaces native species (Thomas 1981)	High (M): Alters trophic levels, reduces areas for recreation (McFarland et al. 2004; Chilton et al. 2002)	List IAP
Sapium sebiferum (Euphorbiaceae)	Yes	Yes (Asia)	Medium	No	Yes (N.Am, Oce)	Yes (21.70%)	High	High (M): Outcompetes native plant spp. (Camarillo et al. 2015)	High (H): Alters nutrient composition (Bruce et al. 1997)	List IAP
Sphagneticola trilobata (Asteraceae)	Yes	Yes (S.Am)	Medium	Yes‡ (ES, IT)	Yes (Asia, Afr, C. Am, N. Am, Oce)	No (STOP)	----	----	----	Residual List

Table 3. The spread potential scores, uncertainty rating and justification for the 24 plant species assessed under question A7. Spread scores are based on Branquart et al. (2016) where a medium score indicates the species reproduces vigorously vegetatively and/or sexually and spreads mainly in the vicinity of the mother plant; dispersion capacity in the environment rarely exceeds 100–200 m from the mother plant. A high score indicates plant is highly fecund and is regularly observed to spread over distances >500–1000 m from the maternal plant.

Species	Spread score	Uncertainty	Justification
Acacia dealbata	Medium	High	Clonal growth from parental plants. Seed dispersed by birds (DAISIE 2006)
Ambrosia confertiflora	High	Low	Seeds spread over long distances when the hooked spines attach to livestock and wild animals, or can be spread by water, especially during flooding, as the woody burr floats (EPPO 2014)
Ambrosia trifida	High	Medium	Seeds spread naturally via water courses. Seeds also a contaminant of seed stock (CABI 2016)
Andropogon virginicus	High	Medium	Seed spread over long distances by wind (Campbell 1983)
Cardiospermum grandiflorum	High	Medium	Fruit capsules can spread via wind or float along water bodies dispersing the propagules over long distances (EPPO 2012b).
Celastrus orbiculatus	High	Medium	Birds and small mammals spread seed (CABI 2016)
Cinnamomum camphora	High	Medium	Reproduces by seed which are eaten and spread by birds (Firth 1979)
Cortaderia jubata	High	Low	In California, each plant can produce over 100 000 seeds which are wind dispersed (Drewitz and DiTomaso (2004)
Egeria densa	High	Medium	Spread by stem fragments throughout watercourse (State of Washington 2016)
Ehrharta calycina	High	Medium	Seeds spread by wind movement (Wittkuhn 2010)
Euonymus fortunei	High	Medium	Seeds are dispersed by birds and other wildlife and by water (NPWG 2010)
Fallopia baldschuanica	Medium	Low	Spread by seed, vegetatively and rhizomes (EPPO 2007)
Gymnocoronis spilanthoides	High	Medium	Broken stem fragments are spread by water currents, and can also be accidentally spread by machinery (e. g. boats, trailers, etc.) or animal hooves, and grow into a new plant when settling in a stream bed, and then form new colonies (EPPO 2012b).
Hakea sericea	High	Low	Winged seeds which are produced in large numbers are dispersed by wind (Richardson et al. 1987)
Humulus scandens	High	Low	Reproduces by seeds which are spread by wind and water (EPPO 2007a)
Hygrophila polysperma	High	Low	Brittle stem fragments are capable of spreading by water currents (Kasselmann 1994). Spread can be facilitated by recreational activities (DCR 2003).
Lespedeza cuneata	High	Medium	Aggressively spreading species. Reproduces by seed as well as vegetatively (Bugwood 2016)
Ligustrum sinense	High	Low	Prolific seed producer and the fruit is spread by birds up to 1 km from parental plant (Swarbrick et al. 1999).
Lonicera maackii	High	Low	Birds and mammals disperse seeds over long distances in the USA (Castellano and Gorchov 2013).

Species	Spread score	Uncertainty	Justification
Lygodium japonicum	High	Low	Tiny spores are readily dispersed by wind (CABI 2016)
Oxalis pes-caprae	Medium	Medium	Vegetative reproduction dispersed by agricultural activity and water (DAISIE 2006).
Pennisetum setaceum	High	Low	Seeds spread over long distances by wind (PCA 2005)
Pistia stratiotes	High	Low	Long dispersal of plants facilitated by water movement (Hussner and Heiligtag 2013). Additional spread likely from water birds and recreational activities
Prosopis juliflora	High	Low	Seed is spread by birds and mammals over long distances. Seeds can become incorporated into waterbodies facilitating spread (CRC Weed Management 2003)
Salvinia molesta	High	Medium	The floating form of the plant facilitates its spread within waterbodies (McFarland et al. 2004); likewise, flooding also has the potential to carry plants to new waterbodies or wetland habitats (McFarland et al. 2004).
Sapium sebiferum	High	Medium	Seeds can become incorporated into waterbodies and disperse through the system. Birds eat and disperse seeds (Jubinsky and Anderson 1996)

plant species. Four species, *Ambrosia trifida* L., *Egeria densa* Planch., *Fallopia baldschuanica* (Regel) Holub and *Oxalis pes-caprae* L., were assigned to the EU Observation list due a medium impact score.

Stage 2 (Risk management)

Of the 22 species assessed under stage 2, 19 were considered as a high priority for a PRA at the EU level (Table 4). All species were regarded as having the potential for further spread in climatically suitable regions (see Table 4).

Andropogon virginicus L., *Humulus scandens* (Lour.) Merr., and *Lespedeza cuneata* (Dum. Cours.) G.Don, were regarded as having the highest potential for further spread where each could colonise 4 biogeographical regions.

Three species, *Euonymus fortunei* (Turcz.) Hand.-Maz., *Ligustrum sinense* Lour. and *Lonicera maackii* (Rupr.) Maxim., were considered low priority for PRA as all are widely cultivated within the EU without showing significant signs of invasive behaviour (Table 4). However, all three species are known to be invasive in North America, particularly in the eastern States which have similar climatic zones to regions in Europe (see Köppen-Geiger climate classification, Kottek et al. 2006). Based on the precautionary principle, national measures could be applied to these species, including country specific PRA.

Most species (68 %) evaluated under question B3 (can the risk of introduction and spread into and within the EU be effectively controlled by trade restrictions?), are sold within the EU and therefore a European level PRA would be required to assess if trade restrictions could prevent further introduction and spread (Table 3). Where trade restrictions were regarded as ineffective, as in the case of *Ambrosia confertiflora* DC, *Andropogon virginicus*, *Cortaderia jubata* and *Prosopis juliflora* (Sw.) DC., members of the workshop considered that cost-effective integrated control actions could be applied against these species and therefore they are a priority for a European level PRA.

Discussion

Globally, numerous prioritisation schemes have been specifically designed to address specific taxonomic groups (Brunel et al. 2010, Worner et al. 2013), regions or habitats (Dawson et al. 2015), pathways (NOBANIS 2015) or requirements of specific regulations (see McGeoch et al. 2016). With the implementation of the IAS Regulation, the European Commission has placed a clear focus on mitigating the negative impacts of IAS on biological diversity and ecosystem services, coupled with an underlying requirement to focus efforts on prevention rather than cure. Often, risk management components are lacking in prioritisation schemes (Heikkilä 2011), even though there is a clear advantage of incorporating such aspects to prioritise species that can be effectively controlled over other more difficult species (Hulme 2009). The current EU

Table 4. Results from the prioritisation exercise (Stage 2: risk management). Based on the potential for further spread and available prevention and control methods, 19 species where identified a priority for an EU level risk assessment. Under question B1, the potential biogeographical regions that could be invaded are listed in brackets where abbreviations follow: ATL: Atlantic, CON: Continental, MED: Mediterranean, STE: Steppic. Under question B2 countries (abbreviations correspond to ISO codes) are indicated where the species has shown evidence of invasiveness.

Species	B.1. Potential for further spread	B.2. Widely cultivated without invasive behaviour	B.3. Can intro/ spread be reduced by trade restrictions	B.4. Can intro/spread be reduced by other preventative action	B.5. Can populations be cost-effectively eradicated	Conclusion of stage 2
Acacia dealbata	Yes (ATL, MED)	No (FR, PT)	Yes (forestry spp.)			Priority for EU RA
Ambrosia confertiflora	Yes (MED)	No (not established)	No (seed contaminant)	No (small seed difficult to detect)	Yes (effective management measures exist and risk management can identify national or international measures)	Priority for EU RA
Andropogon virginicus	Yes (ATL, CON, MED, STE)	No (FR)	Yes* (internet sale)	No (small seed difficult to detect)	Yes (large conspicuous grass, with existing management methods)	Priority for EU RA
Cardiospermum grandiflorum	Yes (MED)	No (Not widely planted, Inv. similar climatic regions)	Yes (traded)			Priority for EU RA
Celastrus orbiculatus	Yes (ATL, CON, MED)	No (Not widely planted, inv. similar climatic regions)	Yes (traded)			Priority for EU RA
Cinnamomum camphora	Yes (MED)	No (Not widely planted, inv. similar climatic regions)	Yes (traded)			Priority for EU RA
Cortaderia jubata	Yes (ATL, MED)	No (not established)	Yes* (internet sale)	No (small seed difficult to detect)	Yes (large conspicuous grass, with existing management methods)	Priority for EU RA
Ehrharta calycina	Yes (MED)	No (Not widely planted, inv. similar climatic regions)	Yes (traded)			Priority for EU RA

Species	B.1. Potential for further spread	B.2. Widely cultivated without invasive behaviour	B.3. Can intro/ spread be reduced by trade restrictions	B.4. Can intro/spread be reduced by other preventative action	B.5. Can populations be cost-effectively eradicated	Conclusion of stage 2
Euonymus fortunei	Yes (CON, STE)	Yes (STOP)	----	----	----	Not a priority for RA (national measures)
Gymnocoronis spilanthoides	Yes (MED)	No (HU, IT)	Yes (widely sold within EU)			Priority for EU RA
Hakea sericea	Yes (ATL, MED)	No (PT)	Yes (traded)			Priority for EU RA
Humulus scandens	Yes (ATL, CON, MED, STE)	No (FR)	Yes (traded)			Priority for EU RA
Hygrophila polysperma	Yes (MED)	No (DE)	Yes (traded)			Priority for EU RA
Lespedeza cuneata	Yes (ATL, CON, MED, STE)	No (not established)	Yes (currently absent from EU)			Priority for EU RA
Ligustrum sinense	Yes (ALT, CON, MED)	Yes (STOP)	----	----	----	Not a priority for RA (national measures)
Lonicera maackii	Yes (ALT, CON, MED)	Yes (STOP)	----	----	----	Not a priority for RA (national measures)
Lygodium japonicum	Yes (MED)	No (not established)	Yes (currently absent from EU)			Priority for EU RA
Pennisetum setaceum	Yes (ATL, MED)	No (ES)	Yes (traded)			Priority for EU RA
Pistia stratiotes	Yes (MED)	No (DE)	Yes (widely traded within EU)			Priority for EU RA
Prosopis juliflora	Yes (MED)	No (not established)	Yes* (internet sale)	No	Yes (large conspicuous shrub species, with existing management methods)	Priority for EU RA
Salvinia molesta	Yes (MED)	No (AU, BE, FR, IT, PT)	Yes (widely traded within EU)			Priority for EU RA
Sapium sebiferum	Yes (ATL, MED)	No (not established)	Yes (currently absent from EU)			Priority for EU RA

prioritisation scheme has been specifically designed to incorporate the requirements of the IAS Regulation and to the best of our knowledge, this is the first-time invasive alien plant species have been prioritised using a scheme compliant with the IAS Regulation.

This study identified 19 globally invasive alien plant species with a high priority for a PRA at the EU level. As shown in our results, all 19 species comply with the IAS definition and criteria of art. 4 of the IAS Regulation, i.e. alien species being capable of causing major detrimental impacts to biodiversity and the associated ecosystem services after establishment and spread within the territory of the EU. Within the first stage of the prioritisation scheme, four species (*A. trifida*, *E. densa*, *F. baldschuanica* and *O. pes-caprae*) were assigned to the EU Observation List highlighting that at the current time the species are likely to cause only a moderate detrimental impact to biodiversity and associated ecosystem services. *A. trifida* has become a major weed of annual crops in the US (Weaver 2003) and is a threat for the economy where it has established in Europe, especially in SW France (Chauvel et al. 2015), while *O. pes-caprae* has impacts on livestock. It should be noted that the placement of species in the three lists is not a definitive placement and each species should be reviewed as and when new information comes to light. This is particularly important for any species included in the EU list of Minor Concern and EU Observational List.

In the first stage of the prioritisation scheme, eleven species were assigned to the Residual List and thus did not qualify for further assessment. Having a clear understanding of the taxonomic identity of a species is an essential component in any prioritisation, and subsequent PRA. This is important to ensure that the assessment is performed on a distinct organism (IPPC 2016) but also to ensure that information used in the assessment is relevant to the organism under consideration (Elith et al. 2012). In our initial list of 37 species, the taxonomy of one species, *Cornus sericea*, was identified as being uncertain as in Europe naturalised plants belong to a complex of hybrids of *C. sericea* and *C. alba* (Q-Bank 2016). It has also been suggested that *C. alba* is conspecific with *C. sericea* (National Botanic Garden of Belgium 2016). We suggest that further research is carried out on the exact identity of the species within Europe before any PRA is conducted to reduce uncertainty.

If an invasive plant is native to part of the European Union, this would preclude its inclusion on the list of species of Union concern. Although *Hydrilla verticillata* is often considered non-native to Europe, there is some uncertainty to the status of the species and Lansdown (2013) details the species as native to Belarus, Ireland, the United Kingdom (southern Scotland) and the Russian Federation. There is additional uncertainty of its native status in Latvia and Poland (Cook and Lüönd 1982). In the absence of a pan-global biogeographical molecular study the uncertainty of native populations within Europe will remain (Zhu et al. 2015). It should be noted that provisions are made within the IAS Regulation (Article 11) for species native to the Union, where their inclusion on national lists can be used to enhance regional cooperation.

Most species included in the Residual List (75 %) warrant their place due to the lack of current information on the species. A PRA is only as robust as the scientific information which is used to compile the assessment and even though uncertainty ratings can go some way to capturing data gaps, or conflicting information, without some baseline data consideration is needed to whether a PRA is warranted. Based on the lack of quantitative impact studies, and to some extent information on the biology and ecology of the species (at a global scale), we considered *Albizia lebbeck*, *Clematis terniflora*, *Euonymus japonicus*, *Lonicera morrowii*, *Prunus campanulata* and *Rubus rosifolius* are not suited for a PRA at this time. We do suggest that a comprehensive literature review is conducted periodically for each species in the Residual List, including those species where there is uncertainty in potential for establishment (*C. odorata*, *C. grandiflora* and *S. trilobata*). If new scientific information comes to light that may change the outcome of the prioritisation, the species should be re-evaluated.

Impact studies can be biased to species which are widespread and/or high-profile species to particular sectors of society (Hulme et al. 2013). When considering species which are absent from the EU, there is a clear need to use the invasion history from another region as a proxy (Gallardo et al. 2015). As already mentioned, most species assessed under question A9, impacts on ecosystem functions and services, received a medium score (69 %) with a high level of uncertainty (55 %). This is in contrast with the previous question on impacts on native species where 84 % of the species received a high score with medium uncertainty (68 %). This is not a surprise as impacts can be ambiguous to define in relation to ecosystem services and impacts can be inconspicuous in many studies conducted over a short timeframe (Eviner et al. 2012). It is however fair to note that our understanding of the effects of invasive plants on ecosystem services is growing (Vilà et al. 2010), and with the prominence of ecosystem services in the IAS Regulation further studies will undoubtedly follow.

All 22 species evaluated under stage 2 have potential for further spread, though three species, namely *Euonymus fortunei*, *Ligustrum sinense* and *Lonicera maackii* were not considered a priority for an European level PRA due to being widely cultivated within the region without showing any signs of invasive behaviour. *E. fortunei* has been cultivated within the region since the late 1800s where it is grown in parks and gardens (Personal Communication, John David, Royal Horticultural Society, UK, 2016). It has however, been identified in the eastern USA as a species spreading into native plant communities (Missouri Botanical Garden 2016), and research has shown it causes native species decline (Bauer and Reynolds 2016, Mattingly et al. 2016). We recommend that Member States monitor these species, e.g. considering the possibility to join a network of sentinel gardens (to detect as soon as possible any sign of potential invasiveness) (Visser et al. 2014).

In the prioritisation scheme, questions B3-B5 focus on the cost effectiveness of prevention and management measures and assess if the introduction and spread of the species can be reduced by trade restrictions, other preventative actions (pathway management) or cost-effective management in the field (Branquart et al. 2016). A positive answer to any of the three questions indicates that a full PRA may identify actions to mitigate entry or spread. The risk from the majority of species (84 %) could be mitigated with trade restrictions as most are either traded or absent from the EU. However, for *A. confertiflora*, *A. virginicus*, and *C. jubata* it was considered that pathway management would be ineffective in detecting and preventing the incurrence of small plant propagules. As all species are relatively large in form, management *in situ* should be a feasible cost-effective option for isolated incurrences, particularly as management options exist for each species (see Panetta 2015).

It should be noted for *Andropogon virginicus*, *Prosopis juliflora* and *Cortaderia jubata*, trade in these species is predominately via internet sites such as eBay and Amazon and as such any trade restrictions may be ineffective in the absence of greater enforcement of existing regulations (Lenda et al. 2014). The volume of movement of these species is likely to be low along this pathway, but not necessarily insignificant, as has been shown for other species where a small number of introductions have resulted in invasive populations (for example *Polygonum perfoliatum* in the USA (IPANE 2016)).

The EU prioritisation scheme does not consider potential impacts which may be realised because of climate change scenarios, or indeed the potential for further spread and establishment because of future climatic projections. Of course, the effect of climate change on a species is a key consideration in any subsequent PRA but we suggest that the detailed analysis needed to address this issue is not suited to a prioritisation scheme. We reiterate the point made in Branquart et al. (2016) that a prioritisation scheme is no substitution for a comprehensive PRA but instead acts as a valuable tool to filter out those species where a PRA is not currently needed allowing efforts to focus on those species where a detailed RA is required.

In conclusion, in utilising the EU prioritisation process for alien plants, 19 species have been identified as high priorities for PRA. These species present a prominent risk to the EU, either now or in the future and thus warrant a full PRA. Whether these species are eventually included on the list of Union concern remains to be seen and will depend, in part, on the outcome of the subsequent PRA and decision makers of the Member States.

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