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Oriented analysis to enable prioritization of Invasive Alien Species (EU Regulation 1143/2014)

Horizon scanning to identify and prioritize high-risk alien species

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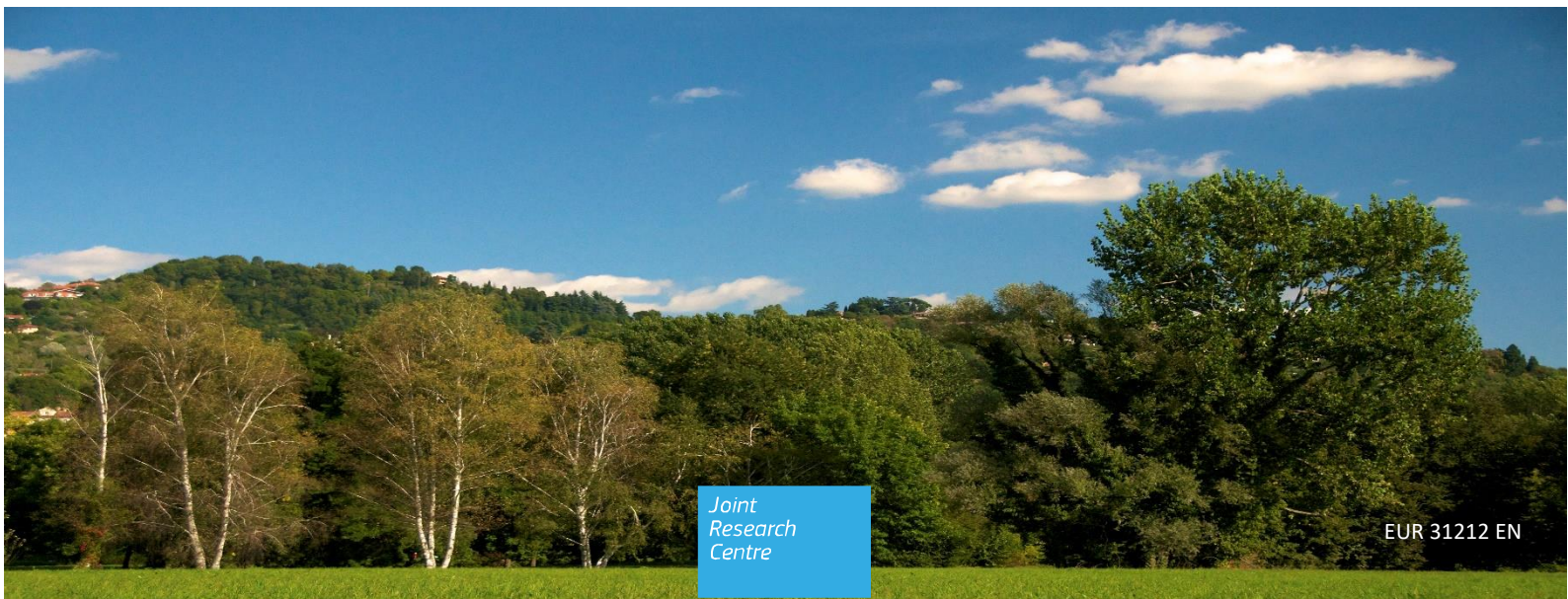

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Abstract

This report describes a horizon scanning methodological approach for identifying Invasive Alien Species (IAS) not yet present, or with a limited distribution, across the EU Member States. The selected species can be prioritized for Pest Risk Assessment and scrutinized as candidates for listing as IAS of Union concern. A brief case study is provided to support the implementation of the EU Regulation 1143/2014/EC ("IAS Regulation") through the selection of high-risk IAS whose introduction and spread in the EU should be prevented and managed.

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Executive summary

Policy context

This report fits into the context of the EU nature and biodiversity policies by supporting the EU Regulation (EU) 1143/2014 (hereinafter referred to as the IAS Regulation), aimed at prevention and management of the introduction and spread of Invasive Alien Species (IAS). Thus, the report contributes to the accomplishment of Action 16, Target 5 of the EU 2030 Biodiversity Strategy, and of the Aichi Target 9 of the Strategic Plan for Biodiversity 2011-2020 under the Convention of Biological Diversity.

The report was conceived to benefit all those supporting the implementation of the IAS Regulation. It is also important for the European Alien Species Information Network (EASIN) to formalise its methodological approach in selecting high-risk IAS, for the EU Directorate-General for Environment, other Commission services and the scientific community. The report also improves the understanding of the EASIN internal methodological approach for the identification of IAS to be subjected to risk assessment and scrutiny for the updating the IAS list of Union Concern (i.e. a subset of IAS earmarked as of high risk for the EU biodiversity).

As the rate of IAS introductions is increasing worldwide (Hulme 2009; Katsanevakis et al. 2013a, Essl et al. 2015; Roques et al. 2016), it is essential to identify IAS likely to arrive in the future, to reduce or prevent new biological invasions. Horizon scanning (HS) is an important approach to prioritize the emerging and most threatening IAS with the highest risk of introduction in a given region (Shine et al., 2010; Roy et al. 2014; Sutherland et al., 2015), and can support EU Member States (MS) in implementing the IAS Regulation. The review of recent literature on HS, which includes the compilation of studies metadata and the resulting list of IAS relevant to the EU territory, is essential for keeping the EU MS informed and prepared about potential biological invasions. The methodological approach presented here identifies and selects IAS that are likely to constitute a severe risk to the EU biodiversity in the future (horizon IAS) based on recently published HS scientific literature. From all recently identified horizon IAS, we extracted a subset of high-risk horizon IAS, based on set of criteria. The data can be used to update the EASIN Catalogue and Geodatabase, and to inform prioritization of species for risk assessments supporting the update of the Union Concern list. Moreover, this approach makes the EASIN identification and prioritization process for IAS HS more transparent, robust and reusable for regular updates of priority lists.

Key conclusions

The IAS Regulation requires the EU MS to manage established and widely spread IAS of Union concern and prevent new biological invasions. As the rate of IAS introductions is increasing alarmingly, an early identification of IAS likely to be introduced in the EU is fundamental. This will allow the adoption of required measures and the revision and adjustment of MS surveillance systems for early detection and preparedness for eradication. HS is an invaluable tool to identify new biological invasion threats and a requisite of a scientific information support system as provided by EASIN to the EU MS to implement the IAS Regulation.

Main findings

This report describes a fast, transparent, and repeatable approach for horizon IAS (information), based on recent HS scientific literature. The method generates a list of horizon IAS for the EASIN Catalogue and Geodatabase, and for supporting future risk assessments, prioritization and listing as IAS of Union concern. Hence, the approach can inform the EU Commission Directorate General for Environment (DG ENV) and other parties concerned with the IAS Regulation implementation.

A case study presented in the report used the methodological approach to support the DG ENV in the selection of high-risk species for risk assessment in accordance with the IAS Regulation. The approach, successfully applied under considerable time-constraints, generated a short list of 5 plant and 5 animal species for risk assessment. At the same time, information gathered during the process was used as an input for the EASIN Catalogue "Horizon Scanning Species".

Related and future JRC work

The presented methodological approach to identify and select horizon IAS is a fast and systematic tool that will be used regularly in the context of EASIN to update its horizon IAS datasets (in the EASIN Catalogue and Geodatabase) and to support the national Competent Authorities in charge of the IAS Regulation implementation. The inclusion of the horizon IAS in the EASIN databases will enable the monitoring of changes in their spatial distributions, which additionally inform MS prevention and management actions.

Quick guide

Invasive Alien Species (IAS) are organisms introduced into a natural environment outside their native ranges through human activities, either unintentionally or deliberately. IAS are considered one of the main threats to biodiversity worldwide and cause serious ecological and socio-economic problems. Recognising this growing threat, the European Union (EU) adopted the Regulation (EU) 1143/2014 (IAS Regulation), aimed at prevention and management of the introduction and spread of IAS of Union concern. The European Alien Species Information Network (EASIN) was appointed as the official EU information system supporting MS in the implementation of the IAS Regulation.

1 Introduction

Invasive Alien Species (IAS) are organisms introduced into a natural environment outside of their native ranges through human activities, either unintentionally or deliberately. They can adapt to the novel habitats, establish and spread, and may cause significant negative effects on the invaded ecosystems. IAS are one of the most important threats to biodiversity worldwide and cause serious ecological and socio-economic problems (Millennium Ecosystem Assessment 2005; Ricciardi et al. 2013; Jeschke et al. 2014; IPBES, 2019).

The rate of IAS introductions has increased due to globalisation and expansion of some activities, such as transport, fisheries, horticulture, and wildlife trade, with majority of introductions being accidental (Hulme 2009; Katsanevakis et al. 2013a, Essl et al. 2015; Roques et al. 2016). The prevention of introduction and mitigation of consequences of biological invasions in Europe constitutes a significant challenge. To address this issue in a concerted way, the European Union (EU) adopted the Regulation (EU) 1143/2014 (hereinafter referred to as the IAS Regulation), aimed at prevention and management of the introduction and spread of IAS. The IAS Regulation prioritises a subset of IAS of Union concern included in the Union list (Art. 4). The regulated IAS can severely harm MS' biodiversity and are therefore subjected to dedicated concerted measures at Union level (EU 2014). The list of IAS of Union Concern, is informed by the European Alien Species Information Network (EASIN) (EU 2014, Art. 25), which provides access to data on IAS in Europe, and is updated regularly following a Risk Assessment scrutiny and approval protocol (Commission Delegated Regulation EU 2018/968/EC). Member State obligations include the prevention of the introduction and spread of listed species, the enforcement of effective early detection and rapid eradication measures for new introductions, and the adoption of management measures for species widely spread.

To reduce or prevent new IAS introductions, it is essential to identify likely future biological invasions. To this end, horizon scanning (HS) is an important approach to prioritize the most threatening and emerging IAS with the highest risk in a region (Shine et al., 2010; Roy et al. 2014; Sutherland et al., 2015), and can support EU MS in implementing the IAS Regulation.

HS entails a systematic search for high-risk species, so-called "horizon" IAS, that are not yet present, or present with a limited distribution across the EU countries, but are likely to arrive, establish and spread in a close future (i.e. a decade). In recent years, numerous HS studies for IAS were published, a subset of which are of interest to the EU territories (e.g. Roy et al. 2014, 2015, Gallardo et al. 2016, Carboneras et al. 2018, Bayon and Vilà 2019, Tsiamis et al. 2020, Vilizzi et al. 2021). Their combined use has a potential to support the implementation of the IAS Regulation. Information in the HS studies can be filtered using a series of criteria to select high-risk horizon IAS for Europe and serve as an aid to choose high priority IAS for risk assessment. The objective of this report was to formalise a methodological approach to use already available HS information to select high-risk horizon IAS to support the IAS Regulation implementation. The process was designed to be transparent, repeatable, and quick to be performed in future exercises on a regular basis, and to update the EASIN Catalogue and Geodatabase.

Therefore, this report aims to support the IAS Regulation by presenting a methodological approach to analyse the results of recent HS studies and select high-risk IAS for Europe. The outcomes include a list of IAS of high priority for risk assessment to help the EU Directorate-General for Environment in updating the list of IAS of Union Concern.

2 Methods

2.1 Literature review and metadata collection

- An online search was performed to identify the peer-reviewed articles published in the last decade, focusing on HS for IAS that may threaten Europe in the near future. The time range of the search (2011-2021) was selected to ensure that the published results were relevant up to the next decade. The studies eligible for the review, were those defining horizon IAS as "species not yet present, or present with a limited distribution across the EU countries, but are likely to arrive, establish and spread, and have an impact on native biodiversity and associated ecosystem services over the next decade".
- The identified publications were downloaded and their metadata compiled: year of publication, appropriateness of the horizon period considered, geographical, environmental and taxon scopes, definition of horizon IAS (as above), specific methodology aspects, such as impact assessment type, and specific IAS risk groups (i.e. grouped per criteria such as amenability to prevention and early eradication).

2.2 Selection of species for risk assessment

- The horizon IAS identified as potential high risk for the EU were checked against the species listed as of Union concern (i.e. species regulated by the IAS Regulation) and Member State concern[1] (i.e. IAS that are regulated at national level), and the species listed as such were excluded from further analysis. The remaining set of species underwent a two-step selection process. First, the species were systematically excluded if:

— Highlighted as high-risk species in less than 2 references reviewed.

— Not cited in the references of the HS studies for the EU but only at regional level (references in Annex 1 marked in blue).

— "Cryptogenic" or "Questionable" species in accordance with Art. 4 of the IAS Regulation.

— Already risk assessed under the IAS Regulation.

— Listed in Annex IV of Regulation (EC) No 708/2007 regarding aquaculture.

— Listed in the European Directive regarding plant health (2031/2016).

- In the second step of the selection process species underwent an assessment via deliberation within the EASIN team, which encompassed terrestrial, freshwater and marine expertise. Each species was assessed separately. First, the information relevant to its risk assessment was compiled: species taxonomic group, habitat, reproduction and spread patterns, origin and native range, known and probable pathways of invasion, current distribution in the EU, and risk of introduction, establishment and spread. Then, the species were further discussed and excluded if they did not fulfil mandatory criteria of the IAS Regulation. Hence, species were removed if:

— Not alien to the EU.

— Unlikely to be capable of establishing a viable population and spreading in the environment under current conditions and in foreseeable climate change conditions.

— Species for which there was no sufficient evidence that they have a significant adverse impact on biodiversity or the related ecosystem services, in accordance with Art. 4 of the IAS Regulation.

— Their inclusion in the Union list would not effectively prevent, minimise or mitigate its adverse impacts.

- Moreover, the species were excluded if:

[1] EASIN stores IAS of Member State concern in the EASIN Catalogue. This list can be retrieved through the Species Search and by accessing to the Member States Competent Authorities

— Lessepsian species and those whose secondary spread is mainly achieved through natural dispersal, and no effective prevention and control can currently be applied to them.

— Widespread across the EU, meaning that no cost-efficient management control can be applied to them.

— Regardless the extent of their current distribution in EU, their potential management is unrealistic due to specific species traits (e.g. planktonic organisms, microscopic dinoflagellates).

— Their correct identification is extremely difficult or requires the use of molecular tools, also when confusion with similar species is very high (e.g. *Mytilopsis sallei*).

— They are currently commercially exploited in the EU (i.e. *Homarus americanus*), or farmed in aquaculture (i.e. *Oreochromis mossambicus, Oreochromis niloticus*).

— Their physiological tolerance would not allow expanding through all EU ecosystems.

2.3 Making "horizon" IAS species available in the EASIN Catalogue and Geodatabase

- The horizon IAS for Europe were added to the EASIN Catalogue and Geodatabase to provide easily accessible information on species' traits and occurrences to both EU MS and the wider public. The horizon IAS compiled from the scientific literature (i.e. the product of section 2.1 without undergoing process in section 2.2) were checked against the EASIN Catalogue to avoid duplication of species entries. For horizon IAS not on the EASIN catalogue, information on species was collected using the EASIN Catalogue protocol. To each species, we assigned:

- Scientific and common names,
- taxonomy,
- environment,
- native ranges (and if applicable first occurrence in the EU),
- status: "Alien" (i.e. any live specimen of a species, subspecies or lower taxon of animals, plants, fungi or micro-organisms introduced outside its natural range, including any part, gametes, seeds, eggs or propagules of such species, as well as any hybrids, varieties or breeds that might survive and subsequently reproduce), "Questionable" (i.e. new entries not verified by experts or species with unresolved taxonomic status) and "Cryptogenic" (i.e. species that have no definitive evidence of their native or alien status),
- potential or identified CBD pathways (CBD 2014).

- The species with "Alien" status were uploaded in the EASIN Catalogue and Geodatabase as "Horizon Scanning Species". The horizon IAS species already included in the EASIN Catalogue were also tagged as "Horizon Scanning Species" (https://easin.jrc.ec.europa.eu/spexplorer/search/). Horizon IAS search and mapping was enabled through the EASIN 'Species Search and Mapping' tools. The species with "Questionable" or "Cryptogenic" status were temporarily withhold until further consultation with the EASIN Editorial Board experts.

3 Case Study: Selecting 10 species for risk assessment

The EASIN team was required by the EU Directorate General for Environment to compile in two weeks, evidence on high-risk species for the forthcoming risk assessment, according to the IAS Regulation and the future update of the list of IAS of Union concern. The case study was carried out on 10 horizon IAS.

3.1 Data collection

The online search for HS literature (see section 2.1) retrieved 10 peer-reviewed articles published between 2014 and 2021 (see Annex 1 for the list of publications). All 10 studies were eligible for further analysis (criteria included in section 2.1), since their time horizon was comprised between 2022 and 2032, their geographic scope included Europe, and their definition of horizon IAS was compatible with the adopted definition. The studies were reviewed to retrieve the species identified as highest priority and / or highest risk (for groups identified as highest priority and highest risk, see Annex 1). As a result, 491 potential high-risk horizon IAS for Europe were identified (duplicates removed; for the list, see Annex 1).

3.2 Systematic exclusions

From the 491 potential high-risk horizon IAS for Europe, the following systematic exclusions were performed:

1. **Species cited in only one HS reference**: 179 species remaining;
2. **Species not cited in any of the three pan European-focused references** (*Asterias amurensis, Cotoneaster horizontalis, Dikerogammarus villosus, Dreissena rostriformis bugensis, Gyrodactylus salaris, Neogobius melanostomus, Trachemys scripta elegans*): 172 species remaining;
3. **Species of Union concern** (including the 2021 update of the Union concern list), and of Member States concern: 82 species remaining;
4. **Species with "Cryptogenic" or "Questionable" status** (*Amphistegina lobifera, Botrylloides violaceus, Bufo mauritanicus, Chelydra serpentina, Mephitis mephitis, Pelodiscus sinensis*): 76 species remaining;
5. **Species already risk assessed** (*Cinnamomum camphora, Cortaderia selloana, Homarus americanus, Micropterus dolomieu, Misgurnus anguillicaudatus, Orconectes rusticus, Penaeus aztecus and Trichosurus vulpecula*): 68 species remaining. Although the species Siganus luridus, Siganus rivulatus and Hemigrapsus sanguineus had been considered in previous risk assessments conducted for marine species, these three species were left for further deliberation based on new information and management feasibility proposed by Tsiamis et al. 2020.

Finally, amongst the remaining species, there were no species listed under Annex IV of Regulation (EC) No 708/2007 regarding aquaculture, but *Agrilus planipennis* was excluded as being listed under the European Directive regarding plant health (2016/2031), leaving 67 species for deliberation within EASIN team (see Annex 1 for all species lists following exclusion steps).

3.3 Deliberation and final list

Following the systematic exclusions, the 67 species selected underwent elimination during discussions within EASIN team. The environment, taxonomy and likely invasion pathways were compiled for all 67 species and each species was scrutinised against the criteria set in point 2.2 (see Annex 1 for the exclusions during the deliberation phase). From further deliberation, we excluded species that met at least one of the following conditions:

1. Partly native,
2. Unlikely to establish in the EU,
3. Without information about negative impacts,
4. Whose designation as of Union concern would not prevent their negative impacts,
5. Lessepsian species or spread via natural dispersal,
6. already widespread in the EU,
7. whose management would be unrealistic due to the nature of the species or identification problems,

8. Commercially exploited
9. Whose physiology would prevent them to spread in the EU

The remaining 46 species were thoroughly discussed during few rounds of EASIN team internal meetings to choose the species regarded as of highest risk and most likely to be considered for further risk assessments. Finally, 5 plant and 5 animal species were shortlisted. These species were placed in a table with all the information regarding their inclusion criteria: criteria of the IAS Regulation, other listings or risk assessments relevant to the species, management possibilities, and their features relevant to risk assessment, such as ecology and invasion potential (see Annex 2). The final list of species proposed for risk assessment to DG Environment is shown in Table 1.

Table 1. List of 5 plant and 5 animal horizon IAS proposed to the DG Environment for risk assessment.

Species name	**Taxonomic position**	**Environment**	**Not in the EU**
Euonymus fortunei	plant	terrestrial	
Chromolaena odorata	plant	terrestrial	x
Cipangopaludina chinensis	animal	freshwater	
Coptodon zillii	animal	freshwater	x
Cryptostegia grandiflora	plant	terrestrial	x
Cynops pyrrhogaster	animal	freshwater	
Hemigrapsus sanguineus	animal	marine	
Lantana camara	plant	terrestrial	
Pachycondyla chinensis	animal	terrestrial	x
Sphagneticola trilobata	plant	terrestrial	

3.4 Addition of the horizon IAS to the EASIN Catalogue and Geodatabase

The information about horizon IAS was also added to the EASIN Catalogue and Geodatabase. All the 491 species (outcome of section 3.1) were checked against the EASIN database, leaving 83 species. Problematic species that were not added or flagged as "Horizon Scanning Species" in the EASIN Catalogue included:

- carp hybrid (*Cyprinus carpio* x *Carassius* sp.*,* specifically*: Cyprinus carpio* x *Carassius auratus*, *Cyprinus carpio* x *Carassius gibelio*, or *Cyprinus carpio* x *Carassius carassius*): lack of information on such hybrids;
- *Microtus agrestis* (Linnaeus, 1761 the EASIN Editorial Board will confirm if the species should be considered as a threat to Ireland but native to mainland Europe;
- *Phragmites australis* (Cav.) Trin. ex Steud.: the EASIN Editorial Board will advise on the native or alien status;
- *Sparus aurata* (Linnaeus, 1758):insufficient information to define the alien status for Canary Islands and Madeira;
- *Thymallus thymallus* (Linnaeus, 1758): considered native to Europe.

The remaining 79 species were added to the EASIN Catalogue and EASIN Geodatabase as "Horizon Scanning Species".

4 Conclusions

Horizon scanning is an essential tool supporting the implementation of the IAS Regulation. By identifying potential IAS approaching the EU MS in future, HS studies are invaluable in assessing and mitigating future biological invasions and risks, allowing MS to prevent or early detect and eradicate the new IAS, essential for the successful IAS management (Peyton et al. 2019). However, different studies use different methodologies and may differ in environment, taxonomic and geographical scope, and timeframe. Therefore, the review of most recent HS that include metadata, and the compilation of horizon IAS list relevant to the EU in the foreseeable future, are essential steps for keeping the EU MS informed about potential biological invasions.

This report was conceived to provide a methodological approach to prioritise future IAS threats in the EU, combining information from the most recent HS studies in a timely manner, to support the implementation of the IAS Regulation by MS. Our methodology (i) highlights new horizon IAS species, (ii) updates the existing IAS information provided through EASIN and (iii) proposes horizon IAS of high priority for risk assessments that inform prospective Union concern lists. Considering the EU legislation and priorities, the criteria for choosing the high-risk and priority species for risk assessment are based on current EU Regulations, as well as on considerations regarding species identity and feasibility of their management.

The methodological approach was tested in a case study, in which EASIN was asked to propose 10 species for risk assessment to the Directorate-General Environment (DG ENV). The task had strong time constraints of two weeks, hence a succinct and transparent methodology was the best option. The methodology comprising systematic exclusions and consensus via deliberation was found to be a fast and efficient tool to choose the high-priority horizon IAS for risk assessment.

Finally, the species lists compiled in a HS review exercise can be used to perform EASIN-Lit (literature review) activity to enrich EASIN Catalogue and Geodatabase. Such information is made available to the EU MS and the wider public under “Horizon Scanning Species” designation, and may be used to improve monitoring efforts in the MS allowing for better-informed decisions regarding the biosecurity surveillance and higher probability of early detection of newly introduced IAS.

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List of abbreviations and definitions

Cryptogenic species for which details on the alien status in a region are available but for which explicit evidence is lacking, implying that the species could be native (Carlton, 1996).

DG ENV EU Directorate-General Environment

EASIN European Alien Species Information Network

EU European Union

HS Horizon Scanning

IAS Invasive Alien Species: organisms introduced into natural environment outside of their native ranges by humans, either unintentionally or deliberately, which are able to adapt to the novel habitat, establish and spread, and may cause significant negative effects on their invaded ecosystems.

MS Member State(s)

Questionable in the EASIN protocol, these are species not verified by experts or species with unresolved taxonomic status

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