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Research article

Identification of potential invasive alien species in Spain through horizon scanning

Carlos Cano-Barbacil [a,*], Martina Carrete [b], Pilar Castro-Díez [c], Miguel Delibes-Mateos [d], Josep A. Jaques [e], Marta López-Darias [f], Manuel Nogales [f], Joan Pino [g,h], Macarena Ros [i], Anna Traveset [j], Xavier Turon [k], Montserrat Vilà [l,m], María Altamirano [n], Inés Álvarez [o], Andrés Arias [p], Dani Boix [a], Carlos Cabido [q], Eva Cacabelos [r], Fernando Cobo [s], Joaquín Cruz [e], José A. Cuesta [t], Beatriz Dáder [u], Pedro del Estal [u], Belinda Gallardo [v], Miguel Gómez Laporta [w], Pablo González-Moreno [x], José Carlos Hernández [y], Borja Jiménez-Alfaro [z], Adrián Lázaro Lobo [c,z], Mar Leza [aa], Marta Montserrat [ab], Francisco J. Oliva-Paterna [n], Laura Piñeiro [ac], Carlos Ponce [ac], Pere Pons [ad], Roser Rotchés-Ribalta [g,ae], Núria Roura-Pascual [ad], Marta Sánchez [l], Alejandro Trillo [l], Elisa Viñuela [u], Emili García-Berthou [a]

[a] *GRECO, Institute of Aquatic Ecology, University of Girona, 17003, Girona, Spain*
[b] *Departamento de Sistemas Físicos, Químicos y Naturales, Universidad Pablo de Olavide, Ctra. de Utrera, km. 1, 41013, Seville, Spain*
[c] *Biological Invasions Research Group (BioInv), Departamento de Ciencias de la Vida, Universidad de Alcalá, Pza. San Diego, s/n, 28801, Alcalá de Henares, Madrid, Spain*
[d] *Instituto de Estudios Sociales Avanzados (IESA-CSIC), Plaza Campo Santo de los Mártires, 7, 14004, Córdoba, Spain*
[e] *Departament de Biologia, Bioquímica i Ciències Naturals, Universitat Jaume I, Av. Vicent Sos Baynat, s/n, 12071, Castelló de la Plana, Spain*
[f] *Island Ecology and Evolution Research Group, Instituto de Productos Naturales y Agrobiología (IPNA-CSIC), Avda. Astrofísico Francisco Sánchez, 3, 38206, San Cristóbal de La Laguna, Canarias, Spain*
[g] *CREAF, E08193 Bellaterra, (Cerdanyola del Vallès), Catalonia, Spain*
[h] *Departament de Biologia Animal, Biologia Vegetal i Ecologia, Edifici C. Universitat Autònoma de Barcelona, 08193, Bellaterra, Catalonia, Spain*
[i] *Departamento de Zoología, Facultad de Biología, Universidad de Sevilla, Sevilla, Spain*
[j] *Instituto Mediterráneo de Estudios Avanzados (IMEDEA,CSIC-UIB), C/ Miquel Marquès, 21, 07190, Esporles, Mallorca, Illes Balears, Spain*
[k] *Departamento de Ecología Marina, Centro de Estudios Avanzados de Blanes (CEAB-CSIC), Accés a la Cala St. Francesc, 14, 17300, Blanes, Spain*
[l] *Estación Biológica de Doñana (EBD-CSIC), Avda. Américo Vespucio 26, 41092, Sevilla, Spain*
[m] *Department of Plant Biology and Ecology, University of Sevilla, 41012, Sevilla, Spain*
[n] *Department of Zoology and Physical Anthropology, Faculty of Biology, University of Murcia, CEIR Campus Mare Nostrum (CMN), Murcia, Spain*
[o] *Real Jardín Botánico (RJB-CSIC), C/ Claudio Moyano 1, 28014, Madrid, Spain*
[p] *Departamento de Biología de Organismos y Sistemas (Zoología), Universidad de Oviedo, 33071, Oviedo, Spain*
[q] *Sociedad de Ciencias Aranzadi, Departamento de Herpetología, Calle Alto de Zorroaga 11, E-20014, San Sebastián, Spain*
[r] *Hydrosphere - Environmental laboratory for the study of aquatic Ecosystems, 36331, Vigo, Spain*
[s] *Departamento de Zooloxía, Xenética e Antropoloxía Física, Facultade de Bioloxía, Universidade de Santiago de Compostela, A Coruña, Spain*
[t] *Instituto de Ciencias Marinas de Andalucía (ICMAN-CSIC), 11519, Puerto Real, Cádiz, Spain*
[u] *Unit of Crop Protection, Escuela Técnica Superior de Ingeniería Agronómica, Alimentaria y de Biosistemas, Universidad Politécnica de Madrid (UPM), 28040, Madrid, Spain*
[v] *Instituto Pirenaico de Ecología (IPE), CSIC, Avda. Montañana 1005, 50192, Zaragoza, Spain*
[w] *Proyecto PARG, Ministerio del Ambiente y Agua, PNUD, Quito, Ecuador*
[x] *Department of Forest Engineering, ERSAF, University of Córdoba, Córdoba, Spain*
[y] *Departamento de Biología Animal, Edafología y Geología, Universidad de La Laguna, c/ Astrofísico Francisco Sánchez s/n, 38206, La Laguna, Santa Cruz de Tenerife, Spain*
[z] *Biodiversity Research Institute IMIB (Univ. Oviedo-CSIC-Princ. Asturias), Mieres, Spain*
[aa] *Departamento de Biología (Zoología), Universitat de les Illes Balears, Crta. Valldemossa, km. 7,5, 07122, Palma, Illes Balears, Spain*
[ab] *Institute for Mediterranean and Subtropical Horticulture "La Mayora"-UMA-CSIC, Avda Dr Weinberg s/n, 29750, Algarrobo-Costa, Malaga, Spain*
[ac] *TRAGSATEC Group, Madrid, Spain*
[ad] *Animal Biology Lab & BioLand. Departament de Ciències Ambientals, Universitat de Girona, 17003, Girona, Catalonia, Spain*
[ae] *Department of Evolutionary Biology, Ecology and Environmental Sciences, Faculty of Biology, Universitat de Barcelona, 08028, Barcelona, Spain*

* Corresponding author. Department of River Ecology and Conservation, Senckenberg Research Institute and Natural History Museum Frankfurt, Clamecystrasse 12, 63571, Gelnhausen, Germany.
E-mail address: Carlos.cano-barbacil@senckenberg.de (C. Cano-Barbacil).

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ABSTRACT

Invasive alien species have widespread impacts on native biodiversity and ecosystem services. Since the number of introductions worldwide is continuously rising, it is essential to prevent the entry, establishment and spread of new alien species through a systematic examination of future potential threats. Applying a three-step horizon scanning consensus method, we evaluated non-established alien species that could potentially arrive, establish and cause major ecological impact in Spain within the next 10 years. Overall, we identified 47 species with a very high risk (e.g. *Oreochromis niloticus*, *Popillia japonica*, *Hemidactylus frenatus*, *Crassula helmsii* or *Halophila stipulacea*), 61 with high risk, 93 with moderate risk, and 732 species with low risk. Many of the species categorized as very high or high risk to Spanish biodiversity are either already present in Europe and neighbouring countries or have a long invasive history elsewhere. This study provides an updated list of potential invasive alien species useful for prioritizing efforts and resources against their introduction. Compared to previous horizon scanning exercises in Spain, the current study screens potential invaders from a wider range of terrestrial, freshwater, and marine organisms, and can serve as a basis for more comprehensive risk analyses to improve management and increase the efficiency of the early warning and rapid response framework for invasive alien species. We also stress the usefulness of measuring agreement and consistency as two different properties of the reliability of expert scores, in order to more easily elaborate consensus ranked lists of potential invasive alien species.

1. Introduction

One of the most unique attributes of the Anthropocene is the spread of alien species around the world, due to human activities and the breakdown of biogeographical barriers (Capinha et al., 2015). Such alien species are, in many cases, able to successfully establish themselves in new areas, becoming invasive and acting as one of the most important drivers of change in biodiversity and ecosystem services (Sala et al., 2000; Vilà et al., 2011). Invasive alien species (IAS) can cause widespread habitat alteration, replacement or displacement of native species, transmission of diseases and parasites, hybridization, and negative impacts on human health, and well-being (Diagne et al., 2021; Pimentel et al., 2000; Pyšek et al., 2020). They are of particular concern in insular territories (Bellard et al., 2017). Biological invasions are thus responsible for about 54% of animal extinctions (Clavero and García-Berthou, 2005), and their mean global economic costs are estimated to be more than US$26.8 billion annually (Diagne et al., 2021). In addition, the threat from IAS continues to grow, as the number of introductions worldwide is ever rising, with no sign of saturation (Seebens et al., 2017).

There is consensus on the importance of preventing the introduction of new alien species as the most efficient management tool against IAS (Pyšek et al., 2020). Hence, efforts should be made to determine which alien species may become invasive and cause future environmental and socioeconomic impacts. Once identified, their introduction should be prevented by primarily acting on their entry pathways, and secondarily developing early detection and eradication plans. Horizon scanning (HS) is one way to address this challenge. It involves a systematic review by experts of future threats that species may pose, aiming to prioritize research on potential new IAS that are poorly recognized (Roy et al., 2014; Sutherland et al., 2011). Reporting net economic and ecological benefits, HS is now considered an essential tool for IAS management (Caffrey et al., 2014; Keller et al., 2007). In this context, the procedure consists of building up a list of potential IAS, preparing a simplified assessment of their risks, and reaching expert consensus on a prioritized list of those species (Roy et al., 2014). Horizon scanning is not a risk assessment, as the latter requires an exhaustive bibliographic review of each species and the use of specific mathematical methods or software to quantify the risks (González-Moreno et al., 2019; Vilà et al., 2019). In contrast, HS prioritizes species that actually deserve such risk analyses (Roy et al., 2014). Numerous HS have been performed to identify potential IAS at different spatial scales (see e.g. Dawson et al., 2023; Peyton et al., 2019), analysing different taxa (Gallardo et al., 2016; Roy et al., 2019; Tsiamis et al., 2020). However, approaches to establish lists of potential IAS of national concern that consider a large array of taxonomic groups are rare, despite being essential to underpin policy and management decisions.

Identification of potential IAS can be biased by the personal experience and interests of the experts involved in the HS exercise, and by data availability (Sutherland et al., 2011), given that the lack of impact evidence or invasion history does not imply absence of threat (Roy et al., 2014; Simberloff et al., 2013). Thus, selecting assessors with great expertise, providing clear guidelines, and using explicit measures of reliability can all help to improve consistency and better understand the sources of uncertainty (González-Moreno et al., 2019; Oficialdegui et al., 2023). Previous HS have used different statistics to assess the degree at which experts agreed on their evaluation of species. For instance, Gallardo et al. (2016) used Fleiss' kappa (Fleiss, 1971), while Oficialdegui et al. (2023) used Krippendorff's α (Krippendorff, 2004). Other authors used complementary methods to measure uncertainty, such as requiring the experts to provide the degree of certainty of each score (see e.g. Copp et al., 2009; D'hondt et al., 2015).

Mediterranean countries are important biodiversity hotspots, but also host a significant number of terrestrial, freshwater and marine alien species (Dawson et al., 2017; Drake and Lodge, 2004; Tierno de Figueroa et al., 2013). Spain in particular is a strategic area that connects Europe with Africa and Mediterranean with Atlantic waters, being a key node for preventing the spread of IAS between these regions. Some HS studies have already been conducted in Spain for certain taxonomic groups such as plants (Andreu and Vilà, 2010; Bayón and Vilà, 2019), or ecosystems such as aquatic environments (Oficialdegui et al., 2023; Oliva-Paterna et al., 2021). However, a comprehensive HS analysis for Spain that covers all taxa and ecosystems is lacking. Therefore, our general aim was to perform such an HS analysis for Spain. This was achieved by (1) identifying a list of alien species that are not established in Spain but are likely to arrive, become so and spread, through the evaluation of entry pathways and expected impacts, and (2) measuring agreement and consistency as two different properties of the reliability of individual experts' evaluations. We expect our results will aid in the decision-making needed to implement national and European regulations in Spain.

2. Methods

2.1. Study area

We performed our HS for all Spanish territories, i.e. mainland Spain, the Canary Islands (Atlantic Ocean), the Balearic Islands (Western Mediterranean Sea), and the autonomous cities of Ceuta and Melilla (North Africa), as well as small insular territories in the Mediterranean

Sea and the Atlantic Ocean (Fig. S1). Spain has complex orography and high spatial and temporal climate variability, being the most climatically diverse country in Europe (IGN, 2019). Following the Köppen-Geiger classification, the country includes 13 different climates (IGN, 2019), from hot desert (Bwh) to subarctic (Dfc). Annual mean temperatures range from 2.5 °C in mountainous areas to 22.5 °C in the Canary Islands, while total annual precipitation varies from around 100 mm in the eastern Canaries and Almería to over 2000 mm in Northern Spain (IGN, 2019). Under natural conditions, most Spanish rivers display Mediterranean flow regimes, with a high-flow period during the wet season (i.e. autumn and winter), and a low-flow period during the dry season (i.e. late spring, summer) (Mezger et al., 2021). However, these rivers are highly regulated by more than 1200 large dams (MAPAMA, 2020). Finally, the Spanish marine ecosystems belong to the group known as warm-temperate seas, based on their surface temperatures. These seas show a clear gradient from south to north, ranging from approximately an annual mean temperature of 20 °C in the Canary Islands to less than 12 °C in higher latitudes. There are also marked seasonal temperature variations in the northern half of the studied area, and especially in the Mediterranean, a closed sea that undergoes a significant temperature increase during the summer (AEMET, 2015).

2.2. Horizon scanning protocol

Our HS protocol largely followed Roy et al. (2019), and used an adapted version of the consensus method proposed by Sutherland and Woodroof (2009) and Sutherland et al. (2011) to obtain a ranked list of potential IAS with high biodiversity impact. The protocol involved three main stages: (1) determining the composition and scope of five previously established thematic groups (i.e. marine species, freshwater animals, terrestrial vertebrates, terrestrial invertebrates, and plants; see section 2.2.1.), (2) building a preliminary list of species within each thematic group, performing a rapid evaluation and compiling a preliminary consensus list within groups, and (3) establishing a general consensus and ranked list of potential IAS across thematic groups (Fig. 1 and Table S1 for further details on the protocol and calendar).

2.2.1. Stage 1: composition and scope of the thematic groups

We established five thematic groups, namely: (1) marine, which included all animals, plants and algae from marine habitats; (2) freshwater animals, incorporating aquatic invertebrates that spend most of their life cycle in the water, and fish of freshwater ecosystems and transitional systems such as estuaries or coastal lagoons; (3) terrestrial vertebrates, comprising amphibians, reptiles, birds, and mammals; (4) terrestrial invertebrates; and (5) plants, including terrestrial and aquatic plants from inland waters. We did not consider microorganisms in this study. Each thematic group comprised two co-leaders and four (terrestrial vertebrates) to eight (terrestrial invertebrates) experts—depending on the initial number of species to evaluate (see Table S2)—. This brought together expertise within each group on different taxa and on mainland Spain and island territories. We respected gender parity, also combining the presence of early career and senior researchers in all groups.

2.2.2. Stage 2: preliminary lists of species within each thematic group

Each thematic group started from a potential—but not exhaustive—list of species that we identified using the CABI tool (CABI, 2022). Similarly to Roy et al. (2019), our search criteria selected alien species that: (1) did not have established populations in the study area, (2) present a documented history of invasion and cause undesirable impacts in neighbouring countries to Spain or in other areas worldwide that climatically match the study area (using the Köppen-Geiger climate zones as reference); (3) are traded within the study area or in areas with strong commercial links with Spain or with recognized pathways for their entry; and (4) occur in captivity (e.g. zoological parks, aquaculture facilities and greenhouses) in the study area. Therefore, we excluded

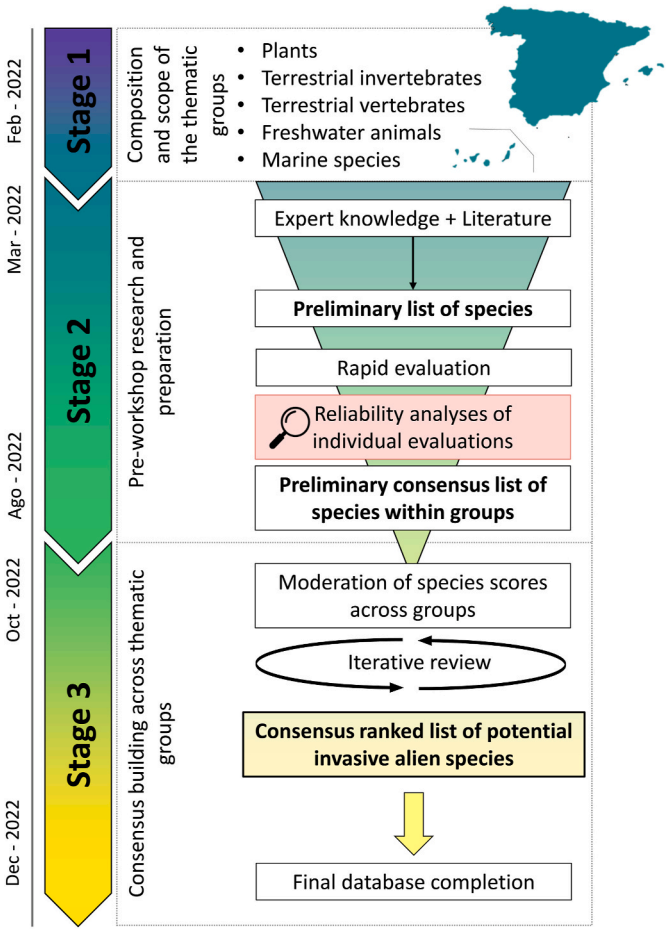

Fig. 1. Horizon scanning protocol used in this study. Based on Roy et al. (2019), it applies the consensus method proposed by Sutherland and Woodroof (2009) and Sutherland et al. (2011).

native species from mainland Spain that could become invasive in insular territories, and *vice versa*.

Due to the very long lists obtained for plants and terrestrial invertebrates (see Table 1), we ranked the species according to their "degree of invasion" (i.e. number of occurrences globally that are considered "invasive") and selected the 200 taxa with a higher degree of invasion. We completed preliminary lists with those species that were included in previous HS conducted in Europe and Spain (Andreu and Vilà, 2010; Bayón and Vilà, 2019; Oficialdegui et al., 2023; Oliva-Paterna et al., 2021; Roy et al., 2014, 2015, 2019), and with those IAS listed in Spanish and European regulations (Law 42/2007, RD 630/2013 and (EU) 1143/2014). Then, experts evaluated the resulting lists over a period of one month, identifying species wrongly included (e.g. native to part of Spain, species complexes or IAS already established; see Table S3 for the complete list of removed species) and/or proposing other potential invasive species for consideration that were not so far included.

Prior to the final workshop, each expert evaluated individually at least 50 species, filling in a spreadsheet template slightly modified from Peyton et al. (2019) (see **Appendix 1**) with scores on their likelihood of arrival, establishment, and impact on biodiversity and ecosystems. These items were scored on a scale of 1 (very unlikely) to 5 (very likely), following criteria established in previous studies (e.g. Blackburn et al., 2014; Peyton et al., 2019) (see Tables S4–S6 for further details). Experts also scored the confidence level of each assignment (Table S7) as low (L, no direct observational evidence available or evidence is difficult to interpret or considered low quality), medium (M, some direct observational evidence is available but may be ambiguous or difficult to scale within the specific geographical context), or high (H, direct

Table 1
Summary of the number of existing, evaluated, and prioritized species within each thematic group. The "Spanish Catalogue of Invasive Alien Species" refers to the Spanish regulation on invasive alien species (Law 42/2007 and RD 630/2013). See text for further details.

Group	Species initially obtained from CABI	Species finally evaluated	Prioritized species with very high/high risk	Species with very high/high risk included in the *Spanish Catalogue of Invasive Alien Species*	Species with very high/high risk included in the list of IAS of Union concern
Marine	56	116	9	1	0
Freshwater	132	182	14	4	2
Terrestrial vertebrates	72	96	31	9	4
Terrestrial invertebrates	5845	267	15	0	0
Plants	628	272	39	3	3
TOTAL	**6733**	**933**	**108**	**17**	**9**

observational evidence is available and straightforward to interpret without controversy and considered to be of high quality) (Blackburn et al., 2014). Similar to Roy et al. (2014), the overall score for each species was calculated as the product of the above mentioned three scores. In sum, the final score for each species assessed by each expert ranged potentially from 1 to 125. Each species was evaluated by 2–5 experts and therefore, received 2–5 final scores.

To assess the agreement and consistency among experts' individual preliminary scores and to facilitate consensus building, we performed two complementary reliability analyses. First, we used Krippendorff's α (Krippendorff, 2004), a standard measure of reliability (Hayes and Krippendorff, 2007) that has proven useful in ecology (e.g. Cano-Barbacil et al., 2020). Krippendorff's α ranges from -1 to 1, with values of 1 indicating perfect agreement, 0 indicating no agreement beyond chance, and -1 indicating inverse agreement (Krippendorff, 2004). Bootstrapped Krippendorff's α and its 95% confidence interval were obtained using the "kripp.boot" function of the R package "kripp.boot" (Proutskova and Gruszczynski, 2017), through the "ordinal" method. We used a beta regression model, run with "betareg" function from the R package "betareg" (Cribari-Neto and Zeileis, 2010; Ferrari and Cribari-Neto, 2004), to test whether there were differences between the agreement of the scores for the different thematic groups and items evaluated. Lastly, we calculated Kendall's coefficient of concordance (W), which is a non-parametric method that also informs about the correlation among experts' scores (Legendre, 2005). To estimate W, we used the "kendallNA" function of the "irrNA" package (Brueckl and Heuer, 2022), which allows for missing values. Note that reliability is used with various meanings in the literature and Krippendorff's α measures higher agreement (i.e. the extent to which different experts tend to assign the same value to each category), whereas Kendall's W measures consistency among experts' scores (i.e. extent to which different experts tend to assign the same relative order to items) (see Table S8 for an illustration). Consistency (often also called reliability) and agreement are different properties of measurement reproducibility that are sometimes unrelated (Bennett et al., 2017; Tinsley and Weiss, 2000). Therefore, we evaluated the relationship between Krippendorff's α and Kendall's W using Spearman's rank correlation. All statistical analyses were carried out using R version 4.2.2 (R Core Team, 2023).

After analysing the agreement and consistency, experts from each thematic group met by videoconference to discuss and modify, when necessary, discrepant scores and to establish a preliminary consensus list for each thematic group based on individual evaluations.

2.2.3. Stage 3: consensus building of the final list across thematic groups

Consensus building among the groups took place during an in-person workshop including joined and separated sessions for thematic groups. In the first session, group leaders presented an overview of their high-ranked species. The experts then had another chance to revise and change their scores in order to moderate scoring approaches among groups, and to include potential new IAS or to exclude those that did not fit the HS criteria (e.g. species recently established). At this stage, the thematic groups were asked to reach a common species score, including confidence levels. In the second session, we combined the lists from the five thematic groups into a single list. Experts were asked to justify their evaluations to ensure a consistent application of scores across all the thematic groups. As a result, we obtained a consensus ranked list of the 933 potential IAS that were considered to represent a very high, high, moderate and low threat to biodiversity and ecosystems in the Spanish territories. The very high threat group included species with the two highest overall scores (125 or 100). Similarly, the high threat group consisted of species with scores of 80 or 75; the moderate threat group, species with scores of 64 or 60; and the low threat group, species with scores below 60.

After the workshop the experts had the chance to review the list, particularly to check the establishment status of each species. We analysed the information retrieved from CABI for each species in order to evaluate the native range, functional group, likely entry pathways and evidence of impact mechanisms of the prioritized species (i.e. those with very high and high risk). We categorized species using published classifications and the terminology of the Convention of Biological Diversity (CABI, 2022; CBD, 2014; Roy et al., 2019) (see Tables S9–S12 for further details). Lastly, we checked the presence of species with very high and high risk in the "Spanish Catalogue of Invasive Alien Species" (RD 630/2013).

3. Results

The preliminary lists compiled 933 alien species with potential to arrive within the next ten years, become established, and have an impact on native biodiversity and ecosystems in the study area. Plants (n = 272), terrestrial invertebrates (n = 267) and freshwater animals (n = 182) had the greatest number of potential IAS, whereas marine (n = 116) and terrestrial vertebrates (n = 96) had the lowest number. On average, terrestrial vertebrates and marine species were evaluated by 3.44 and 3.01 experts, respectively. In comparison, freshwater organisms, invertebrates and plants were assessed by an average of 2.16, 2.04 and 2 experts, respectively.

3.1. Reliability analyses reveal significant concordance among individual evaluations

After conducting the individual risk assessments for each potential IAS, we found that the degree of agreement among experts was significantly different among thematic groups (pseudo-R^2 = 0.749, φ = 43.75, P = 0.006), the lowest being for terrestrial vertebrates (α_{Total} = 0.226), and the highest for terrestrial invertebrates (α_{Total} = 0.548) (Fig. 2a and 2**b** and Table S13). We also found significant differences among the different items evaluated. Experts showed higher agreement when evaluating the probability of arrival compared to scoring the probability of establishment and impact of the species (Fig. 2c and Table S13), with the two latter items showing lower confidence levels (Fig. S2). For instance, 50.8% of the evaluations of the probability of arrival showed a

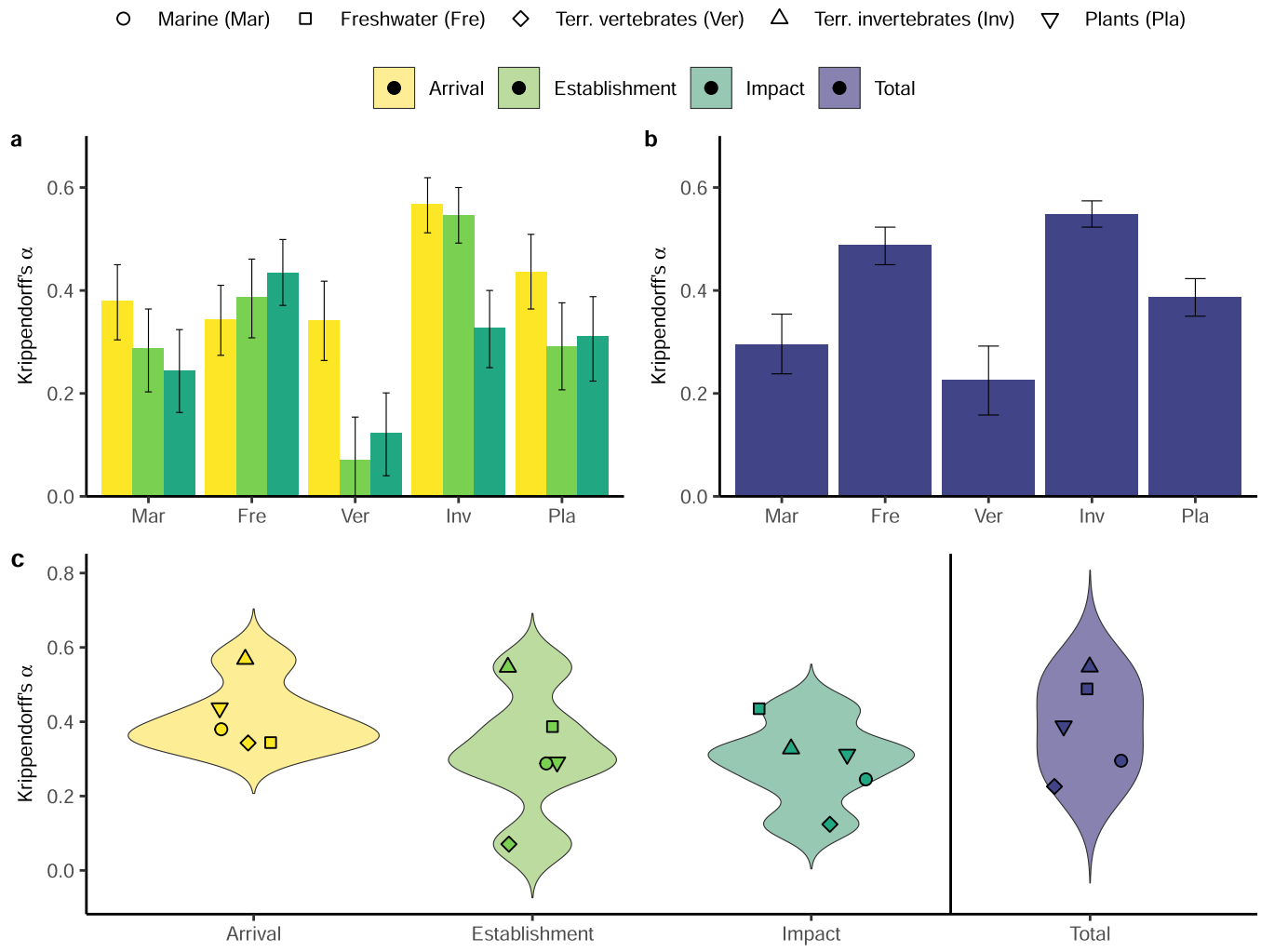

Fig. 2. (a) Agreement among experts (bootstrapped Krippendroff's α and 95% confidence interval) of the three items evaluated (likelihood of arrival, establishment, and impact) by thematic groups during the horizon scanning. (b) Agreement among experts on the total score obtained for each thematic group. (c) Violin graph showing the agreement among experts on the different items evaluated by thematic groups (symbols). Mar = marine species; Fre = freshwater animals; Ver = terrestrial vertebrates; Inv = terrestrial invertebrates; Pla = plants.

high level of confidence, whereas only 39.9% and 25.9% of the evaluations of probability of establishment and impact, respectively, exhibited high confidence levels. Despite obtaining relatively low values with Krippendorff's α, the Kendall coefficients indicate that there was significant consistency in the scores of every item for all thematic groups (Table S14). Conversely, consistency was higher for the arrival of terrestrial invertebrates and freshwater animals, but lower for the establishment and impact of marine organisms and terrestrial vertebrates, although the two measures were significantly correlated (ρ = 0.818, $P < 0.001$; Fig. S3).

3.2. Consensus ranked list of potential invasive species

The final consensus ranked list of potential IAS revealed that 47 species posed a very high risk of arrival, establishment, and ecological impact in Spain (overall scores of 125-100; see Table 2), 61 showed a high risk (80-75), and 93 a moderate risk (64-60) (see Tables S15–S18). The remaining 732 species were categorized as of low risk (<60) (Table S19) and therefore are considered as species with low invasive potential in Spain. The thematic group with the highest number of species classified as very high risk (n = 18) was terrestrial vertebrates (Fig. 3), followed by plants (n = 11), terrestrial invertebrates (n = 8), freshwater animals (n = 7) and marine species (n = 3). Similarly, plants (n = 28) and terrestrial vertebrates (n = 13) were the thematic groups with the highest number of species classified as high risk.

3.2.1. Taxonomic and functional groups of the prioritized species

Irrespectively of the environment, vertebrates (n = 41) and phanerogams (n = 39) together represented 74.2% of the 108 prioritized species (i.e. species with very high and high risk). Arthropods (17 species) were the third group with species classified as having very high and high risk of becoming IAS (Fig. 4a). In terms of functional groups, primary producers were the most represented with 41 species (Fig. 4b), including 39 phanerogams, one green alga and one aquatic fern. Conversely, the least numerous functional group with species with very high or high risk of becoming IAS was filter-feeding species (n = 3). Most terrestrial vertebrates and freshwater animals (86.7%) were predator or omnivorous species, while most terrestrial invertebrates (80%) were herbivorous (Fig. 4b).

3.2.2. Likely native range and entry pathways of the prioritized species

Most of the prioritized species from terrestrial or freshwater ecosystems were native to temperate Asia (37.0%; 40 species) and North America (29.6%; 32 species), with only a small proportion (5.6%) native

Table 2
List of the 47 potential invasive alien species with very high risk of arrival, establishment, and ecological impact in Spain.

Marine (3)	Terrestrial vertebrates (18)	Plants (11)
Halophila stipulacea	*Hemidactylus frenatus*	*Crassula helmsii*
Ulva ohnoi	*Lampropeltis getula*	*Pueraria montana* var. *lobata*
Glycera dibranchiata	*Sciurus carolinensis*	*Cabomba caroliniana*
Freshwater (7)	*Pelophylax lessonae*	*Hydrilla verticillata*
Oreochromis niloticus	*Cynops pyrrhogaster*	*Reynoutria* x *bohemica*
Pomacea canaliculata	*Rhinella marina*	*Salvinia molesta*
Phoxinus phoxinus	*Ocadia sinensis*	*Sphagneticola trilobata*
Gambusia affinis	*Mauremys* (*Chinemys*) *reevesii*	*Miscanthus sinensis*
Dreissena rostriformis bugensis	*Acridotheres tristis*	*Prunus serotina*
Dikerogammarus villosus	*Anser cygnoides*	*Lagarosiphon major*
Procambarus virginalis	*Castor canadensis*	*Ligustrum sinense*
Terrestrial invertebrates (8)	*Osteopilus septentrionalis*	
Popillia japonica	*Macrochelys temminckii*	
Radopholus similis	*Pantherophis guttatus*	
Lissorhoptrus oryzophilus	*Acridotheres cristatellus*	
Orientus ishidae	*Psittacula eupatria*	
Rhagoletis cingulata	*Sternotherus odoratus*	
Aromia bungii	*Trachemys ornata*	
Toumeyella parvicornis		
Argyrotaenia ljungiana		

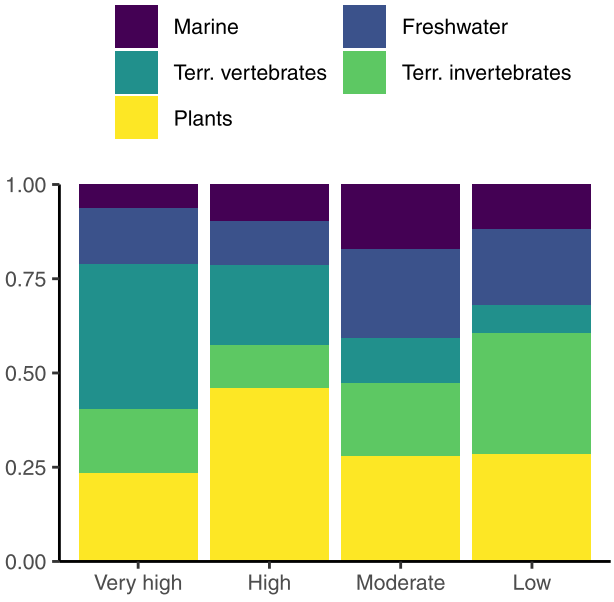

Fig. 3. Proportion of potential invasive alien species that have very high (n = 47), high (n = 61), moderate (n = 93) and low (n = 732) risk of becoming invasive in Spain, based on their likelihood of arrival, establishment and impact on biodiversity and ecosystems.

to Oceania. Among marine species, three were native to the western Indo-Pacific (India, East Africa, and Red Sea), two to the central Indo-Pacific (Philippines, Malaysia, Taiwan, and northern Australia), two to the Northwest Atlantic (eastern USA and Canada) and two to the Northwest Pacific (Japan, Korea, northeast China and eastern Russia) (Fig. 5).

The main entry pathway of the prioritized species (Fig. 5) was escape from confinement (n = 88), followed by stowaway transport (n = 46). However, 66.7% of the prioritized species were polyvectic, i.e. species

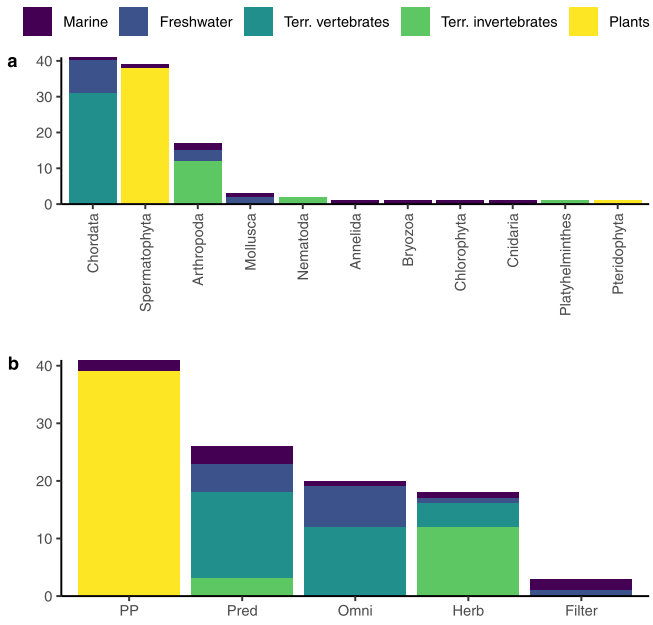

Fig. 4. Number of prioritized species resulting from our horizon scanning for Spain by (a) taxonomic group and (b) functional group. PP = Primary producers; Pred = Predators; Omni = Omnivores; Herb = Herbivores; Filter = Filter feeders.

having two or more known entry pathways. On average, freshwater species had the highest number of known entry pathways per species (mean = 2.71), followed by plants (mean = 2.49), terrestrial vertebrates (mean = 2.20), marine species (mean = 1.67) and terrestrial invertebrates (mean = 1.54).

3.2.3. *Impact mechanisms of the prioritized species*

The main impact mechanism of prioritized species was competition for resources with native species (75.9%; Fig. 6). More than 30% of the prioritized species could also have negative effects on native biodiversity through fast-growing, preying on native species, and/or carrying and transmitting pathogens. On average, freshwater species had the highest number of known impact mechanisms per species (mean = 4.29), followed by plants (mean = 3.03), terrestrial vertebrates (mean = 2.77), marine species (mean = 2.33) and terrestrial invertebrates (mean = 1.60).

4. Discussion

This study represents the first HS analysis conducted in Spain that identifies a list of potential IAS across taxonomic groups and ecosystems. It also highlights the importance of including and correctly using various reliability statistics in HS protocols, in order to measure the agreement and consistency of experts' individual evaluations. Applying these statistics allowed experts involved in this study to identify discrepant scores and produce the consensus ranked list of potential IAS.

4.1. *Prioritized list of potential alien invasive species*

Following the three-step consensus method (Roy et al., 2019; Sutherland et al., 2011), we prioritized 108 species with very high (n = 47) or high (n = 61) risk of becoming invasive in Spanish ecosystems within the next 10 years. Our results are consistent with previous HS, and some of the prioritized species in this exercise were already considered as potentially having very high risk for Spanish ecosystems in previous studies (e.g. Amur sleeper (*Percottus glenii*), *Procambarus*

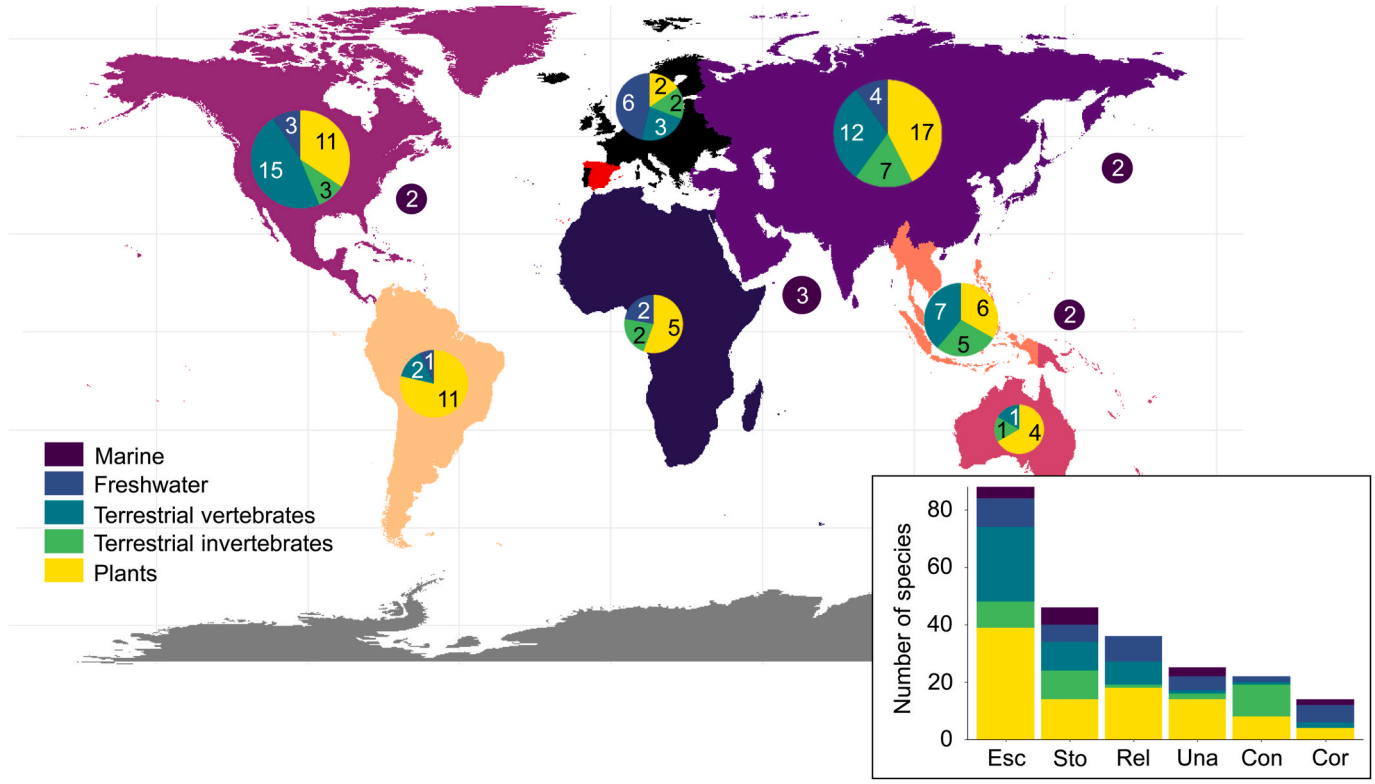

Fig. 5. Native range of prioritized species resulting from our horizon scanning for Spain. The number of species for each thematic group is indicated in the pie charts, the size of which is proportional to the total number of species. Note that some species are native to more than one region, and therefore, the sum of all species is not equal to 108 (total number of prioritized species). The study area is highlighted in red. The bar graph at the bottom classifies the main entry pathways of prioritized species (Esc = Escape; Sto = Stowaway; Rel = Release; Una = Unaided; Con = Contaminant; Cor = Corridor). Note that species may have more than one known or potential entry pathway.

virginalis or *Crassula helmsii*) (Andreu and Vilà, 2010; Oficialdegui et al., 2023). Many of these prioritized species are already present in Europe and neighbouring countries to Spain. This is the case, for example, of the grey squirrel (*Sciurus carolinensis*), which is native to deciduous forests in the USA and is considered invasive in the UK, Ireland and Italy (Lowe et al., 2000), or the Amur sleeper, which is one of the most widespread and successful invaders in European inland waters (Copp et al., 2005; Reshetnikov, 2010). Some prioritized species, such as *Salvinia molesta* or *C. helmsii*, the Chinese turtle (*Mauremys reevesii*), or *P. virginalis* (found in Asturias –northern Spain– for the first time during this study) are species that have already been detected locally, although not yet established in Spain (de la Vega et al., 2021; MAGRAMA, 2013a; Salas-Pascual and Quintana Vega, 2016). Similarly, while this manuscript was being prepared for submission, Png-Gonzalez et al. (2023) updated the list of marine aliens in Spain, showing that actually *Schizoporella japonica*, which we identified as high concern, is already considered a casual alien species in Spain, which reinforces the robustness of our HS exercise. *Ulva ohnoi* and *Penaeus monodon* were also included in this list, however their current status in the study area is unknown. As for the remaining species that were found to have a moderate or low impact, it is important to note that the absence of impact evidence or invasion history in many cases does not necessarily imply the lack of existing or future impacts (Simberloff et al., 2013). Therefore, based on the precautionary principle, prevention is key to managing the environmental challenge of invasive species.

Most of the prioritized species have a long invasive history and are very frequent in the pet trade, for example the common house gecko (*Hemidactylus frenatus*) or the Chinese turtle (see e.g. de la Vega et al., 2021). Twelve very high or high risk IAS are included in the list of the "100 of the World's Worst Invasive Alien Species" (Lowe et al., 2000): *Sciurus carolinensis, Pueraria montana* var. *lobata, S. molesta, Pomacea canaliculata, Rhinella marina, Acridotheres tristis, Sphagneticola trilobata, Gambusia affinis, Platydemus manokwari, Prosopis glandulosa, Herpestes auropunctatus,* and *Boiga irregularis*. However, 84.3% of the 108 alien species prioritized in this study are not included in the "Spanish Catalogue of Invasive Alien Species" (RD 630/2013). In the specific case of terrestrial invertebrates, none of the 15 prioritized species are included in this legislation. Thus, given that one of the objectives of this study is to prevent the most potentially harmful IAS from colonizing and damaging Spanish biodiversity and ecosystems, we propose to carry out a more exhaustive risk analysis focused on those species.

Marine taxa were poorly represented in the prioritized species list compared to other groups, despite European seas being one of the most important invasion hotspots worldwide (Tsiamis et al., 2018) and recent studies showing the importance of the Spanish coasts for the establishment of new IAS (González-Ortegón et al., 2020; Zamora-Marín et al., 2023). This pattern was also observed in previous HS (Roy et al., 2014, 2019) and even in the list of species of concern of the European Union IAS Regulation, which includes only two marine/brackish species (*Eriocheir sinensis* and *Rugulopteryx okamurae*). This limited coverage of marine taxa in the current and previous exercises indicates a lack of information on biological invasions in marine habitats (Giakoumi et al., 2016; Occhipinti-Ambrogi and Savini, 2003). However, the thematic group least represented in the prioritized species list in relative terms (i.e. number of taxa included per estimated total number of species) was terrestrial invertebrates. The lack of information and expertise in some taxonomic groups has been identified as a major reason for the difficulty in covering all marine species and terrestrial invertebrates with the same level of precision (Roques et al., 2008). This lack of knowledge can lead to underestimating the invasive potential of these species, unless they are economic pests, pathogen vectors or phytosanitary threats (Roques et al., 2008). Moreover, marine species and terrestrial invertebrates

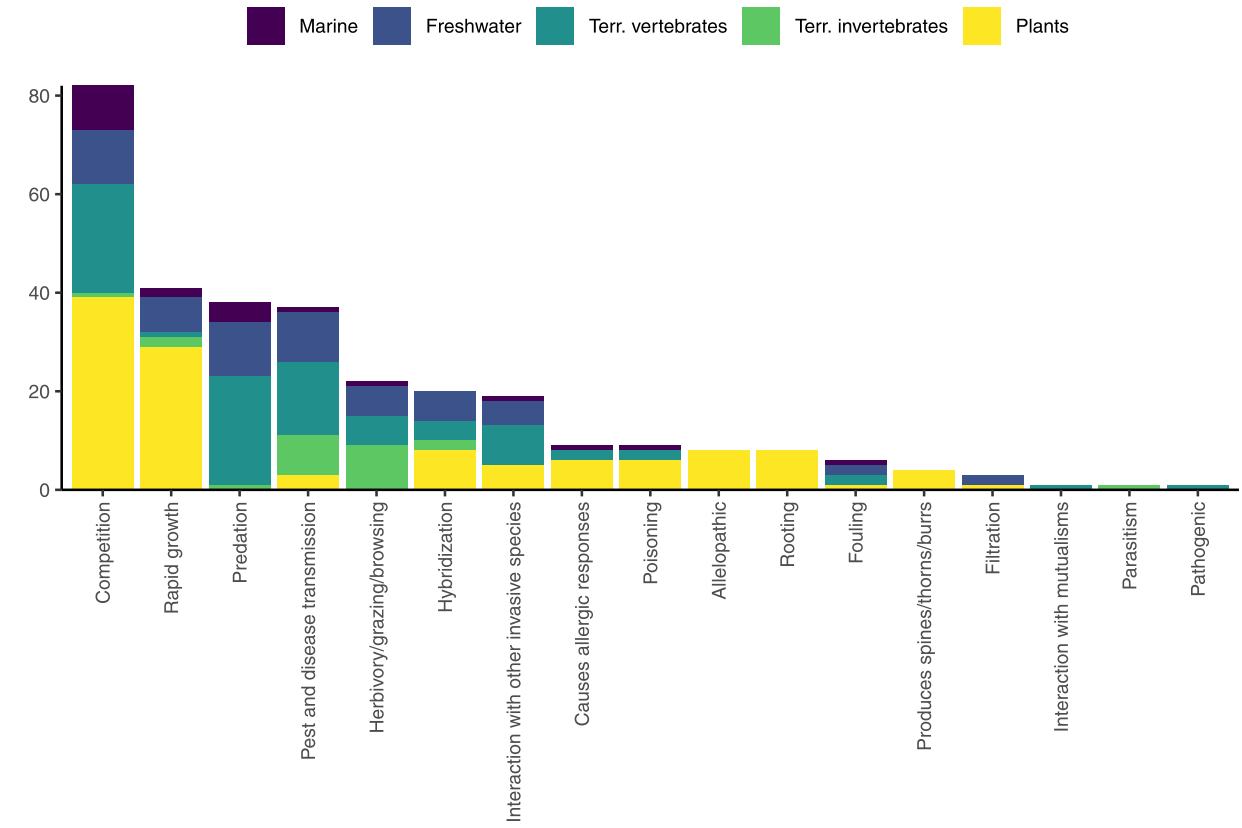

Fig. 6. Number of prioritized species resulting from our horizon scanning for Spain that can cause an impact on native biodiversity and ecosystems through the different mechanisms evaluated. Note that species may have an impact on biodiversity through several mechanisms.

were the thematic groups with the lowest number of known introduction pathways and impact mechanisms per species, so further research on these taxa and ecosystems is urgently needed (Roques et al., 2008; Tsiamis et al., 2020).

Introductions from Asia and North America are likely to be more common compared to other regions, as also indicated by other studies carried out in Europe (Gallardo et al., 2016; Roy et al., 2019; Seebens et al., 2015; Zieritz et al., 2017) and Spain (Bayón and Vilà, 2019; Ofícialdegui et al., 2023). This suggests that mechanisms involving long distance transport can play an important role in the entry of potential IAS, which is also corroborated by recent inventories of IAS established in Spain (e.g. Muñoz-Mas and García-Berthou, 2020; Zamora-Marín et al., 2023). However, escape from confinement was considered the most likely route of entry, especially for plants and terrestrial vertebrates. This pattern is consistent with already established European IAS (DAISIE, 2009) and with previous HS at the European level (Roy et al., 2019). In fact, most alien plants are expected to arrive as escaped ornamental or horticultural plants. Similarly, many alien terrestrial vertebrates are expected to arrive as escaped pets or escapes from farms and zoos (Hulme et al., 2008; Saul et al., 2017). By contrast, for terrestrial invertebrates and marine species, transport prevails as entry pathway (stowaway and contaminant categories) (Hulme et al., 2008; Saul et al., 2017). Indeed, these unintentional introductions via contaminant, stowaway, corridor and unaided pathways have increased in prevalence among species introductions over recent decades (Zieritz et al., 2017). Importantly, the spread of potentially invasive species from neighbouring regions is expected to be the third most important donor of IAS. We found that most of the prioritized species are polyvectic, which complicates the possibility of preventing their introduction or tracing their invasion trajectory (Ulman et al., 2017).

In agreement with previous analyses, competition, rapid growth, and predation were reported as the main impact mechanisms of potential invasive species (Roy et al., 2019). However, the magnitude of these impacts can differ between islands and continental territories (Dueñas et al., 2018). Predation by vertebrates is considered one of the main impact mechanisms, especially on islands, and is a major threat to native birds, mammals, and reptiles (Doherty et al., 2016). In contrast, competition is not an impact mechanism likely to cause species extinctions or extirpations in the short term (Davis, 2003; but see Hernández-Brito et al., 2014), although it can cause major changes in community composition and diversity (Kumschick et al., 2015).

4.2. *The particular cases of the Balearic and Canary Islands*

Insular territories are particularly vulnerable to biological invasions as many native species have evolved in isolation and, therefore, some of them have lost their ability to evade predators, defend themselves from pathogens and parasites, or compete with other species (Bellard et al., 2017; Simberloff, 1995). In particular, it is well known that invasive species are one of the main factors threatening endangered species in the Balearic and Canary archipelagos (see Nogales et al., 2006; Riera et al., 2002; Traveset et al., 2009). Additionally, both the Mediterranean and Macaronesian biogeographic regions are expected to be the most threatened by alien species (Roy et al., 2019). Thus, identifying potential invasive species in these archipelagos is fundamental to prevent future invasions and prioritize management efforts.

Some of the prioritized species could cause a particularly important impact on Spanish islands and their surroundings seas, according to the expert assessment and literature (Table S20). For instance, the small Indian mongoose (*H. auropunctatus*) is considered one of the 100 most harmful IAS and is known to cause the extirpation and extinction of native birds, reptiles and amphibians on other islands (Barun et al., 2011). In fact, the scope of Spanish regulations for some of the prioritized taxa is limited to insular territories only (e.g. species of the

Colubridae family, *Lampropeltis getula*, *B. irregularis,* and *Pantherophis guttatus*). Lastly, it is worth mentioning that some species have already been cited in the archipelagos, although there is no evidence that they have become established in the wild. This is the case of the apple snail (*P. canaliculata*), found in the Ayagaures reservoir in Gran Canaria (MAGRAMA, 2013b). The common myna (*A. tristis*), until recently a fairly common cage species, was introduced into the Balearic and Canary Islands after the escape of some birds that were able to breed in urban and rural environments on Gran Canaria, Tenerife, and La Palma. This species has also been seen in the wild in Fuerteventura, Lanzarote, and Mallorca (Lorenzo, 2007). To date, it has been eradicated from both archipelagos (Saavedra Cruz and Reynolds, 2019). The common myna can cause serious damage to the islands' fauna, as it competes with small mammals and other birds for nesting spaces, and is capable of feeding on the eggs and chicks of other species. Furthermore, there are reports of a still localized presence of three plant species: *S. molesta*, a water fern recently cited for Gran Canaria in artificial habitats; *Casuarina equisetifolia*, present in the Canary Islands for some time, but very localized, and *Passiflora suberosa,* cited for La Palma (Gobierno de Canarias, 2023; Salas-Pascual and Quintana Vega, 2016). Some individuals of the mosquito *Aedes aegypti,* which is the main vector of arboviruses such as yellow fever and dengue, were also detected in the Canary Islands in 2022, although the species is not established (Ministerio de Sanidad, 2022).

The Canary Islands are also at high risk of introduction and establishment of tropical or subtropical marine species, and the shallow waters around the archipelago could be stepping stones for East and West Atlantic warmwater species. Furthermore, the Macaronesia region serves as an important hub for the transportation of oil platforms from several locations around the world, causing a remarkable number of new introductions (Castro et al., 2022; Png-Gonzalez et al., 2023). Species such as *S. japonica* or *Pterois miles* could be introduced by this pathway (Castro et al., 2022; Nuttall et al., 2014). Moreover, the case of *Glycera dibranchiata* has already been studied in Canarias (MITECO, 2017). This species is frequently used as live bait and the impact of its accidental introduction could lead to competitive displacement or predation of native species, since there are several similar species on these coasts from the family Glyceridae.

It is important to note that this study has not included native species from other areas of Spain that could become invasive in the Balearic and Canary archipelagos, causing a great impact. For instance, *Pelophylax saharicus,* finally excluded from this study as it is native to Ceuta and Melilla, has already been cited in the Canary Islands as invasive. Therefore, it would be advisable in the near future to carry out specific horizon scanning for the Balearic and Canary archipelagos.

4.3. Reliability of individual evaluations: a new step for the horizon scanning protocol

Estimation of the invasive potential of alien species can be influenced by the personal research experience and interests of the experts involved in the exercise, as well as by data availability (Sutherland et al., 2011). For this reason, previous studies have already pointed out the usefulness of applying specific measures of reliability to better understand these sources of uncertainty (Gallardo et al., 2016; Oficialdegui et al., 2023). As far as we know, this study is the first using two complementary statistics in HS of alien species to evaluate the agreement and consistency of experts' evaluations. Calculating these specific measures of reliability allowed experts to identify and reduce the impact of sources of uncertainty, and to establish consensus scores. We found that individual scores on the likelihood of arrival, establishment and impact on biodiversity and ecosystems prior to the workshop showed significant consistency within all the groups of experts. This indicates that experts tended to assign the same relative scores to the evaluated items. These results concord with previous assessments of invasive species, which in general showed high consistency on impacts among experts (Bernardo-Madrid et al., 2022). However, we found that the degree of agreement in evaluations was significantly different between items. Lower levels of agreement were observed for those items where experts also had lower confidence levels. This could be due in part to the greater uncertainty in evaluating the likelihood of establishment and impact than the likelihood of arrival, as little information is available and it is difficult to predict potential impacts by extrapolating from other territories (Elliott-Graves, 2016; McGeoch et al., 2012). We also observed that consistency and agreement were correlated, despite providing different information, a finding rarely acknowledged in the literature (Bennett et al., 2017; Tinsley and Weiss, 2000). The two reliability measures were correlated, however they responded differently in our study. Although Krippendorff's alpha has been emphasized in previous ecological studies (e.g. Cano-Barbacil et al., 2020; Oficialdegui et al., 2023), the example in Table S8 shows that consistency statistics can be even more informative in ranking exercises.

5. Conclusions

There is a pressing need to improve evidence-based assessments of the IAS risks to prioritize actions in several geographical regions and countries. Although HS uses expert judgment to extrapolate complex processes such as the likelihood of establishment or the impact of species in a new area, usually from incomplete evidence, several previous exercises have been successful in predicting alien species introductions (Roy et al., 2014, 2019). The present HS strengthens IAS policies in many ways, including improved regulation, justification of trade restrictions and monitoring surveillance procedures. Compared to previous HS in Spain, our analysis screens potential invaders from a wider range of terrestrial, freshwater and marine organisms. This allows us not only to update the list of potential IAS that deserve prioritizing management efforts and resources, but also to identify species that merit more exhaustive risk analyses. Our results also support the convenience to include reliability analyses in HS protocols for IAS. The use of agreement and consistency statistics can help identify sources of uncertainty, and catalyse the consensus building of a final list across thematic groups.

Credit author statement

Leaders of thematic groups devised the study. CCB prepared the preliminary list of species and compiled the data. All authors evaluated potential invasive species. Statistical analyses were carried out by CCB with specific assistance from EGB. CCB wrote the original draft, and all authors commented on and contributed to revising the draft versions.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jenvman.2023.118696.

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Supplementary information

Identification of potential invasive alien species in Spain through horizon scanning

Authors: Carlos Cano-Barbacil et al.

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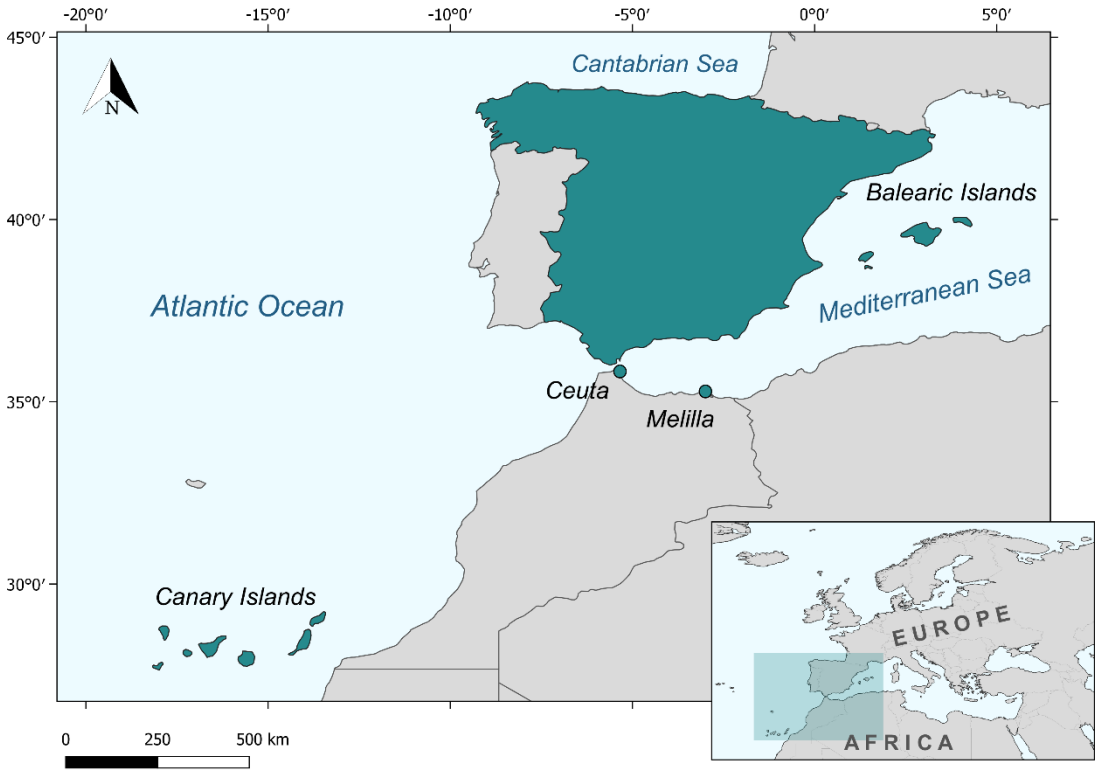

Figure S1. Map of the study area which includes the Spanish mainland, the Canary Islands in the Atlantic Ocean, the Balearic Islands in the Mediterranean Sea, and the autonomous cities of Ceuta and Melilla on the northern coast of Africa.

Table S1. Project calendar.

Deadline	Tasks
22nd March 2022	Establish the protocol, the Excel to fill in, the potential composition of groups and preliminary species list
1st April 2022	Group leaders contacted available experts, sent instructions and preliminary species list, and resolved doubts
1st May 2022	Proposal of candidate species and changes to the preliminary species list
22nd July 2022	Submission of individual evaluations
September 2022	Excel files unified, possible errors detected and the workshop prepared
27-28th October 2022	Workshop (Universidad de Alcalá, Alcalá de Henares, Spain)

Table S2. List of participants in the horizon scanning per group. M = Marine species, FW = Freshwater animals, TV = Terrestrial vertebrates, TI = Terrestrial invertebrates, P = Plants. Asterisks indicate group leaders.

Thematic group	Expert	Institution
M	Xavier Turon *	CEAB
M	Macarena Ros Clemente *	Universidad de Sevilla
M	Jose A. Cuesta	ICMAN-CSIC
M	María Altamirano	Universidad de Málaga
M	Andrés Arias	Universidad de Oviedo
M	José Carlos Hernández	Universidad de La Laguna
M	Eva Cacabelos	Universidad de Vigo. Hydrosphere. MARE-Madeira
FW	Carlos Cano Barbacil *	Universitat de Girona
FW	Emili García Berthou *	Universitat de Girona
FW	Belinda Gallardo	IPE-CSIC
FW	Francisco José Oliva Paterna	Universidad de Murcia
FW	Marta Sánchez	EBD-CSIC
FW	Dani Boix	Universitat de Girona
FW	Fernando Cobo	Universidade de Santiago de Compostela
TV	Martina Carrete *	Universidad Pablo de Olavide
TV	Marta López Darias *	IPNA-CSIC
TV	Manuel Nogales Hidalgo	IPNA-CSIC
TV	Miguel Delibes Mateos	IESA-CSIC
TV	Carlos Cabido	Aranzadi
TV	Pere Pons	Universitat de Girona
TI	Josep Anton Jaques Miret *	Universitat Jaume I
TI	Anna Traveset Vilaginés *	IMEDEA
TI	Elisa Viñuela	Universidad Politécnica de Madrid
TI	Mar Leza	Universitat de les Illes Balears
TI	Pedro del Estal	Universidad Politécnica de Madrid
TI	Beatriz Dáder	Universidad Politécnica de Madrid
TI	Marta Montserrat	IHSM-UMA-CSIC
TI	Núria Roura Pascual	Universitat de Girona
TI	Joaquín Cruz	Universitat Jaume I
TI	Miguel Gómez Laporta	Universitat de les Illes Balears
P	Montserrat Vilà Planella *	EBD-CSIC
P	Pilar Castro Díez *	Universidad de Alcalá
P	Pablo González Moreno	Universidad de Córdoba
P	Inés Álvarez	Real Jardín Botánico, CSIC
P	Alejandro Trillo	EBD-CSIC
P	Roser Rotchés	CREAF
P	Joan Pino	CREAF
P	Adrián Lázaro Lobo	Universidad de Alcalá
P	Borja Jiménez-Alfaro	Universidad de Oviedo

Table S3. List of removed species known to have become established recently, to be a species complex, microorganisms, or thought to be native to part of Spain.

Species	Thematic group	Reason
Acrothamnion preissii	Marine	Established
Alitta succinea	Marine	Established
Anadara inaequivalvis	Marine	Established
Antithamnionella boergesenii	Marine	Established
Aplidium accarense	Marine	Established
Apoglossum gregarium	Marine	Established
Ascidiella aspersa	Marine	Established
Botrylloides violaceus	Marine	Established
Caprella mutica	Marine	Established
Carybdea marsupialis	Marine	Established
Caulerpa cilindracea	Marine	Established
Caulerpa taxifolia	Marine	Established
Chaetopleura angulata	Marine	Established
Ciona intestinalis	Marine	Established
Dictyota cyanoloma	Marine	Established
Didemnum vexillum	Marine	Established
Diplosoma listerianum	Marine	Established
Ensis directus	Marine	Established
Fistularia commersonii	Marine	Established
Grandidierella japonica	Marine	Established
Grateloupia imbricata	Marine	Established
Hydroides dirampha	Marine	Established
Hypnea spinella	Marine	Native
Laniropsis serricaudis	Marine	Established
Jaera istri	Marine	Established
Lagocephalus sceleratus	Marine	Established
Lophocladia lallemandii	Marine	Established
Macrorhynchia philippina	Marine	Established
Myicola ostreae	Marine	Established
Paracaprella pusilla	Marine	Established
Paranthura japonica	Marine	Established
Percnon gibbesi	Marine	Established
Phyllorhiza punctata	Marine	Established
Pinctada imbricata radiata	Marine	Established
Polysiphonia atlantica	Marine	Native
Pseudochattonella verruculosa	Marine	Microoganism
Pseudomyicola spinosus	Marine	Species complex
Rhodosoma turcicum	Marine	Established
Spirorbis marioni	Marine	Established
Stenothoe georgiana	Marine	Established
Styela plicata	Marine	Established

Species	Thematic group	Reason
Symplegma brakenhielmi	Marine	Established
Tubastraea coccinea	Marine	Established
Watersipora subatra	Marine	Established
Aspius aspius	Freshwater	Established
Carassius gibelio	Freshwater	Established
Cherax destructor	Freshwater	Established
Cherax quadricarinatus	Freshwater	Established
Corbicula fluminalis	Freshwater	Established
Limnoperna fortunei	Freshwater	Established
Lymnaea (Radix) peregra	Freshwater	Established
Marissa cornuarietis	Freshwater	Established
Oreochromis mossambicus	Freshwater	Established
Poecilia reticulata	Freshwater	Established
Pomacea maculata	Freshwater	Established
Pseudodiaptomus marinus	Freshwater	Established
Sphaeroma walkeri	Freshwater	Established
Urnatella gracilis	Freshwater	Established
Xiphophorus maculatus	Freshwater	Established
Bufotes balearicus	Terrestrial vertebrates	Established
Canis lupus familiaris	Terrestrial vertebrates	Established
Chrysemys picta	Terrestrial vertebrates	Established
Cygnus olor	Terrestrial vertebrates	Established
Pelophylax saharicus	Terrestrial vertebrates	Native
Pycnonotus cafer	Terrestrial vertebrates	Established
Quelea quelea	Terrestrial vertebrates	Established
Sturnus vulgaris	Terrestrial vertebrates	Native
Acleris ferrugana	Terrestrial invertebrates	Established
Acleris rhombana	Terrestrial invertebrates	Established
Amauromyza maculosa	Terrestrial invertebrates	Established
Bemisia tabaci	Terrestrial invertebrates	Established
Bursaphelenchus xylophilus	Terrestrial invertebrates	Established
Choristoneura lafauryana	Terrestrial invertebrates	Established
Diabrotica virgifera zeae	Terrestrial invertebrates	Established
Dinoderus minutus	Terrestrial invertebrates	Established
Eurytoma amygdali	Terrestrial invertebrates	Established
Galleria mellonella	Terrestrial invertebrates	Established
Heteropsylla cubana	Terrestrial invertebrates	Established
Noctua pronuba	Terrestrial invertebrates	Established
Pheidole megacephala	Terrestrial invertebrates	Established
Phenacoccus solenopsis	Terrestrial invertebrates	Established
Pristiphora erichsonii	Terrestrial invertebrates	Established
Saperda populnea	Terrestrial invertebrates	Established
Scirtothrips aurantii	Terrestrial invertebrates	Established
Scirtothrips dorsalis	Terrestrial invertebrates	Established
Spodoptera frugiperda	Terrestrial invertebrates	Established

Species	Thematic group	Reason
Tecia solanivora	Terrestrial invertebrates	Established
Toxoptera citricida	Terrestrial invertebrates	Established
Trioza erytreae	Terrestrial invertebrates	Established
Tropideres dorsalis	Terrestrial invertebrates	Established
Trypodendron domesticum	Terrestrial invertebrates	Established
Wahlgreniella nervata	Terrestrial invertebrates	Established
Xiphinema rivesi	Terrestrial invertebrates	Established
Aloe vera	Plants	Established
Antigonon leptopus	Plants	Established
Arceuthobium azoricum	Plants	Established
Asparagus asparagoides	Plants	Established
Azolla microphylla	Plants	Established
Bambusa vulgaris	Plants	Established
Berberis aquifolium	Plants	Established
Calotropis procera	Plants	Established
Cupressus arizonica	Plants	Established
Digitaria ciliaris	Plants	Established
Ehrharta calycina	Plants	Established
Elodea nuttallii	Plants	Established
Erigeron karvinskianus	Plants	Established
Euphorbia tirucalli	Plants	Established
Fimbristylis dichotoma	Plants	Established
Fraxinus americana	Plants	Established
Fraxinus pennsylvanica	Plants	Established
Grevillea robusta	Plants	Established
Hedychium gardnerianum	Plants	Established
Hydrocotyle ranunculoides	Plants	Established
Impatiens walleriana	Plants	Established
Ipomoea hederacea	Plants	Established
Kalanchoe daigremontiana	Plants	Established
Landoltia punctata	Plants	Native?
Morus alba	Plants	Established
Morus nigra	Plants	Established
Paspalum notatum	Plants	Established
Phormium tenax	Plants	Established
Physalis peruviana	Plants	Established
Pinus radiata	Plants	Established
Portulaca oleracea	Plants	Native
Prosopis juliflora	Plants	Established
Rhaponticum repens	Plants	Established
Rosa multiflora	Plants	Established
Senna corymbosa	Plants	Established
Senna multijuga	Plants	Established
Senna occidentalis	Plants	Established
Tecoma stans	Plants	Established

Species	Thematic group	Reason
Trachycarpus fortunei	Plants	Established
Yucca aloifolia	Plants	Established
Zantedeschia aethiopica	Plants	Established

Table S4. Arrival scoring criteria (adapted from Roy et al., 2019; Tsiamis et al., 2020).

Arrival score	**Description**
Unlikely to arrive within 10 years **(1)**	Species unlikely to arrive in Spain within 10 years (by 2032). Absent from Spain and neighbouring areas, associated with uncommon or unknown pathways of introduction, with no or limited invasive history
Not very likely to arrive within 10 years **(2)**	Species absent from Spain and neighbouring areas, associated with introduction pathways that commonly apply for primary introductions (trade, transport), with no or limited invasive history
Possible arrival **(3)**	Species absent from Spain and neighbouring areas, but associated with introduction pathways that commonly apply for primary introductions (trade, transport), and with considerable invasive history
Likely to arrive **(4)**	Species present in neighbouring areas but not Spain, with considerable invasive history, likely to reach Spain within the next 10 years
Already arrived or near-certain likelihood of arrival **(5)**	Species with near-certain arrival in Spain within 10 years or already present (but not established) (e.g. held in captivity, garden centres, botanical gardens, zoos, aquaria) or eradicated or disappeared recently

Table S5. Establishment scoring criteria (adapted from Roy et al., 2019; Tsiamis et al., 2020).

Establishment score	Description
Unlikely to establish if it arrived **(1)**	Species unlikely to become established in Spain if it arrived. Species with narrow ecological tolerance and low ability to adapt to new habitats and environmental conditions. Native in areas with different bioclimatic conditions and habitat types compared to some Spanish climates
Not very likely to establish, if it arrived **(2)**	Species not very likely to become established in Spain or neighbouring areas, with no or limited invasive history. Species with narrow ecological tolerance and low ability of adaptation to new habitats and environmental conditions, but native to areas with similar bioclimatic conditions and habitat types compared to some Spanish climates
Possible establishment **(3)**	Species that has not established itelf in Spain or neighbouring areas but with considerable invasive history. Species with broad ecological tolerance and high ability to adapt to new habitats and environmental conditions. Native or naturalized in areas with similar bioclimatic conditions and habitat types compared to some Spanish climates
Likely to establish **(4)**	Species that has already established itself in neighbouring areas but not Spain, with considerable invasive history. Species with broad ecological tolerance and high ability to adapt to new habitats and environmental conditions. Native or naturalized in areas (e.g. neighbouring areas) with similar bioclimatic conditions and habitat types compared to some Spanish climates
Near-certain establishment **(5)**	Species with near-certain establishment, if it arrived in Spain. Or a species that had already become established in Spain but was eradicated or disappeared recently

Table S6. Impact scoring criteria (adapted from Blackburn et al., 2014; Peyton et al., 2019).

Impact score	Description
Minimal **(1)**	No deleterious impacts or local, short-term reversible impact on few species or ecosystems. Small inconsequential changes; 0-10% of decline in species population, habitat or function affected or 0-10% impact on human health or agriculture
Minor **(2)**	Local, short-term reversible impact on communities or several ecosystems. Changes in size, quality or function; 10-25% of species population, habitat or function affected or 10-25% impact on human health or agriculture
Moderate **(3)**	Long-term impact, but little spread, no extinction. Considerable, important changes in size, quality or function; 25-50% of species population, habitat or function affected or 25-50% impact on human health or agriculture
Major **(4)**	Long-term irreversible impact, spreading beyond local area. Large, highly significant changes in size, quality or function; 50-75% of species population, habitat or function affected or 50-75% impact on human health or agriculture
Massive **(5)**	Widespread, severe, long-term impact, including extinction. Loss of all, or almost all, of a species, function or habitat; 75-100% of species population, habitat or function affected or 75-100% impact on human health or agriculture

Table S7. Confidence level scoring criteria following Blackburn et al. (2014) (modified from the EPPO pest risk assessment decision support scheme [Alan MacLeod 09/03/2011; revised 28/04/2011; copied from CAPRA, version 2.74; 2]).

Confidence score	Examples
High **(H)**	There is direct relevant evidence to support the assessment. The situation can easily be predicted. There are reliable/good quality data sources on impacts of the species. Interpretation of data/information is straightforward. Data/information not controversial or contradictory.
Medium **(M)**	There is some evidence to support the assessment. Some information is indirect, e.g. data from phylogenetically or functionally similar species have been used as supporting evidence. Interpretation of data is to some extent ambiguous or contradictory.
Low **(L)**	No direct evidence to support the assessment, e.g. only data from other species have been used as supporting evidence. Evidence is poor and difficult to interpret, e.g. because it is strongly ambiguous. Information sources are considered to be of low quality or contain information that is unreliable.

Table S8. Illustration of the two components of reliability (agreement and consistency) and corresponding statistics with three hypothetical cases, each with three experts scoring ten species (modified from Tinsley and Weiss, 2000).

Species	Case A: High agreement and high consistency			Case B: Low agreement and high consistency			Case C: High agreement and low consistency		
	Expert 1	Expert 2	Expert 3	Expert 1	Expert 2	Expert 3	Expert 1	Expert 2	Expert 3
A	1	1	1	1	3	6	5	6	5
B	2	2	2	1	3	6	5	4	4
C	3	3	3	2	4	7	6	4	6
D	4	4	4	2	4	7	4	5	6
E	5	5	5	3	5	8	5	4	4
F	6	6	6	3	5	8	6	6	5
G	7	7	7	4	6	9	4	4	5
H	8	8	8	4	6	9	5	5	4
I	9	9	9	5	7	10	4	5	3
J	10	10	10	5	7	10	6	6	6
Statistic									
Bootstrapped Krippendorff's α (and confidence interval)	1 (1, 1)			-0.01 (-0.28, 0.25)			0.32 (0.03, 0.58)		
Kendall's coefficient of concordance (W)	1 (P = 0.001)			1 (P = 0.001)			0.542 (P = 0.165)		

Table S9. Functional groups and associated abbreviations used in compiling information on prioritized species. Modified from Roy et al. (2019).

Functional group	Abbreviation
Detritivore	Det
Primary producer	PP
Filter feeder	Filter
Herbivore	Herb
Predator or parasite	Pred
Omnivore	Omni
Pollinator	Poll

Table S10. Native geographical region for inland species and associated abbreviations used in compiling information on prioritized species. Modified from Roy et al. (2019).

Geographical region	Abbreviation
Europe	Eur
Africa	Afr
Asia-temperate	As
Asia-tropical	At
Australasia	Aus
Pacific	Pac
North America	NAm
South America	SAm
Antarctica	Ant

Table S11. Native geographical region for marine species and associated abbreviations used in compiling information on prioritized species. Modified from Roy et al. (2019).

Geographical region	Abbreviation	Details
Arctic	ARC	Alaska, N Canada, N Russia
Temperate NW Pacific	TeNWP	Japan, Korea, N China, E Russia
Temperate NE Pacific	TeNEP	W Canada, W USA (California northwards), S Alaska
Temperate NW Atlantic	TeNWA	E USA, E Canada
Temperate NE Atlantic	TeNEA	Europe, NW Africa
Eastern Indo-Pacific	EIP	Hawaii, Guam
Central Indo-Pacific	CIP	Philippines, Malaysia, Taiwan, N Australia
Western Indo-Pacific	WIP	India, E Africa, Red Sea
Tropical Eastern Pacific	TrEP	Central America
Tropical Eastern Atlantic	TrEA	W Africa
Tropical Western Atlantic	TrWA	Caribbean, Brazil
Temperate SE Pacific	TeSEP	Chile, Peru
Temperate SW Atlantic	TeSWA	Argentina
Temperate Southern Africa	TeSAf	South Africa, Namibia
Temperate Australasia	TeAu	Australia, New Zealand
Southern Ocean	SOU	Antarctica

Table S12. Classification of potential pathways (CBD, 2014) through which invasive alien species could arrive. Modified from Roy et al. (2019).

Category	Subcategory	Abbreviation
Release in nature (Rel)	Biological Control	BC
	Erosion control / dune stabilisation	EC
	Fishery in the wild	F
	Hunting	H
	Landscape/flora/fauna improvement in the wild	L
	Conservation purposes or wildlife management	Cons
	Release in nature for use (other than above)	R
	Other intentional release	Other
Escape from confinement (Esc)	Agriculture	Ag
	Aquaculture	Aq
	Botanical garden/zoo/aquaria	BZA
	Pet/aquarium/terrarium	Pet
	Farmed animals	Farm
	Forestry	For
	Fur Farm	FF
	Horticulture	Hort
	Ornamental other than horticulture	Orn
	Research	Res
	Live food and live bait	Live
	Other escape from confinement	Other escape
Transport contaminant (Con)	Contaminant nursery material	CNM
	Contaminated bait	Bait
	Food contaminant	Food
	Contaminant on animals (except parasites)	Con Anim
	Parasites on animals	Par Anim
	Contaminant on plants (except parasites)	Con Plant
	Parasites on plants	Par Plant
	Seed contaminant	Seed
	Timber trade	TT
	Transportation of habitat material	THM
Transport-stowaway (Sto)	Angling/fishing equipment	Ang
	Container/bulk	Container
	Hitchhikers on airplane	Air
	Hitchhikers on ship/boat	Ship
	Machinery/equipment	Mach
	People and luggage / equipment	Lug
	Organic packing material	Org
	Ship/boat ballast water	Ballast
	Ship/boat hull fouling	Hull
	Vehicles	Veh
	Other means of transport	Other transport
Corridor (Cor)	Interconnected waterways (water tunnels and bridges)	Tun
Unaided (Una)	Natural dispersal across border of IAS that have been introduced through pathways 1-5	Nat

Table S13. Results of the beta regression model.

	Estimate	Std. Error	*z*	*P*
(Intercept)	-0.482	0.217	-2.223	**0.026**
Group – Freshwater	0.354	0.258	1.370	0.171
Group – Terr. vertebrates	-0.780	0.294	-2.655	**0.008**
Group – Terr. invertebrates	0.734	0.256	2.872	**0.004**
Group – Plants	0.189	0.261	0.724	0.469
Score – Establishment	-0.444	0.202	-2.196	**0.028**
Score – Impact	-0.561	0.205	-2.742	**0.006**

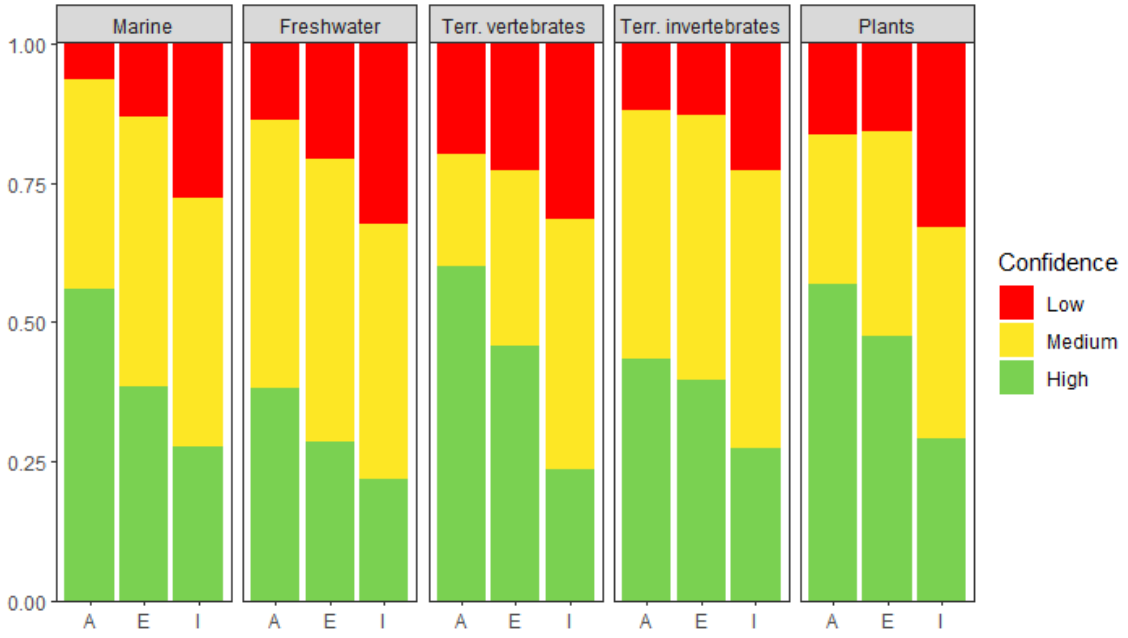

Figure S2. Confidence level shown by experts in the different groups when establishing scores for the three items evaluated. A = likelihood of arrival; E = likelihood of establishment; I = likelihood of impact.

Table S14. Results of consistency analysis.

Group	Score	*W*	*P*
Marine	Arrival	0.611	<0.001
	Establishment	0.545	<0.001
	Impact	0.554	<0.001
	Total	0.568	<0.001
Freshwater	Arrival	0.707	<0.001
	Establishment	0.716	<0.001
	Impact	0.753	<0.001
	Total	0.786	<0.001
Terr. vertebrates	Arrival	0.654	<0.001
	Establishment	0.457	<0.001
	Impact	0.454	<0.001
	Total	0.572	<0.001
Terr. invertebrates	Arrival	0.795	<0.001
	Establishment	0.747	<0.001
	Impact	0.677	<0.001
	Total	0.763	<0.001
Plants	Arrival	0.675	<0.001
	Establishment	0.632	0.002
	Impact	0.730	<0.001
	Total	0.723	<0.001

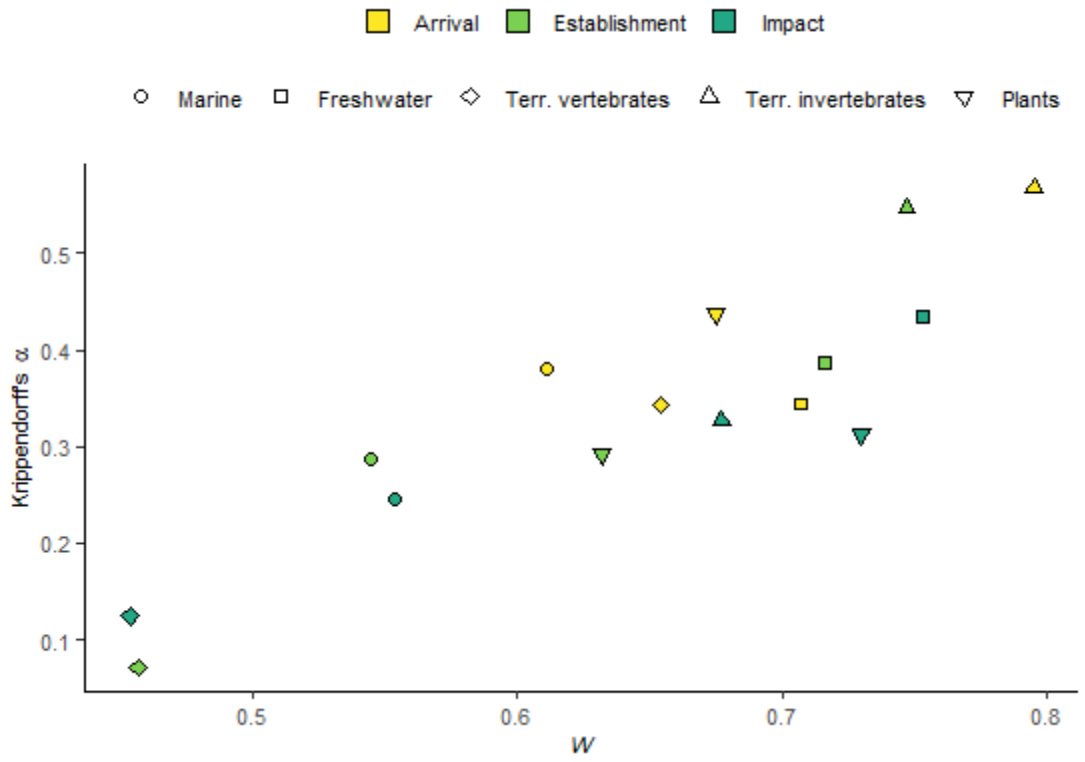

Figure S3. Relationship between Krippendorff's α and Kendall's coefficient of concordance (*W*). ρ = 0.818, $P < 0.001$.

Table S15. Number of potentially invasive species by thematic group with very high, high, moderate and low risk.

Risk	Group	*n*
Very high (100 – 125)	Marine	3
	Freshwater	7
	Terrestrial vertebrates	18
	Terrestrial invertebrates	8
	Plants	11
High (80 – 75)	Marine	6
	Freshwater	7
	Terrestrial vertebrates	13
	Terrestrial invertebrates	7
	Plants	28
Moderate (64 – 60)	Marine	18
	Freshwater	21
	Terrestrial vertebrates	11
	Terrestrial invertebrates	18
	Plants	26
Low (<60)	Marine	89
	Freshwater	147
	Terrestrial vertebrates	54
	Terrestrial invertebrates	234
	Plants	207

Table S16. List of species with very high risk.

Species	Themaitc group	Overall score	Mean confidence
Oreochromis niloticus	Freshwater	125	3.0
Popillia japonica	Terrestrial invertebrates	125	3.0
Radopholus similis	Terrestrial invertebrates	125	3.0
Hemidactylus frenatus	Terrestrial vertebrates	125	3.0
Lampropeltis getula	Terrestrial vertebrates	125	3.0
Sciurus carolinensis	Terrestrial vertebrates	125	3.0
Pelophylax lessonae	Terrestrial vertebrates	125	3.0
Crassula helmsii	Plants	125	3.0
Pueraria montana var. *lobata*	Plants	125	3.0
Cabomba caroliniana	Plants	125	3.0
Hydrilla verticillata	Plants	125	3.0
Reynoutria x *bohemica*	Plants	125	3.0
Salvinia molesta	Plants	125	3.0
Pomacea canaliculata	Freshwater	125	2.7
Cynops pyrrhogaster	Terrestrial vertebrates	125	2.7
Rhinella marina	Terrestrial vertebrates	125	2.3
Ocadia sinensis	Terrestrial vertebrates	125	2.3
Mauremys (*Chinemys*) *reevesii*	Terrestrial vertebrates	125	1.7
Phoxinus phoxinus	Freshwater	100	3.0
Halophila stipulacea	Marine	100	3.0
Lissorhoptrus oryzophilus	Terrestrial invertebrates	100	3.0
Orientus ishidae	Terrestrial invertebrates	100	3.0
Rhagoletis cingulata	Terrestrial invertebrates	100	3.0
Aromia bungii	Terrestrial invertebrates	100	3.0
Acridotheres tristis	Terrestrial vertebrates	100	3.0
Sphagneticola trilobata	Plants	100	3.0
Miscanthus sinensis	Plants	100	3.0
Prunus serotina	Plants	100	3.0
Gambusia affinis	Freshwater	100	2.7
Ulva ohnoi	Marine	100	2.7
Toumeyella parvicornis	Terrestrial invertebrates	100	2.7
Anser cygnoides	Terrestrial vertebrates	100	2.7
Castor canadensis	Terrestrial vertebrates	100	2.7
Osteopilus septentrionalis	Terrestrial vertebrates	100	2.7
Macrochelys temminckii	Terrestrial vertebrates	100	2.7
Pantherophis guttatus	Terrestrial vertebrates	100	2.7
Lagarosiphon major	Plants	100	2.7
Dreissena rostriformis bugensis	Freshwater	100	2.3
Glycera dibranchiata	Marine	100	2.3
Argyrotaenia ljungiana	Terrestrial invertebrates	100	2.3
Acridotheres cristatellus	Terrestrial vertebrates	100	2.3
Psittacula eupatria	Terrestrial vertebrates	100	2.3
Sternotherus odoratus	Terrestrial vertebrates	100	2.3

Species	Themaitc group	Overall score	Mean confidence
Ligustrum sinense	Plants	100	2.3
Dikerogammarus villosus	Freshwater	100	2.0
Procambarus virginalis	Freshwater	100	2.0
Trachemys ornata	Terrestrial vertebrates	100	2.0

Table S17. List of species with high risk.

Species	Themaitc group	Overall score	Mean confidence
Rhopilema nomadica	Marine	80	3.0
Aedes aegypti	Terrestrial invertebrates	80	3.0
Bactrocera dorsalis	Terrestrial invertebrates	80	3.0
Euwallacea fornicatus	Terrestrial invertebrates	80	3.0
Platydemus manokwari	Terrestrial invertebrates	80	3.0
Corvus splendens	Terrestrial vertebrates	80	3.0
Echinocystis lobata	Plants	80	3.0
Sesbania punicea	Plants	80	3.0
Cornus sericea	Plants	80	3.0
Eugenia uniflora	Plants	80	3.0
Gypsophila paniculata	Plants	80	3.0
Thunbergia alata	Plants	80	3.0
Squalius cephalus	Freshwater	80	2.7
Channa argus argus	Freshwater	80	2.7
Perccottus glenii	Freshwater	80	2.7
Gobio gobio	Freshwater	80	2.7
Callosciurus erythraeus	Terrestrial vertebrates	80	2.7
Wisteria sinensis	Plants	80	2.7
Acacia decurrens	Plants	80	2.7
Malva pusilla	Plants	80	2.7
Prosopis glandulosa	Plants	80	2.7
Micropterus dolomieu	Freshwater	80	2.3
Oreochromis aureus	Freshwater	80	2.3
Penaeus monodon	Marine	80	2.3
Pterois miles	Marine	80	2.3
Cervus nippon	Terrestrial vertebrates	80	2.3
Pelophylax cf. *bedriagae*	Terrestrial vertebrates	80	2.3
Sylvilagus floridanus	Terrestrial vertebrates	80	2.3
Elaeagnus umbellata	Plants	80	2.3
Hydrocotyle sibthorpioides	Plants	80	2.3
Hemimysis anomala	Freshwater	80	2.0
Aleurocanthus spiniferus	Terrestrial invertebrates	80	2.0
Sciurus niger	Terrestrial vertebrates	80	2.0
Pelophylax cf. *esculentus*	Terrestrial vertebrates	80	2.0
Mimosa pudica	Plants	80	2.0
Melita nitida	Marine	75	3.0
Meloidogyne chitwoodi	Terrestrial invertebrates	75	3.0
Nandina domestica	Plants	75	3.0
Rosa rugosa	Plants	75	3.0
Cotoneaster franchetii	Plants	75	3.0
Cotoneaster horizontalis	Plants	75	3.0
Leptospermum scoparium	Plants	75	3.0
Cereus uruguayanus	Plants	75	3.0

Species	Themaitc group	Overall score	Mean confidence
Casuarina equisetifolia	Plants	75	3.0
Anomia chinensis	Marine	75	2.7
Enarmonia formosana	Terrestrial invertebrates	75	2.7
Herpestes auropunctatus	Terrestrial vertebrates	75	2.7
Python bivittatus	Terrestrial vertebrates	75	2.7
Anolis sagrei	Terrestrial vertebrates	75	2.7
Mephitis mephitis	Terrestrial vertebrates	75	2.7
Coreopsis lanceolata	Plants	75	2.7
Euonymus fortunei	Plants	75	2.7
Salvia microphylla	Plants	75	2.7
Thevetia peruviana	Plants	75	2.7
Passiflora suberosa	Plants	75	2.7
Schizoporella japonica	Marine	75	2.3
Salix babylonica	Plants	75	2.3
Lemna perpusilla	Plants	75	2.3
Boiga irregularis	Terrestrial vertebrates	75	2.0
Lemna aequinoctialis	Plants	75	2.0
Apalone spinifera	Terrestrial vertebrates	75	1.7

Table S18. List of species with moderate risk.

Species	Themaitc group	Overall score	Mean confidence
Pimephales promelas	Freshwater	64	3.0
Codium parvulum	Marine	64	3.0
Libinia dubia	Marine	64	3.0
Anoplophora chinensis	Terrestrial invertebrates	64	3.0
Anoplophora glabripennis	Terrestrial invertebrates	64	3.0
Megaplatypus mutatus	Terrestrial invertebrates	64	3.0
Meloidogyne enterolobii	Terrestrial invertebrates	64	3.0
Meloidogyne fallax	Terrestrial invertebrates	64	3.0
Meloidogyne graminicola	Terrestrial invertebrates	64	3.0
Nipaecoccus viridis	Terrestrial invertebrates	64	3.0
Muntiacus reevesi	Terrestrial vertebrates	64	3.0
Mimosa pigra	Plants	64	3.0
Andropogon virginicus	Plants	64	3.0
Pilosella caespitosa	Plants	64	3.0
Heracleum sosnowskyi	Plants	64	3.0
Cercopagis pengoi	Freshwater	64	2.7
Gymnocephalus cernuus	Freshwater	64	2.7
Brachidontes pharaonis	Marine	64	2.7
Portunus segnis	Marine	64	2.7
Amblyomma variegatum	Terrestrial invertebrates	64	2.7
Bagrada hilaris	Terrestrial invertebrates	64	2.7
Ferrisia virgata	Terrestrial invertebrates	64	2.7
Phyllocnistis vitegenella	Terrestrial invertebrates	64	2.7
Jatropha curcas	Plants	64	2.7
Clarias gariepinus	Freshwater	64	2.3
Mylopharyngodon piceus	Freshwater	64	2.3
Channa micropeltes	Freshwater	64	2.3
Hemigrapsus sanguineus	Marine	64	2.3
Neogobius melanostomus	Marine	64	2.3
Echinococcus multilocularis	Terrestrial invertebrates	64	2.3
Axis axis	Terrestrial vertebrates	64	2.3
Chelicorophium curvispinum	Freshwater	64	2.0
Coptodon zillii	Freshwater	64	2.0
Callinectes pallidus	Marine	64	2.0
Pseudonereis anomala	Marine	64	2.0
Siganus rivulatus	Marine	64	2.0
Aphelenchoides besseyi	Terrestrial invertebrates	64	2.0
Solenopsis geminata	Terrestrial invertebrates	64	2.0
Rhodeus amarus	Freshwater	64	1.7
Microcosmus exasperatus	Marine	64	1.7
Siganus luridus	Marine	64	1.7
Gammarus tigrinus	Freshwater	64	1.3
Ditylenchus destructor	Terrestrial invertebrates	60	3.0

Species	Themaitc group	Overall score	Mean confidence
Cestrum nocturnum	Plants	60	3.0
Vachellia nilotica	Plants	60	3.0
Spathodea campanulata	Plants	60	3.0
Allamanda cathartica	Plants	60	3.0
Physalis angulata	Plants	60	3.0
Mikania micrantha	Plants	60	3.0
Cinnamomum camphora	Plants	60	3.0
Senna septemtrionalis	Plants	60	3.0
Rivina humilis	Plants	60	3.0
Lagerstroemia indica	Plants	60	3.0
Umbra pygmaea	Freshwater	60	2.7
Pygocentrus nattereri	Freshwater	60	2.7
Xiphophorus hellerii	Freshwater	60	2.7
Aoroides longimerus	Marine	60	2.7
Aoroides curvipes	Marine	60	2.7
Boa constrictor	Terrestrial vertebrates	60	2.7
Pseudemys peninsularis	Terrestrial vertebrates	60	2.7
Pelomedusa subrufa	Terrestrial vertebrates	60	2.7
Berberis thunbergii	Plants	60	2.7
Paulownia tomentosa	Plants	60	2.7
Hakea salicifolia	Plants	60	2.7
Humulus scandens	Plants	60	2.7
Breynia disticha	Plants	60	2.7
Eucalyptus sideroxylon	Plants	60	2.7
Pinus patula	Plants	60	2.7
Hypophthalmichthys molitrix	Freshwater	60	2.3
Poecilia latipinna	Freshwater	60	2.3
Ctenopharyngodon idella	Freshwater	60	2.3
Leucaspius delineatus	Freshwater	60	2.3
Triops longicaudatus	Freshwater	60	2.3
Incisocalliope aestuarius	Marine	60	2.3
Pachygrapsus gracilis	Marine	60	2.3
Urosalpinx cinerea	Marine	60	2.3
Xiphinema americanum	Terrestrial invertebrates	60	2.3
Xiphinema bricolense	Terrestrial invertebrates	60	2.3
Boa imperator	Terrestrial vertebrates	60	2.3
Bubalus bubalis	Terrestrial vertebrates	60	2.3
Nyctereutes procyonoides	Terrestrial vertebrates	60	2.3
Pilosella aurantiaca	Plants	60	2.3
Murdannia keisak	Plants	60	2.3
Barbus barbus	Freshwater	60	2.0
Hesperibalanus fallax	Marine	60	2.0
Varroa jacobsoni	Terrestrial invertebrates	60	2.0
Duttaphrynus melanostictus	Terrestrial vertebrates	60	2.0
Trachemys decussata	Terrestrial vertebrates	60	2.0

Species	Themaitc group	Overall score	Mean confidence
Pontederia cordata	Plants	60	2.0
Casuarina glauca	Plants	60	2.0
Pachychilon pictum	Freshwater	60	1.7
Faxonius virilis	Freshwater	60	1.7
Trachemys emolli	Terrestrial vertebrates	60	1.7

Table S19. List of species with low risk.

Species	Thematic group	Overall score	Mean confidence
Laurencia brongniartii	Marine	50	2.7
Monocorophium uenoi	Marine	50	2.7
Dendroctonus micans	Terrestrial invertebrates	50	2.7
Elatobium abietinum	Terrestrial invertebrates	50	2.7
Chromolaena odorata	Plants	50	2.7
Spiraea japonica	Plants	50	2.7
Ageratum houstonianum	Plants	50	2.7
Eutrichosiphonia paniculata	Marine	50	2.3
Chrysonephos lewisii	Marine	50	2.3
Dreyfusia nordmannianae	Terrestrial invertebrates	50	2.3
Aix sponsa	Terrestrial vertebrates	50	2.0
Acleris comariana	Terrestrial invertebrates	50	1.0
Matuta victor	Marine	48	3.0
Aculops fuchsiae	Terrestrial invertebrates	48	3.0
Aproceros leucopoda	Terrestrial invertebrates	48	3.0
Culex quinquefasciatus	Terrestrial invertebrates	48	3.0
Limnoria quadripunctata	Terrestrial invertebrates	48	3.0
Liriomyza sativae	Terrestrial invertebrates	48	3.0
Pseudacysta perseae	Terrestrial invertebrates	48	3.0
Pseudococcus elisae	Terrestrial invertebrates	48	3.0
Callosciurus finlaysonii	Terrestrial vertebrates	48	3.0
Lupinus arboreus	Plants	48	3.0
Bothriochloa pertusa	Plants	48	3.0
Hedychium coronarium	Plants	48	3.0
Merremia tuberosa	Plants	48	3.0
Ambloplites rupestris	Freshwater	48	2.7
Saurida undosquamis	Freshwater	48	2.7
Aoroides semicurvatus	Marine	48	2.7
Asterocarpa humilis	Marine	48	2.7
Distaplia bermudensis	Marine	48	2.7
Penaeus aztecus	Marine	48	2.7
Platorchestia platensis	Marine	48	2.7
Polyclinum constellatum	Marine	48	2.7
Aedes koreicus	Terrestrial invertebrates	48	2.7
Pealius azaleae	Terrestrial invertebrates	48	2.7
Solenopsis invicta	Terrestrial invertebrates	48	2.7
Oldenlandia corymbosa	Plants	48	2.7
Artemisia biennis	Plants	48	2.7
Ipomoea quamoclit	Plants	48	2.7
Melaleuca quinquenervia	Plants	48	2.7
Emilia fosbergii	Plants	48	2.7
Thunbergia fragrans	Plants	48	2.7

Species	Thematic group	Overall score	Mean confidence
Lepomis cyanellus	Freshwater	48	2.3
Lepomis macrochirus	Freshwater	48	2.3
Salvelinus alpinus	Freshwater	48	2.3
Clarias batrachus	Freshwater	48	2.3
Limnomysis benedeni	Freshwater	48	2.3
Neogobius fluviatilis	Freshwater	48	2.3
Tilapia mariae	Freshwater	48	2.3
Hypophthalmichthys nobilis	Freshwater	48	2.3
Bactrocera cucurbitae	Terrestrial invertebrates	48	2.3
Haplodiplosis marginata	Terrestrial invertebrates	48	2.3
Heterodera glycines	Terrestrial invertebrates	48	2.3
Ripersiella (= *Rhizoecus*) *hibisci*	Terrestrial invertebrates	48	2.3
Spodoptera eridania	Terrestrial invertebrates	48	2.3
Spodoptera litura	Terrestrial invertebrates	48	2.3
Xylosandrus discolor	Terrestrial invertebrates	48	2.3
Xylosandrus morigerus	Terrestrial invertebrates	48	2.3
Zeiraphera griseana (= *diniana*)	Terrestrial invertebrates	48	2.3
Duranta erecta	Plants	48	2.3
Linaria dalmatica	Plants	48	2.3
Paederia foetida	Plants	48	2.3
Cuphea carthagenensis	Plants	48	2.3
Leuciscus leuciscus	Freshwater	48	2.0
Coregonus albula	Freshwater	48	2.0
Amatitlania nigrofasciata	Freshwater	48	2.0
Chondrostoma nasus	Freshwater	48	2.0
Hemichromis letourneuxi	Freshwater	48	2.0
Misgurnus fossilis	Freshwater	48	2.0
Alpheus inopinatus	Marine	48	2.0
Celtodoryx ciocalyptoides	Marine	48	2.0
Charybdis hellerii	Marine	48	2.0
Charybdis japonica	Marine	48	2.0
Arrhenodes minutus	Terrestrial invertebrates	48	2.0
Cnestus (= *Xylosandrus*) *mutilatus*	Terrestrial invertebrates	48	2.0
Euwallacea (= *Xyleborus*) *similis*	Terrestrial invertebrates	48	2.0
Hirschmanniella oryzae	Terrestrial invertebrates	48	2.0
Keiferia lycopersicella	Terrestrial invertebrates	48	2.0
Rhynchophorus palmarum	Terrestrial invertebrates	48	2.0
Solenopsis richteri	Terrestrial invertebrates	48	2.0
Xiphinema intermedium	Terrestrial invertebrates	48	2.0
Xyleborus glabratus	Terrestrial invertebrates	48	2.0
Solanum capsicoides	Plants	48	2.0
Acanthospermum hispidum	Plants	48	2.0
Drymaria cordata	Plants	48	2.0
Rangia cuneata	Freshwater	48	1.7

Species	Thematic group	Overall score	Mean confidence
Laonome calida	Freshwater	48	1.7
Tamiasciurus hudsonicus	Terrestrial vertebrates	48	1.7
Manilkara zapota	Plants	48	1.7
Heteranthera zosterifolia	Plants	48	1.7
Dikerogammarus haemobaphes	Freshwater	48	1.0
Aeolesthes sarta	Terrestrial invertebrates	45	3.0
Agrilus anxius	Terrestrial invertebrates	45	3.0
Agrilus planipennis	Terrestrial invertebrates	45	3.0
Bactericera cockerelli	Terrestrial invertebrates	45	3.0
Bactrocera zonata	Terrestrial invertebrates	45	3.0
Homalodisca vitripennis	Terrestrial invertebrates	45	3.0
Pseudaonidia duplex	Terrestrial invertebrates	45	3.0
Pterandrus rosa	Terrestrial invertebrates	45	3.0
Raoiella indica	Terrestrial invertebrates	45	3.0
Rhagoletis mendax	Terrestrial invertebrates	45	3.0
Rhagoletis pomonella	Terrestrial invertebrates	45	3.0
Hypostomus plecostomus	Freshwater	45	2.7
Pethia conchonius	Freshwater	45	2.7
Cyprinella lutrensis	Freshwater	45	2.7
Lates niloticus	Freshwater	45	2.7
Brachyponera chinensis	Terrestrial invertebrates	45	2.7
Gunnera tinctoria	Plants	45	2.7
Digitaria insularis	Plants	45	2.7
Watsonia bulbillifera	Plants	45	2.7
Phalloceros caudimaculatus	Freshwater	45	2.3
Faxonius rusticus	Freshwater	45	2.3
Homarus americanus	Marine	45	2.3
Megabalanus coccopoma	Marine	45	2.3
Python molurus	Terrestrial vertebrates	45	2.3
Varanus niloticus	Terrestrial vertebrates	45	2.3
Caiman cocodrilus	Terrestrial vertebrates	45	2.3
Nasua nasua	Terrestrial vertebrates	45	2.3
Pseudemys floridana	Terrestrial vertebrates	45	2.3
Eleutherodactylus coqui	Terrestrial vertebrates	45	2.3
Ctenosaura similis	Terrestrial vertebrates	45	2.3
Delonix regia	Plants	45	2.3
Tamarindus indica	Plants	45	2.3
Murraya paniculata	Plants	45	2.3
Euphorbia hypericifolia	Plants	45	2.3
Passiflora edulis	Plants	45	2.3
Rottboellia cochinchinensis	Plants	45	2.3
Potamon fluviatile	Freshwater	45	2.0
Alburnoides bipunctatus	Freshwater	45	2.0
Trioceros jacksonii	Terrestrial vertebrates	45	2.0

Species	Thematic group	Overall score	Mean confidence
Pseudemys rubriventris	Terrestrial vertebrates	45	2.0
Varanus indicus	Terrestrial vertebrates	45	2.0
Bauhinia purpurea	Plants	45	2.0
Albizia lebbeck	Plants	45	2.0
Pterois volitans	Marine	45	1.7
Acridotheres fuscus	Terrestrial vertebrates	45	1.7
Rattus tanezumi	Terrestrial vertebrates	45	1.7
Diaphorina citri	Terrestrial invertebrates	40	3.0
Diprion similis	Terrestrial invertebrates	40	2.7
Cervus canadensis	Terrestrial vertebrates	40	2.7
Mangifera indica	Plants	40	2.7
Ceratopteris thalictroides	Plants	40	2.7
Ficus elastica	Plants	40	2.7
Psidium cattleianum	Plants	40	2.7
Russelia equisetiformis	Plants	40	2.7
Odontesthes bonariensis	Freshwater	40	2.3
Namanereis littoralis	Marine	40	2.3
Panopeus occidentalis	Marine	40	2.3
Boccardiella ligerica	Marine	40	2.3
Bos bison	Terrestrial vertebrates	40	2.3
Cercyon (*Paracycreon*) *laminatus*	Freshwater	40	2.0
Eocuma dimorphum	Marine	40	2.0
Vertebrata fucoides	Marine	40	2.0
Euonymus japonicus	Plants	40	1.7
Aleurocanthus woglumi	Terrestrial invertebrates	36	3.0
Anthonomus eugenii	Terrestrial invertebrates	36	3.0
Anthonomus grandis	Terrestrial invertebrates	36	3.0
Helicoverpa zea	Terrestrial invertebrates	36	3.0
Maconellicoccus hirsutus	Terrestrial invertebrates	36	3.0
Paracoccus marginatus	Terrestrial invertebrates	36	3.0
Pardalaspis quinaria	Terrestrial invertebrates	36	3.0
Planococcus kenyae	Terrestrial invertebrates	36	3.0
Rhagoletis fausta	Terrestrial invertebrates	36	3.0
Abrus precatorius	Plants	36	3.0
Acacia mangium	Plants	36	3.0
Leptospermum laevigatum	Plants	36	3.0
Lygodium japonicum	Plants	36	3.0
Mesosphaerum pectinatum	Plants	36	3.0
Parthenium hysterophorus	Plants	36	3.0
Nymphaea odorata	Plants	36	3.0
Acacia auriculiformis	Plants	36	3.0
Microstegium vimineum	Plants	36	3.0
Oeceoclades maculata	Plants	36	3.0
Bothriochloa bladhii	Plants	36	3.0

Species	Thematic group	Overall score	Mean confidence
Crassocephalum crepidioides	Plants	36	3.0
Cyanthillium cinereum	Plants	36	3.0
Triadica sebifera	Plants	36	3.0
Zostera japonica	Marine	36	3.0
Astronotus ocellatus	Freshwater	36	2.7
Potamon ibericum	Freshwater	36	2.7
Rhodeus ocellatus ocellatus	Freshwater	36	2.7
Monopterus albus	Freshwater	36	2.7
Caulerpa serrulata	Marine	36	2.7
Bactrocera minax	Terrestrial invertebrates	36	2.7
Sphinx pinastri	Terrestrial invertebrates	36	2.7
Anolis cristatellus	Terrestrial vertebrates	36	2.7
Suncus murinus	Terrestrial vertebrates	36	2.7
Rudbeckia laciniata	Plants	36	2.7
Archontophoenix cunninghamiana	Plants	36	2.7
Jatropha gossypiifolia	Plants	36	2.7
Portulaca pilosa	Plants	36	2.7
Azadirachta indica	Plants	36	2.7
Centaurea stoebe subsp. micranthos	Plants	36	2.7
Clematis terniflora	Plants	36	2.7
Solanum seaforthianum	Plants	36	2.7
Hibiscus tiliaceus	Plants	36	2.7
Anopheles quadrimaculatus	Freshwater	36	2.3
Channa marulius	Freshwater	36	2.3
Babka gymnotrachelus	Freshwater	36	2.3
Pylodictis olivaris	Freshwater	36	2.3
Pomoxis annularis	Freshwater	36	2.3
Proterorhinus marmoratus	Freshwater	36	2.3
Proterorhinus semilunaris	Freshwater	36	2.3
Channa panaw	Freshwater	36	2.3
Diadema setosum	Marine	36	2.3
Neodexiospira brasiliensis	Marine	36	2.3
Neoleucinodes elegantalis	Terrestrial invertebrates	36	2.3
Scirtothrips citri	Terrestrial invertebrates	36	2.3
Calliandra houstoniana var. *calothyrsus*	Plants	36	2.3
Lemna turionifera	Plants	36	2.3
Senna alata	Plants	36	2.3
Cassytha filiformis	Plants	36	2.3
Pinus caribaea	Plants	36	2.3
Senna hirsuta	Plants	36	2.3
Indigofera spicata	Plants	36	2.3
Senna spectabilis	Plants	36	2.3
Combretum indicum	Plants	36	2.3
Salvelinus namaycush	Freshwater	36	2.0

Species	Thematic group	Overall score	Mean confidence
Potamocorbula amurensis	Freshwater	36	2.0
Bellamya chinensis	Freshwater	36	2.0
Gobio alverniae	Freshwater	36	2.0
Oncorhynchus tshawytscha	Freshwater	36	2.0
Barbonymus schwanenfeldii	Freshwater	36	2.0
Lota lota	Freshwater	36	2.0
Oncorhynchus nerka	Freshwater	36	2.0
Sander vitreus	Freshwater	36	2.0
Daphnia lumholtzi	Freshwater	36	2.0
Cherax cainii	Freshwater	36	2.0
Lates calcarifer	Freshwater	36	2.0
Ponticola kessleri	Freshwater	36	2.0
Hemichromis fasciatus	Freshwater	36	2.0
Balanus glandula	Marine	36	2.0
Amynthas agrestis	Terrestrial invertebrates	36	2.0
Apis mellifera scutellata	Terrestrial invertebrates	36	2.0
Compsidia (= *Saperda*) *populnea*	Terrestrial invertebrates	36	2.0
Graphocephala atropunctata	Terrestrial invertebrates	36	2.0
Tachinaephagus zealandicus	Terrestrial invertebrates	36	2.0
Thrips palmi	Terrestrial invertebrates	36	2.0
Xiphinema californicum	Terrestrial invertebrates	36	2.0
Xiphinema inaequale	Terrestrial invertebrates	36	2.0
Xiphinema tarjanense	Terrestrial invertebrates	36	2.0
Cissus verticillata	Plants	36	2.0
Clidemia hirta	Plants	36	2.0
Sporobolus pyramidalis	Plants	36	2.0
Acacia paradoxa	Plants	36	2.0
Elodea callitrichoides	Plants	36	2.0
Macroptilium atropurpureum	Plants	36	2.0
Terminalia catappa	Plants	36	2.0
Hydrocotyle moschata	Plants	36	2.0
Celastrus orbiculatus	Plants	36	2.0
Boerhavia diffusa	Plants	36	2.0
Aponogeton distachyos	Plants	36	2.0
Passiflora foetida	Plants	36	2.0
Pontogammarus robustoides	Freshwater	36	1.7
Bythotrephes longimanus	Freshwater	36	1.7
Marenzelleria neglecta	Freshwater	36	1.7
Procambarus acutus	Freshwater	36	1.7
Plotosus lineatus	Marine	36	1.7
Alpheus rapacida	Marine	36	1.7
Callinectes amnicola	Marine	36	1.7
Callinectes marginatus	Marine	36	1.7
Copsychus malabaricus	Terrestrial vertebrates	36	1.7

Species	Thematic group	Overall score	Mean confidence
Najas guadaluupensis	Plants	36	1.0
Eichhornia diversifolia	Plants	36	1.0
Tamias sibiricus	Terrestrial vertebrates	32	2.7
Gunnera manicata	Plants	32	2.7
Herdmania momus	Marine	32	2.3
Polysiphonia morrowii	Marine	32	2.3
Trachysalambria palaestinensis	Marine	32	2.3
Tachycines asynamorus	Terrestrial invertebrates	32	2.3
Acleris fimbriana	Terrestrial invertebrates	32	2.0
Trirachys holosericeus	Terrestrial invertebrates	32	2.0
Trirachys sartus	Terrestrial invertebrates	32	2.0
Vespula pensylvanica	Terrestrial invertebrates	32	2.0
Bidens connata	Plants	32	2.0
Cryptopleurum subtile	Freshwater	32	1.7
Oxytelus migrator	Terrestrial invertebrates	32	1.7
Jacaranda mimosifolia	Plants	30	3.0
Osmerus eperlanus	Freshwater	30	2.7
Molothrus ater	Terrestrial vertebrates	30	2.7
Ficus benjamina	Plants	30	2.7
Passiflora subpeltata	Plants	30	2.7
Crepidula onyx	Marine	30	2.3
Branta hutchinsii	Terrestrial vertebrates	30	2.3
Crocodylus niloticus	Terrestrial vertebrates	30	2.3
Petrea volubilis	Plants	30	2.3
Coccidohystrix insolita	Terrestrial invertebrates	30	2.0
Molothrus bonariensis	Terrestrial vertebrates	30	1.7
Vallisneria nana	Plants	30	1.7
Syzygium jambos	Plants	30	1.7
Cichlasoma urophthalmum	Freshwater	27	3.0
Anthonomus quadrigibbus	Terrestrial invertebrates	27	3.0
Anthonomus signatus	Terrestrial invertebrates	27	3.0
Pineus boerneri	Terrestrial invertebrates	27	3.0
Pissodes punctatus	Terrestrial invertebrates	27	3.0
Quadrastichus erythrinae	Terrestrial invertebrates	27	3.0
Rhagoletis indifferens	Terrestrial invertebrates	27	3.0
Triumfetta rhomboidea	Plants	27	3.0
Geophagus brasiliensis	Freshwater	27	2.7
Pomoxis nigromaculatus	Freshwater	27	2.7
Asterias amurensis	Marine	27	2.7
Anastrepha ludens	Terrestrial invertebrates	27	2.7
Bactrocera carambolae	Terrestrial invertebrates	27	2.7
Belonolaimus longicaudatus	Terrestrial invertebrates	27	2.7
Epiphyas postvittana	Terrestrial invertebrates	27	2.7
Grapholita packardi	Terrestrial invertebrates	27	2.7

Species	Thematic group	Overall score	Mean confidence
Hirschmanniella spinicaudata	Terrestrial invertebrates	27	2.7
Meloidogyne ethiopica	Terrestrial invertebrates	27	2.7
Pissodes nemorensis	Terrestrial invertebrates	27	2.7
Pissodes strobi	Terrestrial invertebrates	27	2.7
Pissodes terminalis	Terrestrial invertebrates	27	2.7
Rhadinaphelenchus cocophilus	Terrestrial invertebrates	27	2.7
Aeschynomene americana	Plants	27	2.7
Syzygium cumini	Plants	27	2.7
Hyptis suaveolens	Plants	27	2.7
Adenanthera pavonina	Plants	27	2.7
Bauhinia monandra	Plants	27	2.7
Chamaecrista nictitans	Plants	27	2.7
Sesbania sesban	Plants	27	2.7
Morone saxatilis	Freshwater	27	2.3
Ameiurus natalis	Freshwater	27	2.3
Trichopodus trichopterus	Freshwater	27	2.3
Morone chrysops	Freshwater	27	2.3
Anastrepha fraterculus	Terrestrial invertebrates	27	2.3
Bactrocera tau	Terrestrial invertebrates	27	2.3
Dacus ciliatus	Terrestrial invertebrates	27	2.3
Dysmicoccus neobrevipes	Terrestrial invertebrates	27	2.3
Grapholita prunivora	Terrestrial invertebrates	27	2.3
Ips grandicollis	Terrestrial invertebrates	27	2.3
Spodoptera exempta	Terrestrial invertebrates	27	2.3
Eleutherodactylus planirostris	Terrestrial vertebrates	27	2.3
Alocasia macrorrhizos	Plants	27	2.3
Gliricidia sepium	Plants	27	2.3
Phyllanthus urinaria	Plants	27	2.3
Leonurus japonicus	Plants	27	2.3
Senna siamea	Plants	27	2.3
Oncorhynchus gorbuscha	Freshwater	27	2.0
Ponticola gorlap	Freshwater	27	2.0
Herichthys cyanoguttatus	Freshwater	27	2.0
Ameiurus catus	Freshwater	27	2.0
Oncorhynchus clarkii	Freshwater	27	2.0
Alitta virens	Marine	27	2.0
Gracilaria salicornia	Marine	27	2.0
Mytilopsis sallei	Marine	27	2.0
Spondylus spinosus	Marine	27	2.0
Acleris gloverana	Terrestrial invertebrates	27	2.0
Acleris minuta	Terrestrial invertebrates	27	2.0
Aonidiella orientalis	Terrestrial invertebrates	27	2.0
Euwallacea perbrevis	Terrestrial invertebrates	27	2.0
Lycorma delicatula	Terrestrial invertebrates	27	2.0

Species	Thematic group	Overall score	Mean confidence
Nacobbus aberrans	Terrestrial invertebrates	27	2.0
Naupactus leucoloma	Terrestrial invertebrates	27	2.0
Scolytus schevyrewi	Terrestrial invertebrates	27	2.0
Unaspis citri	Terrestrial invertebrates	27	2.0
Eleutherodactylus martinicensis	Terrestrial vertebrates	27	2.0
Celtis sinensis	Plants	27	2.0
Pithecellobium dulce	Plants	27	2.0
Emilia sonchifolia	Plants	27	2.0
Ocimum gratissimum	Plants	27	2.0
Pennisetum polystachion	Plants	27	2.0
Oldenlandia lancifolia	Plants	27	2.0
Arthraxon hispidus	Plants	27	2.0
Pomacea lineata	Freshwater	27	1.7
Skistodiaptomus pallidus	Freshwater	27	1.7
Neocaridina heteropoda	Freshwater	27	1.7
Didemnum perlucidum	Marine	27	1.7
Echinogammarus ischnus	Freshwater	27	1.3
Gmelina arborea	Plants	27	1.3
Ameiurus nebulosus	Freshwater	27	1.0
Dikerogammarus aralychensis	Freshwater	27	1.0
Zelkova serrata	Plants	25	2.7
Cichla ocellaris	Freshwater	24	3.0
Acrobasis pyrivorella	Terrestrial invertebrates	24	3.0
Euglandina rosea	Terrestrial invertebrates	24	3.0
Lymantria mathura	Terrestrial invertebrates	24	3.0
Oracella acuta	Terrestrial invertebrates	24	3.0
Lespedeza cuneata	Plants	24	3.0
Dichrostachys cinerea	Plants	24	3.0
Hemibarbus maculatus	Freshwater	24	2.7
Conotrachelus nenuphar	Terrestrial invertebrates	24	2.7
Macaca mulatta	Terrestrial vertebrates	24	2.7
Zoysia matrella	Plants	24	2.7
Mimosa diplotricha	Plants	24	2.7
Flemingia strobilifera	Plants	24	2.7
Merremia umbellata	Plants	24	2.7
Batillaria attramentaria	Freshwater	24	2.3
Osmerus mordax	Freshwater	24	2.3
Nesticella mogera	Terrestrial invertebrates	24	2.3
Nomadacris septemfasciata	Terrestrial invertebrates	24	2.3
Anolis trinitatis	Terrestrial vertebrates	24	2.3
Didelphis marsupialis	Terrestrial vertebrates	24	2.3
Macaca fascicularis	Terrestrial vertebrates	24	2.3
Ficus religiosa	Plants	24	2.3
Cananga odorata	Plants	24	2.3

Species	Thematic group	Overall score	Mean confidence
Acanthogobius flavimanus	Freshwater	24	2.0
Eurytemora carolleeae	Freshwater	24	2.0
Lithoglyphus naticoides	Freshwater	24	2.0
Morone americana	Freshwater	24	2.0
Litopenaeus vannamei	Marine	24	2.0
Schistocerca nitens	Terrestrial invertebrates	24	2.0
Tinocallis nevskyi	Terrestrial invertebrates	24	2.0
Tremex fuscicornis	Terrestrial invertebrates	24	2.0
Eragrostis ciliaris	Plants	24	2.0
Berberis darwinii	Plants	24	2.0
Chorispora tenella	Plants	24	2.0
Cassia fistula	Plants	24	2.0
Erechtites valerianifolius	Plants	24	2.0
Dioscorea alata	Plants	24	2.0
Caladium bicolor	Plants	24	2.0
Thespesia populnea	Plants	24	2.0
Tabebuia rosea	Plants	24	2.0
Stictocardia tiliifolia	Plants	24	2.0
Lepomis gulosus	Freshwater	24	1.7
Caesalpinia pulcherrima	Plants	24	1.7
Callitriche deflexa	Plants	24	1.7
Luffa acutangula	Plants	24	1.7
Sphaeroma quoianum	Freshwater	24	1.3
Rastrococcus invadens	Terrestrial invertebrates	20	3.0
Odocoileus hemionus	Terrestrial vertebrates	20	2.7
Zingiber officinale	Plants	20	2.7
Chelus fimbriata	Terrestrial vertebrates	20	2.0
Pyrus calleryana	Plants	20	2.0
Claudius angustatus	Terrestrial vertebrates	20	1.7
Anastrepha striata	Terrestrial invertebrates	18	3.0
Anastrepha suspensa	Terrestrial invertebrates	18	3.0
Pityophthorus juglandis	Terrestrial invertebrates	18	3.0
Misgurnus mizolepis	Freshwater	18	2.7
Silurus asotus	Freshwater	18	2.7
Chionaspis pinifoliae	Terrestrial invertebrates	18	2.7
Eotetranychus lewisi	Terrestrial invertebrates	18	2.7
Pseudopityophthorus minutissimus	Terrestrial invertebrates	18	2.7
Pseudopityophthorus pruinosus	Terrestrial invertebrates	18	2.7
Rhagoletis ribicola	Terrestrial invertebrates	18	2.7
Rhagoletis suavis	Terrestrial invertebrates	18	2.7
Euonymus alata	Plants	18	2.7
Elephantopus mollis	Plants	18	2.7
Iris domestica	Plants	18	2.7
Sesbania grandiflora	Plants	18	2.7

Species	Thematic group	Overall score	Mean confidence
Albizia chinensis	Plants	18	2.7
Indigofera trita	Plants	18	2.7
Macrothelypteris torresiana	Plants	18	2.7
Macrobrachium rosenbergii	Freshwater	18	2.3
Abbottina rivularis	Freshwater	18	2.3
Carassius cuvieri	Freshwater	18	2.3
Planiliza haematocheila	Freshwater	18	2.3
Viviparus georgianus	Freshwater	18	2.3
Notropis stramineus	Freshwater	18	2.3
Cynoglossus sinusarabici	Marine	18	2.3
Dorvillea similis	Marine	18	2.3
Dyspanopeus texanus	Marine	18	2.3
Mytilopsis adamsi	Marine	18	2.3
Anthonomus bisignifer	Terrestrial invertebrates	18	2.3
Euwallacea piceus	Terrestrial invertebrates	18	2.3
Nasua narica	Terrestrial vertebrates	18	2.3
Striga asiatica	Plants	18	2.3
Tephrosia candida	Plants	18	2.3
Albizia procera	Plants	18	2.3
Lonicera maackii	Plants	18	2.3
Rubus rosifolius	Plants	18	2.3
Pueraria phaseoloides	Plants	18	2.3
Leucaena diversifolia	Plants	18	2.3
Pseudelephantopus spicatus	Plants	18	2.3
Cassia javanica	Plants	18	2.3
Cocos nucifera	Plants	18	2.3
Portulaca quadrifida	Plants	18	2.3
Alysicarpus vaginalis	Plants	18	2.3
Nelumbo nucifera	Plants	18	2.3
Ametropus fragilis	Freshwater	18	2.0
Piaractus brachypomus	Freshwater	18	2.0
Benthophilus nudus	Freshwater	18	2.0
Oryzias sinensis	Freshwater	18	2.0
Perca flavescens	Freshwater	18	2.0
Knipowitschia longecaudata	Freshwater	18	2.0
Ictiobus bubalus	Freshwater	18	2.0
Ictiobus cyprinellus	Freshwater	18	2.0
Ictiobus niger	Freshwater	18	2.0
Micropogonias undulatus	Freshwater	18	2.0
Sternolophus solieri	Freshwater	18	2.0
Carijoa riisei	Marine	18	2.0
Acanthophora spicifera	Marine	18	2.0
Eualetes tulipa	Marine	18	2.0
Glabropilumnus laevis	Marine	18	2.0

Species	Thematic group	Overall score	Mean confidence
Ilyanassa obsoleta	Marine	18	2.0
Myra subgranulata	Marine	18	2.0
Ogyrides mjoebergi	Marine	18	2.0
Polyopes lancifolius	Marine	18	2.0
Sphaerozius nitidus	Marine	18	2.0
Aleurocanthus citriperdus	Terrestrial invertebrates	18	2.0
Bactrocera latifrons	Terrestrial invertebrates	18	2.0
Choristoneura conflictana	Terrestrial invertebrates	18	2.0
Choristoneura fumiferana	Terrestrial invertebrates	18	2.0
Chrysolina coerulans	Terrestrial invertebrates	18	2.0
Chthamalus proteus	Terrestrial invertebrates	18	2.0
Coptotermes gestroi	Terrestrial invertebrates	18	2.0
Euwallacea destruens	Terrestrial invertebrates	18	2.0
Gymnandrosoma aurantianum	Terrestrial invertebrates	18	2.0
Macrosiphum (= *Sitobion*) *miscanthi*	Terrestrial invertebrates	18	2.0
Sepedomerus macropus	Terrestrial invertebrates	18	2.0
Sepedon aenescens	Terrestrial invertebrates	18	2.0
Thaumatotibia leucotreta	Terrestrial invertebrates	18	2.0
Tibraca limbativentris	Terrestrial invertebrates	18	2.0
Leptochloa mucronata	Plants	18	2.0
Ottelia alismoides	Plants	18	2.0
Eragrostis amabilis	Plants	18	2.0
Lindernia crustacea	Plants	18	2.0
Eragrostis unioloides	Plants	18	2.0
Cosmos sulphureus	Plants	18	2.0
Paspalum paniculatum	Plants	18	2.0
Caspiobdella fadejewi	Freshwater	18	1.7
Obesogammarus obesus	Freshwater	18	1.7
Electrogena zebrata	Freshwater	18	1.7
Carassius carassius	Freshwater	18	1.7
Decapterus russelli	Marine	18	1.7
Actaeodes tomentosus	Marine	18	1.7
Ascidia sydneiensis	Marine	18	1.7
Sarconema filiforme	Marine	18	1.7
Sarconema scinaioides	Marine	18	1.7
Euphorbia tithymaloides	Plants	18	1.7
Melanochromis auratus	Freshwater	18	1.3
Ciona savignyi	Marine	18	1.3
Haliclona vansoesti	Marine	18	1.3
Toona ciliata	Plants	18	1.3
Myriophyllum verrucosum	Plants	18	1.0
Hemiculter leucisculus	Freshwater	16	3.0
Alosa pseudoharengus	Freshwater	16	3.0
Phenacoccus manihoti	Terrestrial invertebrates	16	3.0

Species	Thematic group	Overall score	Mean confidence
Anolis wattsi	Terrestrial vertebrates	16	2.7
Plectranthus scutellarioides	Plants	16	2.7
Heterotis niloticus	Freshwater	16	2.3
Aceria guerreronis	Terrestrial invertebrates	16	2.3
Bactrocera tryoni	Terrestrial invertebrates	16	2.3
Anolis extremus	Terrestrial vertebrates	16	2.3
Ischaemum rugosum	Plants	16	2.3
Saururus cernuus	Plants	16	2.3
Solanum mammosum	Plants	16	2.3
Celosia argentea	Plants	16	2.3
Eriocheir hepuensis	Freshwater	16	2.0
Maranta arundinacea	Plants	16	2.0
Fimbristylis littoralis	Plants	16	2.0
Aleurites moluccanus	Plants	16	2.0
Laurencia okamurae	Marine	16	1.7
Sargassum natans	Marine	16	1.7
Corymbia citriodora	Plants	15	3.0
Sternochetus mangiferae	Terrestrial invertebrates	15	2.7
Lucania parva	Freshwater	12	3.0
Belonesox belizanus	Freshwater	12	3.0
Anastrepha obliqua	Terrestrial invertebrates	12	3.0
Oemona hirta	Terrestrial invertebrates	12	3.0
Lithophyllum yessoense	Marine	12	2.7
Acleris variana	Terrestrial invertebrates	12	2.7
Orseolia oryzivora	Terrestrial invertebrates	12	2.7
Polygraphus proximus	Terrestrial invertebrates	12	2.7
Cheilocostus speciosus	Plants	12	2.7
Indigofera tinctoria	Plants	12	2.7
Cedrela odorata	Plants	12	2.7
Annona squamosa	Plants	12	2.7
Moringa oleifera	Plants	12	2.7
Nuphar advena	Plants	12	2.7
Ictalurus furcatus	Freshwater	12	2.3
Catostomus commersonii	Freshwater	12	2.3
Hemibarbus labeo	Freshwater	12	2.3
Botrylloides giganteus	Marine	12	2.3
Gonionemus vertens	Marine	12	2.3
Anastrepha serpentina	Terrestrial invertebrates	12	2.3
Dendrolimus superans sibiricus	Terrestrial invertebrates	12	2.3
Rhacochlaena japonica	Terrestrial invertebrates	12	2.3
Simosyrphus grandicornis	Terrestrial invertebrates	12	2.3
Cettia diphone	Terrestrial vertebrates	12	2.3
Canis latrans	Terrestrial vertebrates	12	2.3
Sciurus aberti	Terrestrial vertebrates	12	2.3

Species	Thematic group	Overall score	Mean confidence
Senna surattensis	Plants	12	2.3
Culaea inconstans	Freshwater	12	2.0
Planorbella trivolvis	Freshwater	12	2.0
Chrosomus eos	Freshwater	12	2.0
Coregonus nasus	Freshwater	12	2.0
Pelosoma lafertei	Freshwater	12	2.0
Gillia altilis	Freshwater	12	2.0
Chama macerophylla	Marine	12	2.0
Cromileptes altivelis	Marine	12	2.0
Dictyosphaeria cavernosa	Marine	12	2.0
Nuttallia obscurata	Marine	12	2.0
Anastrepha grandis	Terrestrial invertebrates	12	2.0
Apis cerana	Terrestrial invertebrates	12	2.0
Archips fuscocupreanus	Terrestrial invertebrates	12	2.0
Cochliomyia hominivorax	Terrestrial invertebrates	12	2.0
Grapholita inopinata	Terrestrial invertebrates	12	2.0
Lopholeucaspis japonica	Terrestrial invertebrates	12	2.0
Margarodes vredendalensis	Terrestrial invertebrates	12	2.0
Tetropium gracilicorne	Terrestrial invertebrates	12	2.0
Anolis aeneus	Terrestrial vertebrates	12	2.0
Flemingia macrophylla	Plants	12	2.0
Ludwigia alternifolia	Plants	12	2.0
Clea helena	Freshwater	12	1.7
Protopterus aethiopicus aethiopicus	Freshwater	12	1.7
Cherax tenuimanus	Freshwater	12	1.7
Micropercops cinctus	Freshwater	12	1.7
Ulva reticulata	Marine	12	1.7
Jasus lalandii	Marine	12	1.7
Draeculacephala minerva	Terrestrial invertebrates	12	1.7
Sida linifolia	Plants	12	1.7
Procambarus alleni	Freshwater	12	1.3
Megalobrama terminalis	Freshwater	12	1.3
Rugosa rugosa	Terrestrial vertebrates	12	1.3
Sporobolus tenuissimus	Plants	12	1.3
Symphyocladiella dendroidea	Marine	12	1.0
Ashworthius sidemi	Terrestrial invertebrates	12	1.0
Choristoneura murinana	Terrestrial invertebrates	12	1.0
Trichosurus vulpecula	Terrestrial vertebrates	10	2.3
Dracaena guianensis	Terrestrial vertebrates	10	2.3
Rusa marianna	Terrestrial vertebrates	10	2.0
Diabrotica undecimpunctata	Terrestrial invertebrates	9	3.0
Paralithodes camtschaticus	Marine	9	2.7
Agrilus auroguttatus	Terrestrial invertebrates	9	2.3
Bactrocera tsuneonis	Terrestrial invertebrates	9	2.3

Species	Thematic group	Overall score	Mean confidence
Choristoneura rosaceana	Terrestrial invertebrates	9	2.3
Garrulax canorus	Terrestrial vertebrates	9	2.3
Zosterops japonicus	Terrestrial vertebrates	9	2.3
Sirex ermak	Terrestrial invertebrates	9	2.0
Artocarpus altilis	Plants	9	2.0
Pimephales vigilax	Freshwater	8	3.0
Adoretus sinicus	Terrestrial invertebrates	8	3.0
Maliarpha separatella	Terrestrial invertebrates	8	3.0
Pissodes fasciatus	Terrestrial invertebrates	8	3.0
Astatoreochromis alluaudi	Freshwater	8	2.7
Aonidomytilus albus	Terrestrial invertebrates	8	2.7
Arthurdendyus triangulatus	Terrestrial invertebrates	8	2.7
Chilo partellus	Terrestrial invertebrates	8	2.7
Hishimonus phycitis	Terrestrial invertebrates	8	2.7
Ips subelongatus	Terrestrial invertebrates	8	2.7
Annona reticulata	Plants	8	2.7
Elaeis guineensis	Plants	8	2.7
Acentrogobius pflaumii	Marine	8	2.3
Aspidiella hartii	Terrestrial invertebrates	8	2.3
Brontispa longissima	Terrestrial invertebrates	8	2.3
Dendroctonus pseudotsugae	Terrestrial invertebrates	8	2.3
Erionota thrax	Terrestrial invertebrates	8	2.3
Erionota torus	Terrestrial invertebrates	8	2.3
Erthesina fullo	Terrestrial invertebrates	8	2.3
Heterodera cajani	Terrestrial invertebrates	8	2.3
Hirschmanniella miticausa	Terrestrial invertebrates	8	2.3
Longidorus diadecturus	Terrestrial invertebrates	8	2.3
Dicrurus macrocercus	Terrestrial vertebrates	8	2.3
Sphaerodactylus vincenti	Terrestrial vertebrates	8	2.3
Cleome rutidosperma	Plants	8	2.3
Acacia crassicarpa	Plants	8	2.3
Eriocereus martinii	Plants	8	2.3
Dalbergia sissoo	Plants	8	2.3
Pteris tripartita	Plants	8	2.3
Lepisosteus spp	Freshwater	8	2.0
Schilbe mystus	Freshwater	8	2.0
Clupeonella cultriventris	Freshwater	8	2.0
Gracilaria tikvahiae	Marine	8	2.0
Aulacomya atra	Marine	8	2.0
Ecteinascidia thurstoni	Marine	8	2.0
Gemma gemma	Marine	8	2.0
Cylas formicarius	Terrestrial invertebrates	8	2.0
Exomala orientalis	Terrestrial invertebrates	8	2.0
Haplaxius crudus	Terrestrial invertebrates	8	2.0

Species	Thematic group	Overall score	Mean confidence
Hypsipyla grandella	Terrestrial invertebrates	8	2.0
Listronotus bonariensis	Terrestrial invertebrates	8	2.0
Monochamus urussovii	Terrestrial invertebrates	8	2.0
Scutellonema bradys	Terrestrial invertebrates	8	2.0
Cassia grandis	Plants	8	2.0
Nymphaea lotus	Plants	8	2.0
Potamogeton epihydrus	Plants	8	2.0
Gammarus fasciatus	Freshwater	8	1.7
Lasmigona subviridis	Freshwater	8	1.7
Paralichthys olivaceus	Freshwater	8	1.7
Katamysis warpachowskyi	Freshwater	8	1.7
Chondrus giganteus	Marine	8	1.7
Sciaenops ocellatus	Marine	8	1.7
Lutjanus kasmira	Marine	8	1.7
Rhea americana	Terrestrial vertebrates	8	1.7
Anotheca spinosa	Terrestrial vertebrates	8	1.7
Cyathula prostrata	Plants	8	1.7
Orontium aquaticum	Plants	8	1.7
Parabramis pekinensis	Freshwater	8	1.3
Chondria collinsiana	Marine	8	1.3
Symplegma reptans	Marine	8	1.3
Haemaphysalis longicornis	Terrestrial invertebrates	8	1.0
Alosa aestivalis	Freshwater	6	3.0
Prays endocarpa	Terrestrial invertebrates	6	3.0
Lepomis microlophus	Freshwater	6	2.7
Carposina sasakii	Terrestrial invertebrates	6	2.7
Dendroctonus ponderosae	Terrestrial invertebrates	6	2.7
Diabrotica barberi	Terrestrial invertebrates	6	2.7
Margarodes prieskaensis	Terrestrial invertebrates	6	2.3
Peromyscus fraterculus	Terrestrial vertebrates	6	2.3
Samanea saman	Plants	6	2.3
Averrhoa carambola	Plants	6	2.3
Dendroctonus frontalis	Terrestrial invertebrates	6	2.0
Margarodes vitis	Terrestrial invertebrates	6	2.0
Gymnorhina tibicen	Terrestrial vertebrates	6	2.0
Pogostemon helferi	Plants	6	1.7
Theodoxus danubialis	Freshwater	6	1.3
Pardalaspis cyanescens	Terrestrial invertebrates	4	3.0
Mononychellus tanajoa	Terrestrial invertebrates	4	2.7
Premnotrypes latithorax	Terrestrial invertebrates	4	2.7
Annona muricata	Plants	4	2.3
Aleurodicus cocois	Terrestrial invertebrates	4	2.0
Aleurodicus destructor	Terrestrial invertebrates	4	2.0
Coptotermes	Terrestrial invertebrates	4	2.0

Species	Thematic group	Overall score	Mean confidence
Idioscopus clypealis	Terrestrial invertebrates	4	2.0
Idioscopus nitidulus	Terrestrial invertebrates	4	2.0
Amphisbaena fuliginosa	Terrestrial vertebrates	4	2.0
Pteria colymbus	Marine	4	1.7
Carneocephala fulgida	Terrestrial invertebrates	4	1.7
Abutilon hirtum	Plants	4	1.7
Oligonychus perditus	Terrestrial invertebrates	2	3.0
Pissodes cibriani	Terrestrial invertebrates	2	3.0
Premnotrypes suturicallus	Terrestrial invertebrates	2	3.0
Premnotrypes vorax	Terrestrial invertebrates	2	3.0
Premnotrypes sanfordi	Terrestrial invertebrates	2	2.7
Premnotrypes solani	Terrestrial invertebrates	2	2.7
Limnoria lignorum	Marine	2	2.3
Botrylloides perspicuus	Marine	2	2.0
Aschistonyx eppoi	Terrestrial invertebrates	2	2.0
Bactrocera umbrosa	Terrestrial invertebrates	2	2.0
Trachypogon spicatus	Plants	2	2.0
Melanothamnus tongatensis	Marine	2	1.7
Coptotermes sjostedti	Terrestrial invertebrates	2	1.7
Choristoneura lambertiana	Terrestrial invertebrates	2	1.3
Dacus bivittatus	Terrestrial invertebrates	2	1.3
Neolecanium cornuparvum	Terrestrial invertebrates	2	1.3
Choristoneura pinus pinus	Terrestrial invertebrates	2	1.0
Pissodes nitidus	Terrestrial invertebrates	1	3.0
Pissodes yunnanensis	Terrestrial invertebrates	1	3.0
Pissodes zitacuarense	Terrestrial invertebrates	1	3.0
Platypus quercivorus	Terrestrial invertebrates	1	3.0
Conopomorpha cramerella	Terrestrial invertebrates	1	1.7
Epochra canadensis	Terrestrial invertebrates	1	1.7
Choristoneura metasequoiacola	Terrestrial invertebrates	1	1.0

Table S20. Prioritized species of special interest in insular Spanish territories due to their possible establishment in coming years or great impact on native biodiversity. Spanish IAS catalogue refers to the Spanish regulation on IAS (e.g., Law 42/2007).

Species	Thematic group	Overall	Risk	Spanish IAS Catalogue	100 of the World's Worst IAS
Lampropeltis getula	Terrestrial vertebrates	125	Very high	Yes	
Pomacea canaliculata	Freshwater	125	Very high	Yes	Yes
Salvinia molesta	Plants	125	Very high	Yes	Yes
Acridotheres tristis	Terrestrial vertebrates	100	Very high	Yes	Yes
Pantherophis guttatus	Terrestrial vertebrates	100	Very high	Yes	
Glycera dibranchiata	Marine	100	Very high		
Aedes aegypti	Terrestrial invertebrates	80	High		
Pterois miles	Marine	80	High		
Herpestes auropunctatus	Terrestrial vertebrates	75	High		Yes
Boiga irregularis	Terrestrial vertebrates	75	High	Yes	Yes
Casuarina equisetifolia	Plants	75	High		
Passiflora suberosa	Plants	75	High		
Schizoporella japonica	Marine	75	High		

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