

JRC SCIENCE FOR POLICY REPORT

Baseline Distribution of Invasive Alien Species of Union concern

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Title Baseline Distribution of Invasive Alien Species of Union Concern

Abstract

A current EU geographical distribution of spatial information for the 37 Invasive Alien Species (IAS) of Union concern (IAS Regulation 1143/2014) is set, based on the best available knowledge, resulting from an assessment of data aggregated through the European Alien Species Information Network (EASIN) in collaboration with the Member States (MS) Competent Authorities of 18 EU countries. This baseline is an important tool supporting the implementation of the IAS Regulation and also provides a factual basis for the review of the application of the IAS Regulation. Ultimately, the information included can be used for monitoring the achievement of Target 5 of the EU Biodiversity Strategy to 2020 for combatting IAS, but also to the implementation of other EU policies with requirements on alien species, such as the Birds and Habitats Directives, and the Marine Strategy and Water Framework Directives.

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Foreword

The Joint Research Centre of the European Commission provides support to the European Union policies with scientific and technical evidence throughout the whole policy cycle, including to other Commission services, EU institutions and Member States. This includes support to the biodiversity policy including in relation to the Invasive Alien Species.

Invasive Alien Species (IAS) are animals and plants that are introduced accidentally or deliberately into a natural environment where they are not normally found, with serious negative consequences for their new environment. They are a major cause of biodiversity loss, represent a major threat to native species in Europe, causing damage costing billions of euros to the European economy every year.

The EU Regulation 1143/2014 entered into force on 1 January 2015. The Regulation addresses the problem of IAS in a comprehensive manner to protect native biodiversity and ecosystem services, as well as to minimize and mitigate the impact of IAS on human health or on the economy. The Regulation foresees three types of interventions: prevention; early detection and rapid eradication; and management. It gives priority to a subset of IAS, included in the list of IAS of Union concern. Species are included in this list inter alia because they can cause such a significant damage in Member States justifying the adoption of dedicated measures at Union level. The first list of IAS of Union concern includes 37 taxa.

This report is the result of an assessment of occurrence and distribution data aggregated through the European Alien Species Information Network (EASIN), in collaboration with 18 Competent Authorities responsible for the implementation of the IAS Regulation. Based on the best available knowledge, a current EU geographical distribution - or baseline - of the 37 IAS of Union concern is set. This constitutes an important tool supporting the implementation of the IAS Regulation. For example it can provide useful information with reference to Art. 16, that requires that Member States notify the European Commission and other Member States of early detections of listed species. In addition, the baseline information will provide a factual basis for the review of the application of the IAS Regulation.

A commonly acknowledged baseline can also help Member States in the establishment of a surveillance system for the targeted species, and can foster cooperation and coordination across borders or within shared biogeographical regions. Ultimately, the information included in the current baseline can be used for monitoring the achievement of Target 5 of the EU Biodiversity Strategy to 2020 for combating IAS, but also for the implementation of other EU policies with requirements on alien species, such as the Birds, Habitats, Marine Strategy and Water Framework Directives.

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- The Global Biodiversity Information Facility (GBIF)
- The Global Invasive Species Information Network (GISIN)
- The Regional Euro-Asian Biological Invasions Centre (REABIC)
- The Hellenic Network on Aquatic Invasive Species (ELNAIS)
- The International Commission for Scientific Exploration of the Mediterranean Sea (CIESM)
- The European Environmental Agency (EEA) / Hellenic Centre for Marine Research (HCMR)
- The International Union for Conservation of Nature (IUCN) online information system for monitoring invasive non-native species in marine protected areas (IUCN-MedMIS)
- The Marine Mediterranean Invasive Alien Species (MAMIAS)
- The Norwegian Biodiversity Information Centre (NBIC) Norway
- The European and Mediterranean Plant Protection Organization (EPPO)

Finally we would like to thank the EASIN Editorial Board Members (<http://easin-eb.jrc.ec.europa.eu/the-board>) as well as the JRC colleague Jose Barredo for the revision of the document and the suggestions.

Executive summary

Policy background

Invasive Alien Species (IAS) constitute one of the most important threats to biodiversity, causing severe ecological and socio-economic impacts. Recognizing the need for a coordinated set of actions to prevent, control and mitigate IAS, the European Parliament and the Council have adopted the EU Regulation 1143/2014 (hereafter referred to as the IAS Regulation). The IAS Regulation gives priority to a list of IAS, named as IAS of Union concern. Species are included in this list *inter alia* because they can cause such a significant damage in Member States (MS) justifying the adoption of dedicated measures at Union level. The first list of IAS of Union concern includes 37 species. Under the IAS Regulation, MS must prevent the species to be introduced and spread, enforce effective early detection and rapid eradication mechanisms for new introductions, and adopt management measures for those that are already widely spread.

Detailed and up to date spatial information on the IAS of Union concern in the MS territories is needed for setting a geographic baseline of their current distribution, in support of the IAS Regulation implementation, in particular with reference to Art. 16 dictating the mandatory notification of early detections of listed species to the European Commission (EC) and to the other MS. This report illustrates the state of the art towards the establishment of a consolidated EU distribution map as a baseline for the 37 IAS of Union concern.

Building the baseline

Spatial information on IAS of Union concern is generally scattered across various sources (scientific literature, online and offline databases, reports, etc.). Addressing this challenge, the European Alien Species Information Network (EASIN), developed by the Joint Research Centre, offers a single aggregation point of alien species (AS) spatial data, which are standardized, harmonized and integrated. Consequently, EASIN was chosen as the primary source of data for compiling the distribution baseline of the IAS of Union concern.

In a second phase, MS Competent Authorities for implementing the IAS Regulation were invited to check the EASIN baseline data of the targeted species, at country and grid 10x10 km level, and to supplement this with national data. The final aim was to promote collaboration and coordination with MS and ensure data sharing and exchange, leading to a consolidated baseline of the IAS of Union concern. The feedback received by the MS Competent Authorities was satisfactory concerning the country level data (18 MS provided data), but it was more limited when it comes to the grid level data (13 MS provided data). This was related with time limitations, the absence of digitalized national data, and technical constraints (e.g. format of data).

Main findings

For each IAS of Union concern spatial information is provided within each MS, at both country and grid 10x10 km level, based on the best available knowledge. The report provides also traits of the targeted species, which have a key role in biological invasions management. For each species the year and country of first introduction in the EU, the main pathway of introduction, the taxonomic group, the habitat, the origin, and the impact are given.

The distribution baseline has revealed that most IAS of Union concern have been introduced and spread across north-western EU countries (e.g. BE, DE, NL, FR, UK), while their presence is more limited in southern MS (e.g. MT, CY, BG). Several species are already quite widespread across EU (e.g. *Trachemys scripta*, *Pacifastacus leniusculus*

and *Eriocheir sinensis*), while other species have been rarely found (e.g. *Herpestes javanicus*, *Parthenium hysterophorus*, *Sciurus niger*) or are still completely absent from EU (*Persicaria perfoliata*).

Most IAS of Union concern have been introduced into EU through escapes from confinement (botanical garden/zoo/aquaria) and through escapes linked with ornamental purposes. Specific patterns have been revealed for plants and for freshwater crayfish. Most of the Union concern IAS originate from America (mainly North America) and Asia (mainly East Asia).

Key conclusions

- The distribution baseline of the 37 IAS of Union concern is an important tool supporting the implementation of the IAS Regulation, and also provides a factual basis for the review of the application of the IAS Regulation.
- A commonly acknowledged baseline will help MS in the establishment of a surveillance system of the targeted species under Art. 14, and can foster MS cooperation and coordination across borders or within shared biogeographical regions, as recalled by Art. 22. The distribution of IAS of Union concern will also help the discussion amongst MS about the appropriate management measures to be implemented (Art. 19).
- A shared baseline will also help MS and the EC in monitoring the evolution of the IAS distribution in Europe and the effectiveness of the actions undertaken by MS Competent Authorities by implementing the IAS Regulation. The evaluation of those data can eventually lead to reconsider or modify implementation activities and give an input when updating the list of IAS of Union concern.
- The distribution baseline provides valuable information also to the implementation of other EU policies related with AS, such as the Birds and Habitats Directives, the Marine Strategy, and Water Framework Directives.
- EASIN proved to be a good source of information of IAS of Union concern distribution records within EU countries, attesting as the role of official information system supporting MS in the implementation of the IAS Regulation (Art. 25).
- Citizen scientist initiatives on IAS, such as smartphone applications, could benefit from the information provided by the present baseline on IAS of Union concern.

1 Introduction

1.1 Background

Invasive Alien Species (IAS) are animals and plants that are introduced accidentally or deliberately into a natural environment where they are not normally found, with serious negative consequences for their new environment. They constitute one of the most important threats to biodiversity, causing severe ecological and socio-economic impacts (Mack et al. 2000; Millennium Ecosystem Assessment 2005; Ricciardi et al. 2013; Jeschke et al. 2014). As a conservative estimate, IAS cost the European Union (EU) Member States €12 billion in damages on annual basis (Kettunen et al. 2009) but cumulated costs probably reach €20 billion per year (<http://www.ieep.eu/work-areas/biodiversity/invasive-alien-species/> accessed on 4 November 2016). In addition, there is an increasing trend towards introduction of new IAS, with the vast majority being introduced unintentionally (Hulme 2009; Essl et al. 2015; Roques et al. 2016). To this end, economic resources invested by the EU in both the research and management of IAS have been growing steadily over the years (Scalera 2010; Silva et al. 2014).

About 14,000 alien species have been reported so far in Europe (Katsanevakis et al. 2015). Plenty of information is available about them, but it is generally scattered across many different information systems and databases (Panov & Gollasch 2004; Gatto et al. 2013). In addition, data format and information about the data (metadata) is a frequent limitation to the interoperability of data repositories and information systems (Katsanevakis et al. 2012; Essl et al. 2015). It is therefore crucial for management, scientific, and educational purposes, to establish a single aggregation point for sharing and disseminating information, where available knowledge on AS from various data sources is standardized, harmonized and integrated (Panov & Gollasch 2004; Ojaveer et al. 2014). To address this need, the European Alien Species Information Network (EASIN¹) has been developed by the European Commission's Joint Research Centre (Katsanevakis et al. 2012). The EASIN system aims to facilitate easier access to data of AS in Europe, and to provide a single repository for accessing all the information necessary to underpin AS related policy and management decisions (Katsanevakis et al. 2013). EASIN facilitates the exploration of AS data from distributed sources through a network of publicly and freely available interoperable web services, following internationally recognized standards and protocols (Katsanevakis et al. 2015).

Recognizing the need for a coordinated set of actions to prevent, control and mitigate the impact of IAS, the European Parliament and the Council adopted the EU Regulation no. 1143/2014 (EU 2014; hereinafter referred to as the IAS Regulation) on the prevention and management of the introduction and spread of IAS, which entered into force on 1 January 2015. The IAS Regulation gives priority at European level to a subset of IAS, named as IAS of Union concern (Art. 4 "the Union list", hereinafter IAS of Union concern). Species are included in this list *inter alia* because they can cause such a significant damage in Member States (MS) justifying the adoption of dedicated measures at Union level. The list of IAS of Union concern will be updated, focusing on species whose inclusion in the list would effectively prevent, minimize or mitigate their adverse impact in a cost efficient manner (EU 2014).

An evaluation process on priority species, based on specific criteria and requirements laid down in Art. 4.3 of the IAS Regulation, and on Risk Assessments meeting the requirements of Article 5.1, led to the adoption of a first list of IAS of Union concern, published with the Commission Implementing Regulation (EU) 2016/1141 of 13.07.2016 (which entered into force on 03.08.2016)². The list contains 37 taxa, including both animals and plants. Under the IAS Regulation, MS must prevent

¹<https://easin.jrc.ec.europa.eu/>

²<http://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1468477158043&uri=CELEX:32016R1141>

introduction and spread of listed species, enforce effective early detection and rapid eradication mechanisms for new introductions, and adopt management measures for those that are already widely spread.

EASIN constitutes the core of the information system supporting MS in the implementation of the IAS Regulation (EU 2014, Art. 25). Moreover, an Early Warning and Rapid Eradication Notification System (NOTSYS) has been developed within EASIN, used by the MS for notifying the European Commission (EC) and all MS about the new occurrences of IAS of Union concern detected on their territory, and for reporting on eradication measures applied, and on their effectiveness, as foreseen in Art. 16-17 of the IAS Regulation.

Detailed and up to date spatial information of the IAS of Union concern in the MS territories is needed for setting a geographic baseline of their current distribution, supporting the implementation of the IAS Regulation, especially when it concerns new detections of IAS of Union concern. This work aims at defining an EU baseline of spatial information for the 37 IAS of Union concern.

1.2 Purpose of the report

This report illustrates the state of the art towards the establishment of a consolidated EU distribution map as a current baseline for the 37 IAS of Union concern. The process for the compilation of spatial data of these species, performed by the EASIN team in close collaboration with MS Competent Authorities, is also described.

1.3 Legislation – implementation

MS Competent Authorities in charge of implementation of the IAS Regulation can through this work avail of a baseline of the distribution of IAS of Union concern in areas surrounding their territory and in areas from where an introduction of an IAS is likely to occur, because of internal market trade, movement of goods and people, or continuity of environment, e.g. river basin.

The EU, with the implementation of the IAS Regulation, while protecting European biodiversity, is also honouring its commitments as a party to the Convention on Biological Diversity (CBD)³. According to Article 8(h) of the Convention, the EU shall, as far as possible and as appropriate, “*prevent the introduction of, control or eradicate those alien species which threaten ecosystems, habitats or species*”. The same commitments are undertaken by the EU as a Party to the Convention on the Conservation of European Wildlife and Natural Habitats, approved by Council Decision 82/72/EE⁴, to take all appropriate measures to ensure the conservation of the habitats of the wild flora and fauna.

Furthermore, CBD Aichi Biodiversity Target 9 states that “*By 2020, invasive alien species and pathways are identified and prioritized, priority species are controlled or eradicated, and measures are in place to manage pathways to prevent their introduction and establishment*”. This objective is reflected in target 5 of the EU Biodiversity Strategy 2010-2020 (EU 2011) and is linked with the IAS Regulation in terms of the prevention principle.

In addition, the Marine Strategy Framework Directive (MSFD; EU 2008) also recognizes alien marine species as a major threat to European biodiversity and

³ Council Decision 93/626/EEC of 25 October 1993 concerning the conclusion of the Convention on Biological Diversity (OJ L 309, 13.12.1993, p. 1).

⁴ Council Decision 82/72/EEC of 3 December 1981 concerning the conclusion of the Convention on the conservation of European wildlife and natural habitats (OJ L 38, 10.2.1982, p. 1).

ecosystem health, requiring MS to consider them when developing strategies allowing European Seas to reach a Good Environmental Status condition by 2020.

Moreover, in the context the Water Framework Directive (WFD; EU 2000) IAS are recognized having a significant impact on water management, which can affect the chance of achieving good or high ecological status/potential. It is recommended that River Basin Management Program activities on IAS should be coordinated within the EU, and national strategies to address invasive species, with the aim of preventing further deterioration in the ecological quality of water bodies, be established.

Finally, AS are also considered in the Birds Directive (EU 2010, art. 11) and the Habitats Directive (EU 1992, art. 22). The endorsement of a distribution baseline for IAS of Union concern could provide valuable information to the implementation of these Directives.

1.4 Scientific value

Despite the availability of several distribution maps at different scales, there are not yet accurate distribution maps of the 37 IAS of Union concern at EU level. The baseline proposed in this report provides a current distribution based on the best available knowledge of these targeted species within the EU. For this objective, distributed spatial data coming from various data sources (scientific literature, databases, national Competent Authorities) are aggregated, harmonized and integrated for the first time, at country and more detailed grid level. MS Competent Authorities had an active role in this process by contributing with national data, validating and endorsing the updated information in EASIN.

The report also provides information on the traits of the IAS of Union concern, which have a key role in biological invasions management. For each species the year and country of first introduction in the EU, the main pathway of introduction, the taxonomic group, the habitat, the origin, and the impact (environmental, economic, social) are given.

Finally, it should be noted that the content of this document also considers some of the top 20 issues tackling IAS in Europe, as provided by Caffrey et al. (2014). These are: a) the need of a coherent EU legislation for effective biosecurity, b) early warning mechanisms through NOTSYS, c) consolidation of knowledge, knowledge transfer, and sharing through EASIN to improve IAS management, and d) networking among international experts through EASIN.

2 Methodology

2.1 Background

Spatial information on IAS of Union concern is scattered across various sources, including the scientific literature, online and offline databases, reports, institute collections, web sources, etc. In addition, the type and format of geographical data vary substantially. Addressing these challenges, EASIN offers a single aggregation point of AS spatial data, which are standardized, harmonized and integrated (Katsanevakis et al. 2012). Consequently, EASIN was chosen as the primary source of data for compiling the distribution baseline of the IAS of Union concern in EU countries.

In a second phase, MS Competent Authorities for implementing the IAS Regulation were invited to check and validate the EASIN baseline data of the targeted species, at country and grid level, supplementing the spatial data with national data. By this way, any error and omission of spatial data could be addressed for each country. The final aim was to promote collaboration and coordination with MS and ensure data sharing and exchange, leading to a consolidated distribution baseline of the 37 IAS of Union concern.

2.2 The use of EASIN as a data source

As mentioned above, EASIN aggregates scientific information and spatial data on AS from several sources, and offers flexible web services for searching and mapping AS within Europe.

A key component of the EASIN system is the “**EASIN Catalogue**”: a comprehensive list of AS in Europe, currently including information on about 14,000 taxa in a wide range of environments. For each taxon, information is available on the year and country of the first observation in Europe, alien status (alien, cryptogenic, questionable), native range, taxonomy, synonyms, common names, environment, pathways, vectors and impact. Links to factsheets are also provided for selected taxa (Katsanevakis et al. 2015). The initial EASIN Catalogue was compiled collating information from 43 databases (Katsanevakis et al. 2012). All data collected were harmonised, standardized and integrated. Since the initial compilation, the EASIN Catalogue has been continuously updated, revised and validated through a process which includes several steps to pursue high quality standards, with the engagement of external experts. All taxonomic groups have been updated and validated by 2016, with the exception of virus taxa.

EASIN offers flexible and efficient online mapping tools for the retrieval of spatial data through the **EASIN Geodatabase**. All species occurrence records mapped in the EASIN Geodatabase result from the crawling of data from a network of **Data Partners**, on the basis of the species contained in the EASIN Catalogue. The process of retrieving the data from the Data Partners is done through the EASIN Data Broker system, which is able to retrieve the species occurrences and related information (date, source) from different kind of data sources and store them in a normalized database structure. Data are transformed by converting the harvested data to the EASIN Data Model through the following steps: Validation, Cleansing and Standardization, Geocoding, Mapping, Application of Quality rules and finally loaded on the Geodatabase (Data warehouse). Data collected are shown in occurrences maps at country, grid 10x10 km, river basin district and marine ecoregion level, which can be downloaded and exported. It should be noted that the grid 10x10 km has been chosen for EASIN, following the corresponding reference grid of the European Environmental Agency (EEA). This grid is also compatible with the data format coming from EASIN Data Partners. However, a higher resolution for EASIN grid maps is planned for the future.

The EASIN Data Partners are global, regional and national databases that provide EASIN with spatial information on AS in Europe. Ownership of the data remains with its source, which is properly cited and linked in the EASIN Geodatabase. The EASIN Data Partners gain increased visibility and networking possibilities through EASIN, and can also benefit from mutual data exchange. EASIN follows international standards and protocols for distribution spatial data (INSPIRE Framework Directive 2007/2/EC – EU 2007; INSPIRE 2013). Given the vast amount of information recorded in EASIN and the need for constant updates and revision, an **Editorial Board** has been established to ensure the quality of the data in the EASIN system (Tsiamis et al. 2016).

The EASIN partnership includes 10 Data Partners, both global and European (reference date November 2016):

- The Global Biodiversity Information Facility (GBIF)
- The Global Invasive Species Information Network (GISIN)
- The Regional Euro-Asian Biological Invasions Centre (REABIC)
- The Hellenic Network on Aquatic Invasive Species (ELNAIS)
- The International Commission for Scientific Exploration of the Mediterranean Sea (CIESM)
- The European Environmental Agency (EEA) / Hellenic Centre for Marine Research (HCMR)
- The International Union for Conservation of Nature (IUCN) online information system for monitoring invasive non-native species in marine protected areas (IUCN-MedMIS)
- The Marine Mediterranean Invasive Alien Species (MAMIAS)
- The Norwegian Biodiversity Information Centre (NBIC) Norway
- The European and Mediterranean Plant Protection Organization (EPPO).

Additional and updated spatial data have been gathered through EASIN-Lit, an internal EASIN activity (Trombetti et al. 2013), that contributes to enriching the Geodatabase through screening the scientific literature and retrieving geo-referenced data.

Besides EASIN-Lit, part of the literature review on IAS of Union concern was outsourced to a fee paid expert, and supplemented by in-house work carried out by the EASIN team and a PhD qualified scientific trainee, availing of JRC internal resources. Finally, a data quality check took place on all spatial data of IAS of Union concern of the EASIN Geodatabase, especially at grid 10x10 km level data, ensuring thus the accuracy of the related information.

2.3 Methodology for Member States contributions

DG Environment (DG ENV) invited MS, during sessions of the IAS Committee established under Art. 27 of the IAS Regulation, to review and supplement the baseline distribution of the IAS of Union concern provided by EASIN. The following timeline was followed:

- 4th IAS Committee (04.12.2015): DG ENV informed MS that EASIN is working on the baseline geographic distribution of the 37 IAS of Union concern.
- 5th IAS Committee (23.02.2016): the EASIN team was invited to inform the Committee on the progress made within EASIN concerning the update of the baseline of the IAS of Union concern.
- 6th IAS Committee Meeting (22.06.2016): the compilation of EASIN spatial data at country level was completed. A dedicated filter and icon for the selection of species of Union concern in the EASIN mapping tool was added. MS could start checking and evaluating country level data; announcement of circulation of grid spatial data (10x10 km) to MS.
- 12.07.2016: country shape files with IAS grid spatial data were sent to all MS, along with EASIN baseline protocol. This document included all details and guideline for MS to check and revise the EASIN spatial data at country and grid

level (Annex I). A deadline for providing feedback to the EASIN team was set at 30.09.2016, later postponed to 31.12.2016.

- 7th IAS Committee Meeting (05.10.2016): EASIN informed the Committee on the feedback received by MS on baseline spatial data, at country and grid level.

During this process, it was discussed whether the term "occurrence of a species" includes an established species (reproducing in the wild and forming self-sustaining populations) or casual (few sporadic records and/or not reproducing in the wild). It should be noted that EASIN records do not make a distinction between established and casual. Therefore, MS were invited to comment the "established" or "casual" status of species at country-level, following a two-steps process:

1. Country-level check

MS were invited to check EASIN reported occurrences of each IAS of Union concern on their territory, and to provide revisions and/or updates of spatial data by using Annex I protocol.

2. Grid-level check (GIS data 10x10 km)

Shape files including all EASIN occurrences data concerning IAS of Union concern per MS and per species were provided to MS. The coordinate system and projection of the spatial information were the European Terrestrial Reference System 1989 and Lambert azimuthal equal-area projection (ETRS89/ETRS-LAEA, EPSG: 3035, <http://spatialreference.org/ref/epsg/etrs89-etrs-laea>). Shape files could be opened and managed with GIS software as ArcGIS, QGIS, GRASS.

MS were invited to compare the EASIN shape file data with their national data at 10x10 km grid. The shapefile provided to each MS by EASIN contained the following information (GIS Attribute Table):

- Identifier of the record (FID: a code for each EASIN record).
- Spatial information (Shape: polygon, line or dot).
- Scientific name of the species of Union concern (Species_NA).
- Name of the entity providing the original observation (EASIN Data Partner: <http://easin.jrc.ec.europa.eu/Partners/Partners>).
- Identifier of the reference (e.g. scientific publication) (code of reference). Full citation references were provided in a separate excel file by EASIN.
- The column "Accepted"; to be filled-in by the MS (Y/N).
- The column "Notes"; to be filled-in by the MS in case "N" has been indicated; appropriate reference(s) when applicable were provided.

In addition, an Excel file was provided by EASIN containing the related full references mentioned in the shape files (reference code and associated citation). References were the sources (e.g. scientific publications, datasets) from which the information about the species occurrences had been extracted and processed by EASIN.

New spatial data entries were provided by the MS using the same shape file received from EASIN (adding new features in the Attribute Table in the GIS environment) or by creating a new shape file following the same structure. New spatial data entries contained all the relevant information included in the Attribute Table:

- Identifier of the record (FID).
- Spatial information (polygon, line or dot).
- Scientific name of the IAS of Union concern (Species_NA).
- Name of the entity providing the record (the official name of the MS national authority organization).
- Identifier of the reference (providing a code of reference). The new code and the full citation reference were added by the MS in the excel file provided by EASIN.

More technical details on the process can be found in the baseline protocol (Annex I).

2.4 Member States feedback

By end of March 2017, 18 MS had submitted feedback concerning the baseline of the IAS of Union concern at country level. Concerning the grid level baseline, 13 MS provided feedback data. All details concerning the MS feedback on the EASIN data are depicted in Table 1.

Table 1. MS feedback on EASIN occurrences data of the 37 IAS of Union concern, at country and grid level.		
Member States	Feedback on country level provided	Feedback on grid level provided
AUSTRIA (AT)	YES	
BELGIUM (BE)	YES	YES
BULGARIA (BG)		
CROATIA (HR)	YES	YES
CYPRUS (CY)	YES	
CZECH REPUBLIC (CZ)	YES	YES
DENMARK (DK)	YES	YES
ESTONIA (EE)	YES	
FINLAND (FI)	YES	YES
FRANCE (FR)	YES	YES
GERMANY (DE)		
GREECE (EL)	YES	YES
HUNGARY (HU)		
IRELAND (IE)	YES	YES
ITALY (IT)		
LATVIA (LV)	YES	YES
LITHUANIA (LT)		
LUXEMBOURG (LU)		
MALTA (MT)		
NETHERLANDS (NL)	YES	
POLAND (PL)	YES	YES
PORTUGAL (PT)		
ROMANIA (RO)		
SLOVAKIA (SK)		
SLOVENIA (SI)	YES	YES
SPAIN (ES)	YES	YES
SWEDEN (SE)	YES	YES
UNITED KINGDOM (UK)	YES	
TOTAL	18	13

2.5. Scientific and technical issues

The baseline check by the MS frequently required close collaboration with the EASIN team, through the exchange of e-mails. During this process, several technical problems regarding the data format and other specifications were addressed. At the same time, a number of issues were raised by MS, which required dedicated coordinated discussions with MS Competent Authorities and DG ENV. These issues are summarized below:

Time limitation: NL pointed that it would be too time consuming to complete the grid level check, and requested additional time. DE raised the same concern and communicated that they would not be able to check the data provided by EASIN.

Lack of national data: CY and EL pointed that they would need extra time for checking grid level data, in the absence of national updated digitalized data in GIS format.

Data format incompatibilities: ES faced difficulties to transform the national official data into the requested Lambert projection (as an obligation to the INSPIRE Framework Directive – EU 2007), and requested a time-extension to properly review all grid level data. Similarly, EE faced format incompatibility concerning the grid level data; extra time was required to re-project their national data to the ETRS 1989 LAEA (EPSG 3035).

Casual records: Several MS raised the question how to address IAS of Union concern which have a “casual” status within their territory; these species correspond to “occasional” (e.g. *Oxyura jamaicensis* in DK, and *Threskiornis aethiopicus* in DK and BE, *Tamias sibiricus* in UK), rare records (e.g. *Eriocheir sinensis* in DK, *Parthenium hysterophorus* in BE), species not reproducing in the wild (e.g. *Eriocheir sinensis* in EE and SE, *Trachemys scripta* in EE, BE and SE, *Oxyura jamaicensis* and *Threskiornis aethiopicus* in PL) or not overwintering (*Eichhornia crassipes* in UK, BE). Such species were finally included in the country-level baseline distribution, but with an indication of “casual status”.

Historical records: The baseline should reflect the **current distribution** of the IAS of Union concern in each MS. Therefore, it was agreed to exclude “historical records” from the baseline, species that are not currently present within their territory (e.g. *Parthenium hysterophorus* in PL, *Eichhornia crassipes*, *Myocastor coypus*, *Nasua nasua*, *Procyon lotor* in SE, *Oxyura jamaicensis* in IE).

Eradicated species: Several MS proposed to exclude from the baseline data concerning species which have been recently eradicated from their country territory (*Oxyura jamaicensis* in ES and in SE, *Procambarus fallax* f. *virginialis* in SE). After consulting with DG ENV, it was agreed to exclude these records from the baseline.

Exclusion of specific EASIN records: Several MS proposed to exclude from the baseline specific EASIN records (e.g. *Heracleum persicum* in FR, *Lithobates catesbeianus* in DK, *Procyon lotor* in EE, *Hydrocotyle ranunculoides* in IE, *Oxyura jamaicensis* in ES, *Corvus splendens* in BE). For each of these species the EASIN team contacted the related MS Component Authority to clarify the reasons for exclusion. After reaching a consensus on these cases, the records have been excluded from the baseline.

2.6. Building the distribution baseline

The final distribution baseline of the IAS of Union concern, at country and grid level, was built based on:

- EASIN data endorsed by the MS Competent Authorities
- additions/exclusions/revisions proposed by MS

Specific doubtful cases were jointly addressed by EASIN and MS Competent Authorities; these cases mostly included casual, historical, eradicated and specific EASIN records not endorsed by MS, as described in chapter 2.5.

Important Note: At the time of finalisation of this report (May 2017) 10 MS have not provided feedback on EASIN distribution data concerning IAS of Union concern at country level, while 15 MS have not provided feedback concerning the grid level (Table 1). As a result, the baseline data presented in the current report for these MS are those corresponding to the original EASIN dataset (see chapter 2.2).

2.7. Traits of IAS of Union concern

A detailed search was performed for each IAS of Union concern in EASIN Catalogue, Risk Assessments of the IAS Regulation and web sources (CABI, NOBANIS, GISD, DAISIE, WORMS, ITIS), concerning information about:

- Common name: in English.
- Taxonomic position: Kingdom, Phylum/Division, Class; following the ITIS (<https://www.itis.gov/>) and WORMS (<http://www.marinespecies.org/>).
- Habitat: terrestrial / freshwater / oligohaline / marine.
- Origin: the native range of each species, provided at sub-continent level.
- Pathways of introduction in Europe: the CBD categorization of pathways (CBD 2014) was adopted for the current study (Table 2). CBD pathways are based on Hulme et al. (2008) study, integrating a set of international standards and guidelines, aiming at harmonizing the existing large number of pathways described. One or more CBD pathways were attributed for each IAS of Union concern, based on updated literature.
- Year of first observation in EU: year of the first detection or report of an IAS of Union concern within EU.
- Country of first observation in EU: the country of first detection or report of an IAS of Union concern within EU.
- Impact: environmental / economic / social; referring to impacts reported globally, but focusing on European studies.

1	RELEASE IN NATURE: Biological control
2	RELEASE IN NATURE: Erosion control/ dune stabilization (windbreaks, hedges, ...)
3	RELEASE IN NATURE: Landscape/flora/fauna "improvement" in the wild
4	RELEASE IN NATURE: Fishery in the wild (including game fishing)
5	RELEASE IN NATURE: Hunting
6	RELEASE IN NATURE: Introduction for conservation purposes or wildlife management
7	RELEASE IN NATURE: Release in nature for use (other than above, e.g., fur, transport, medical use)
8	RELEASE IN NATURE: Other intentional release
9	ESCAPE FROM CONFINEMENT: Agriculture (including Biofuel feedstocks)
10	ESCAPE FROM CONFINEMENT: Farmed animals (including animals left under limited control)
11	ESCAPE FROM CONFINEMENT: Forestry (including afforestation or reforestation)
12	ESCAPE FROM CONFINEMENT: Fur farms
13	ESCAPE FROM CONFINEMENT: Aquaculture / mariculture
14	ESCAPE FROM CONFINEMENT: Botanical garden/zoo/aquaria (excluding domestic aquaria)
15	ESCAPE FROM CONFINEMENT: Pet/aquarium/terrarium species (including live food for such species)
16	ESCAPE FROM CONFINEMENT: Horticulture
17	ESCAPE FROM CONFINEMENT: Ornamental purpose other than horticulture
18	ESCAPE FROM CONFINEMENT: Research and ex-situ breeding (in facilities)
19	ESCAPE FROM CONFINEMENT: Live food and live bait
20	ESCAPE FROM CONFINEMENT: Other escape from confinement
21	TRANSPORT – CONTAMINANT: Contaminant nursery material
22	TRANSPORT – CONTAMINANT: Contaminated bait
23	TRANSPORT – CONTAMINANT: Food contaminant (including of live food)

24	TRANSPORT - CONTAMINANT: Contaminant on animals (except parasites, species transported by host/vector)
25	TRANSPORT - CONTAMINANT: Parasites on animals (including species transported by host and vector)
26	TRANSPORT - CONTAMINANT: Contaminant on plants (except parasites, species transported by host/vector)
27	TRANSPORT - CONTAMINANT: Parasites on plants (including species transported by host and vector)
28	TRANSPORT - CONTAMINANT: Seed contaminant
29	TRANSPORT - CONTAMINANT: Timber trade
30	TRANSPORT - CONTAMINANT: Transportation of habitat material (soil, vegetation,...)
31	TRANSPORT - STOWAWAY: Angling/fishing equipment
32	TRANSPORT - STOWAWAY: Container/bulk
33	TRANSPORT - STOWAWAY: Hitchhikers in or on airplane
34	TRANSPORT - STOWAWAY: Hitchhikers on ship/boat (excluding ballast water and hull fouling)
35	TRANSPORT - STOWAWAY: Ship/boat ballast water
36	TRANSPORT - STOWAWAY: Ship/boat hull fouling
37	TRANSPORT - STOWAWAY: Hitchhikers on ship/boat (excluding ballast water and hull fouling)
38	TRANSPORT - STOWAWAY: Machinery/equipment
39	TRANSPORT - STOWAWAY: People and their luggage/equipment (in particular tourism)
40	TRANSPORT - STOWAWAY: Organic packing material, in particular wood packaging
41	TRANSPORT - STOWAWAY: Vehicles (car, train, ...)
42	TRANSPORT - STOWAWAY: Other means of transport
43	CORRIDOR: Interconnected waterways/basins/seas
44	CORRIDOR: Tunnels and land bridges
45	UNAIDED: Natural dispersal across borders of invasive alien species that have been introduced through pathways 1 to 5
46	UNKNOWN

3 Results

3.1. Baseline distribution at country level

The overall country-level baseline of IAS of Union concern is presented in Table 3. The higher number of IAS of Union concern have been found in BE (28 species), FR (25 species), NL (25 species) and DE (25 species), while CY (2 species) and MT (no species) have the lowest number within EU (Figures 1 and 2). However, concerning exclusively established populations (casuals not included), DE (25 species), FR (24 species), IT (24 species) and NL (20 species) present the highest number (Figure 1). The reptile *Trachemys scripta* is the most common IAS of Union concern within EU, since it has been found in 24 MS (Figure 3). The invertebrates *Pacifastacus leniusculus* and *Eriocheir sinensis* are also very common in EU, reported in 23 and 22 MS respectively (Figure 3). Other species have been rarely found across EU (e.g. *Herpestes javanicus*, *Parthenium hysterophorus*, *Sciurus niger*) or are not present (*Persicaria perfoliata*) (Figure 3).

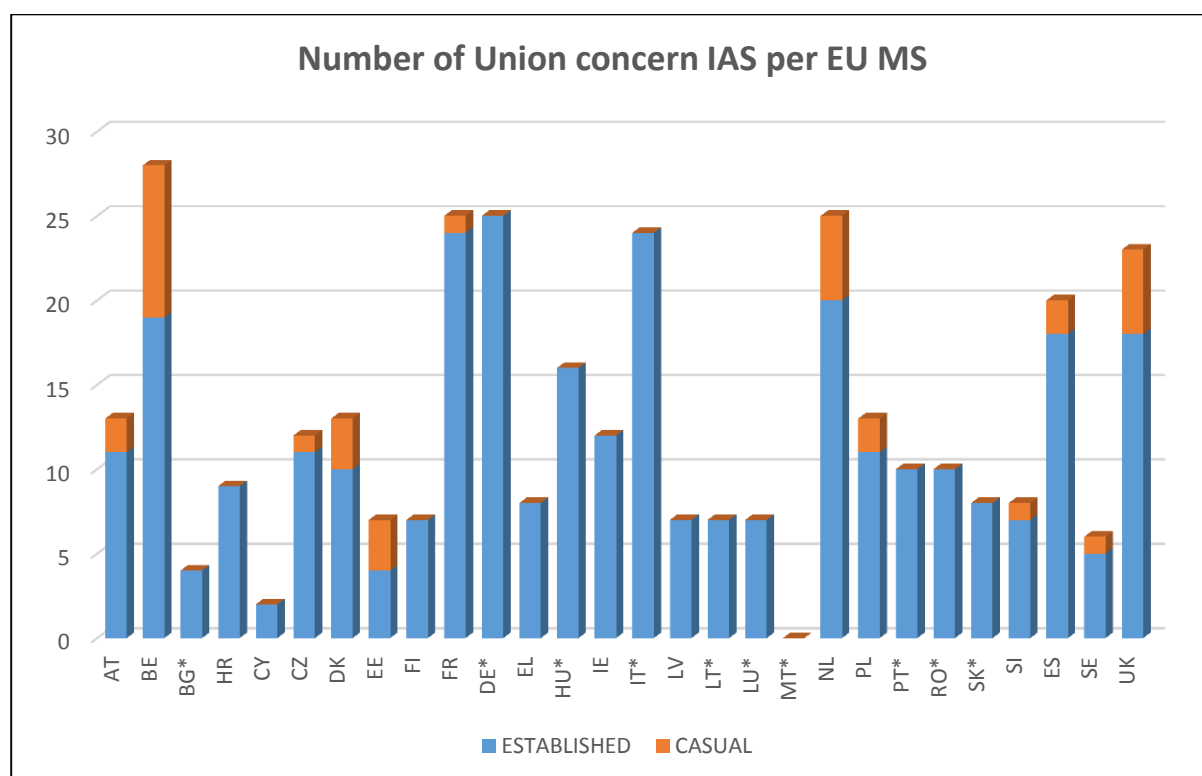


Figure 1. Number of IAS of Union concern per EU MS. Both established and casual country-level records are depicted. Information corresponding to MS marked with * comes only from EASIN. In these cases there is no distinction between established and casual records.

Table 3. IAS of Union concern per EU MS. E=established populations, C=casual occurrences. Information corresponding to MS marked with * and grey-shaded comes only from EASIN datasets. In these cases there is no distinction between established and casual records (all marked as Present = "P"). For *Trachemys scripta* three subspecies are included: *T. scripta scripta*, *T. scripta elegans*, and *T. scripta troostii*.

SPECIES NAME	AT	BE	BG*	HR	CY	CZ	DK	EE	FI	FR	DE*	EL	HU*	IE	IT*	LV	LT*	LU*	MT*	NL	PL	PT*	RO*	SK*	SI	ES	SE	UK	
<i>Baccharis halimifolia</i>		E								E					P											E		E	
<i>Cabomba caroliniana</i>	E	E					E			E	P		P							E	E							E	E
<i>Callosciurus erythraeus</i>		C								E					P					E									
<i>Corvus splendens</i>										C		E	P			E				E	E						C		
<i>Eichhornia crassipes</i>		C				E				E	P		P		P					C		P	P			E		C	
<i>Eriochoir sinensis</i>	C	E				E	C	C	E	E	P		P	E	P	E	P	P		E	E	P	P	P		E	E	E	
<i>Heracleum persicum</i>						E	E	E	E																		E	E	
<i>Heracleum sosnowskyi</i>							E	E	E		P		P			E	P				E		P	P					
<i>Herpestes javanicus</i>				E																									
<i>Hydrocotyle ranunculoides</i>		E								E	P		P		P					E						E		E	
<i>Lagarosiphon major</i>	E	E								E	P		P	E	P					E		P				E		E	
<i>Lithobates catesbeianus</i>		E								E	P	E			P										E			E	
<i>Ludwigia grandiflora</i>		E								E	P		P	E	P					E						E		E	
<i>Ludwigia peploides</i>		E								E		E			P					E						E			

<i>Lysichiton americanus</i>		E				E	C	E	E	P			E					E					E	E		
<i>Muntiacus reevesi</i>		E				E							E					E						E		
<i>Myocastor coypus</i>	E	E	P	E		E	E			E	P	E	P					E	E		P	P	E	E		
<i>Myriophyllum aquaticum</i>	E	E							E	P		P	E	P			P		E		P	P		E	E	
<i>Nasua nasua</i>		C							E	P														E		
<i>Orconectes limosus</i>	E	E	P	E		E				E	P		P		P	E	P	P		E	E		P	P	E	E
<i>Orconectes virilis</i>																			E						E	
<i>Oxyura jamaicensis</i>	E	E				E	C		E	E	P		P	E	P				E	C	P			C	E	
<i>Pacifastacus leniusculus</i>	E	E		E		E	E	E	E	E	P	E	P		P	E	P	P		E	E	P		P	E	E
<i>Parthenium hysterophorus</i>		C																								
<i>Percottus glenii</i>			P	E					E		P		P						E			P	P			
<i>Persicaria perfoliata</i>																										
<i>Procambarus clarkii</i>	E	E			E					E	P			P					E		P				E	
<i>Procambarus fallax</i> f. <i>virginalis</i>				E		E					P			P					E				P			
<i>Procyon lotor</i>	E	E		E		E	E			E	P		P	E	P		P	P		C	E		P	P	E	E
<i>Pseudorasbora parva</i>	E	E		E		E	E			E	P	E	P		P	P			E	E		P			E	
<i>Pueraria montana</i> var. <i>lobata</i>														P												

<i>Sciurus carolinensis</i>		C									P			E	P					C							E	
<i>Sciurus niger</i>		C																										
<i>Tamias sibiricus</i>		E							E	P			E	P					E						C		C	
<i>Threskiornis aethiopicus</i>	C	C				C	C		E	P	E			P	E				C	C	P				E		C	
<i>Trachemys scripta*</i>	E	C	P	E	E	E	E	C	E	E	P	E		E	P	E		P		C	E	P	P		E	E	C	C
<i>Vespa velutina nigrithorax</i>		C							E	P				P							P				E			

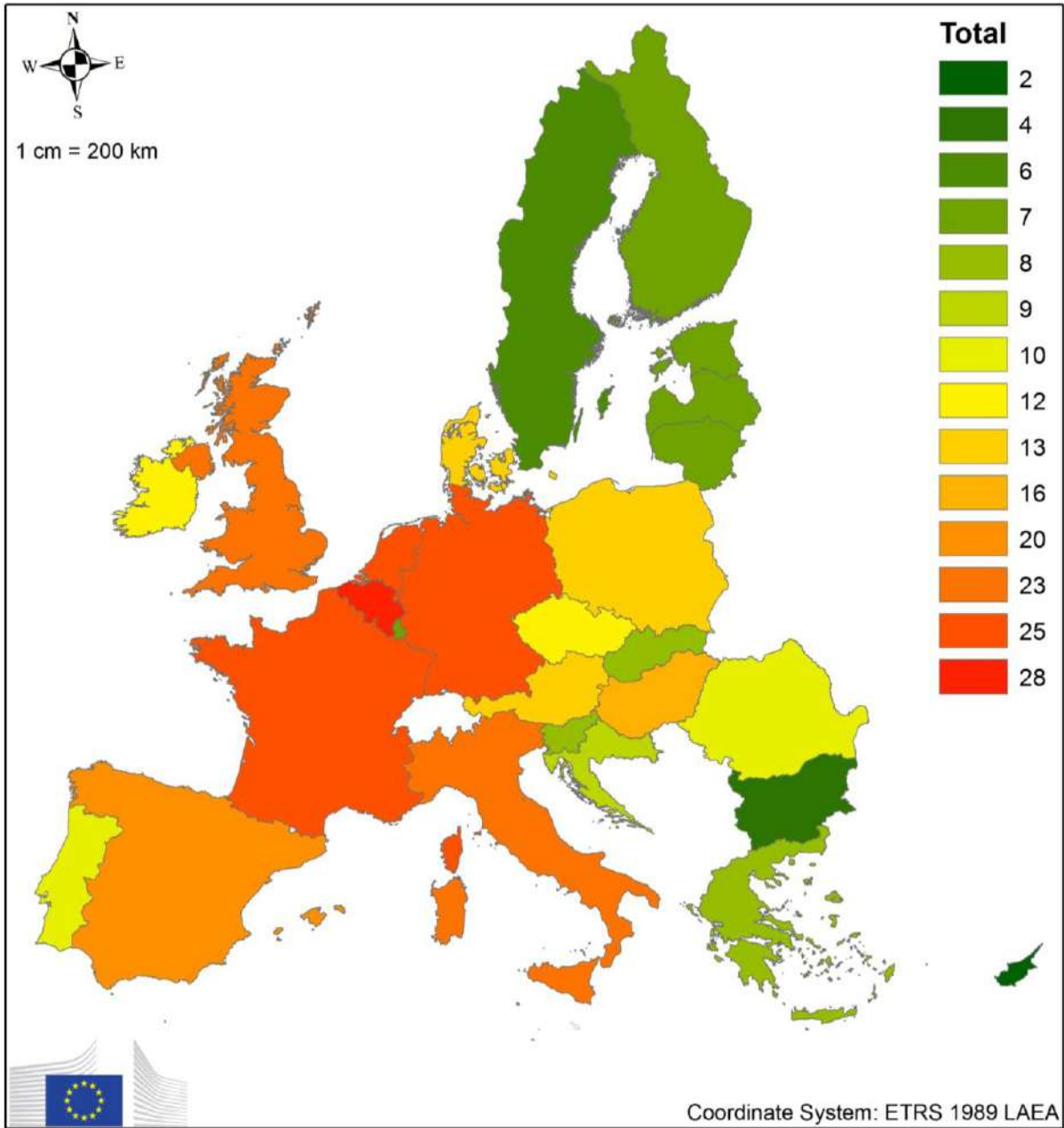


Figure 2. Cumulative number of IAS of Union concern per EU MS. Both established and casual country-level records per country are included in the analysis.

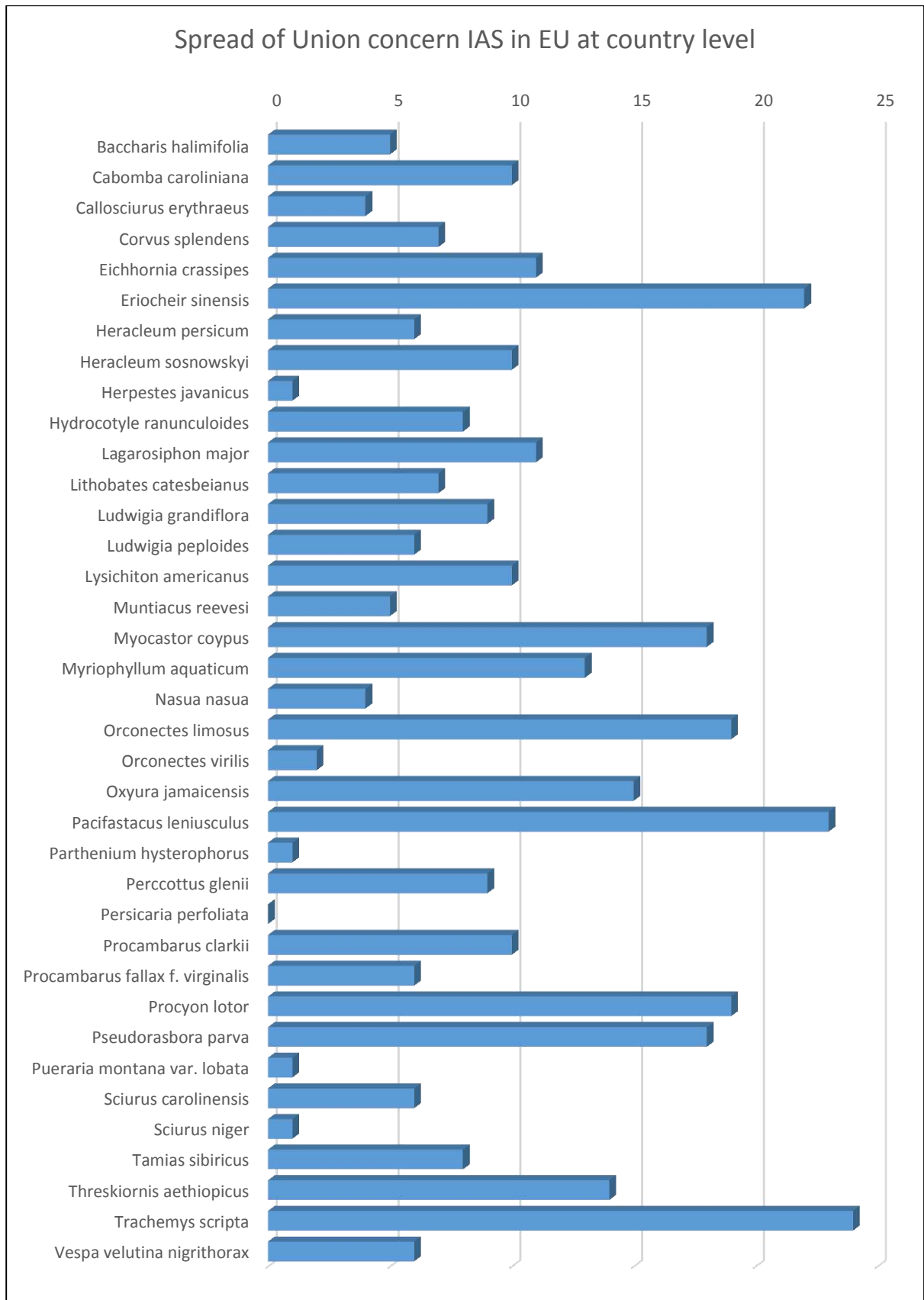


Figure 3. Number of MS where each IAS of Union concern has been reported. Both established and casual country-level records per country are included in the analysis.

3.2. Baseline distribution at grid level

The overall grid-level baseline of all IAS of Union concern in Europe is presented in Figure 4. Dense grid level occurrences have been reported mostly from BE, UK, FR, and NL, based on the available georeferenced information for each MS. The species *Procyon lotor*, *Orconectes limosus* and *Sciurus carolinensis* show the highest spread in all EU in terms of number of occurrences at grid level (10x10 km) (Figure 5). On the other hand, limited spread characterises the species *Parthenium hysterophorus*, *Sciurus niger*, *Procambarus fallax* f. *virginalis* and *Callosciurus erythraeus* (Figure 5). The overall grid-level (10x10 km) baseline distributions across EU for each IAS of Union concern are depicted in Figures 6-41, with the exception of *Persicaria perfoliata* which has not been found across EU by 2017.

Important Note: Detailed spatial information at grid level 10x10 km as well as original sources are provided for each IAS of Union concern and for each EU country in Annex II.

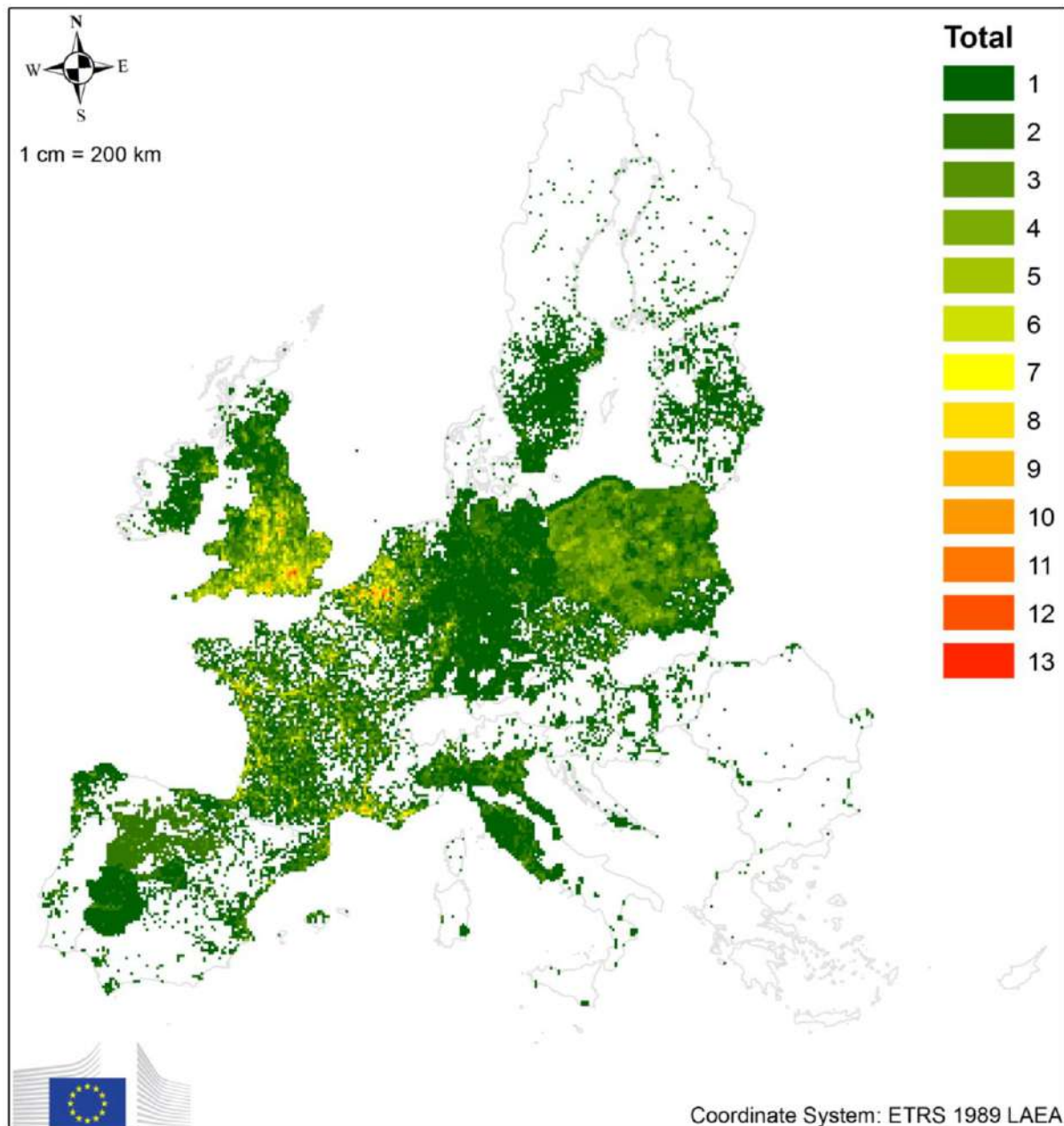


Figure 4. Cumulative number of IAS of Union concern at grid level (per single 10x10 km grid pixel) in EU, based on the available georeferenced information for each MS.

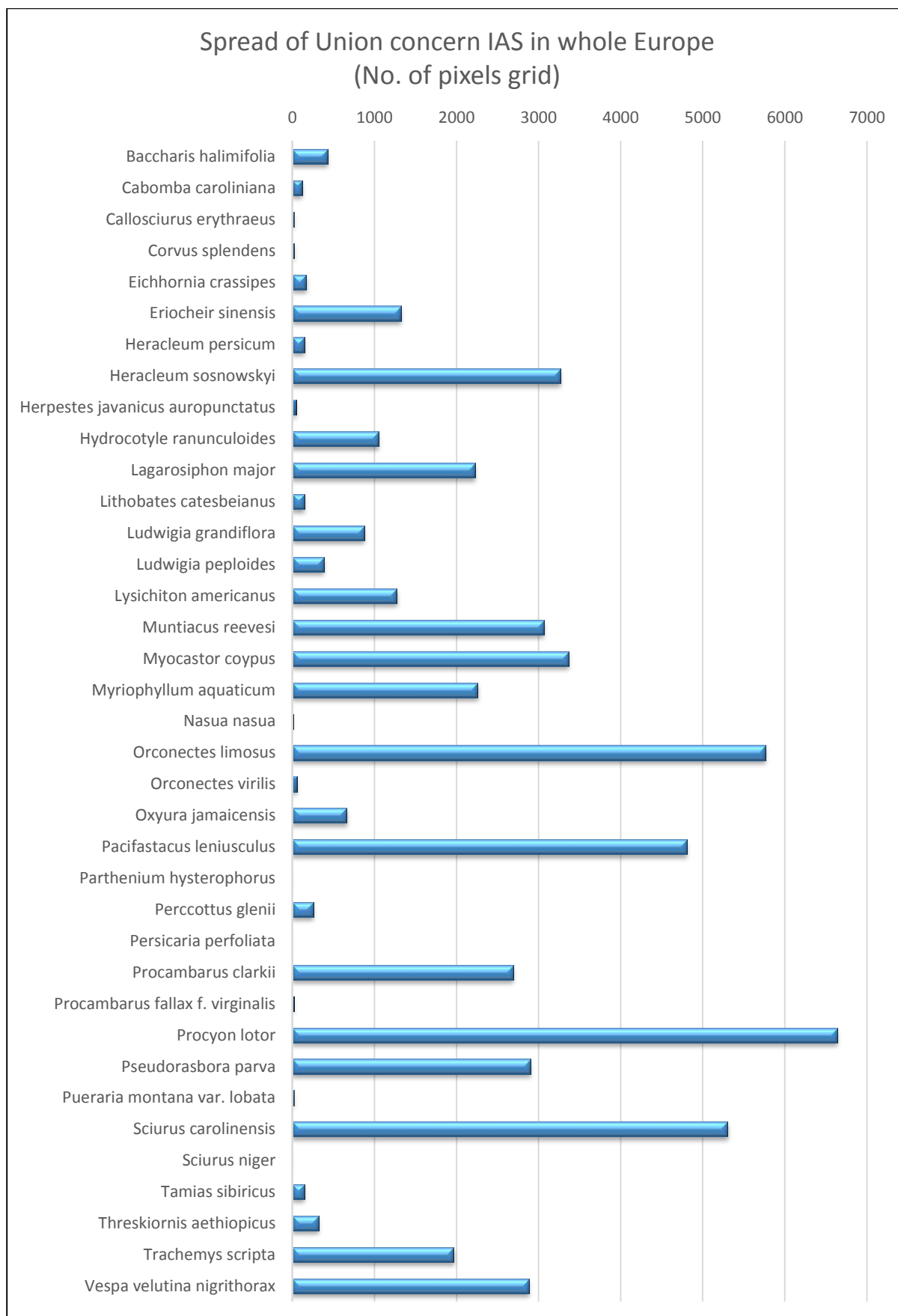


Figure 5. Number of grid cells (10x10 km) where each IAS of Union concern has been reported in EU, based on the available georeferenced information.

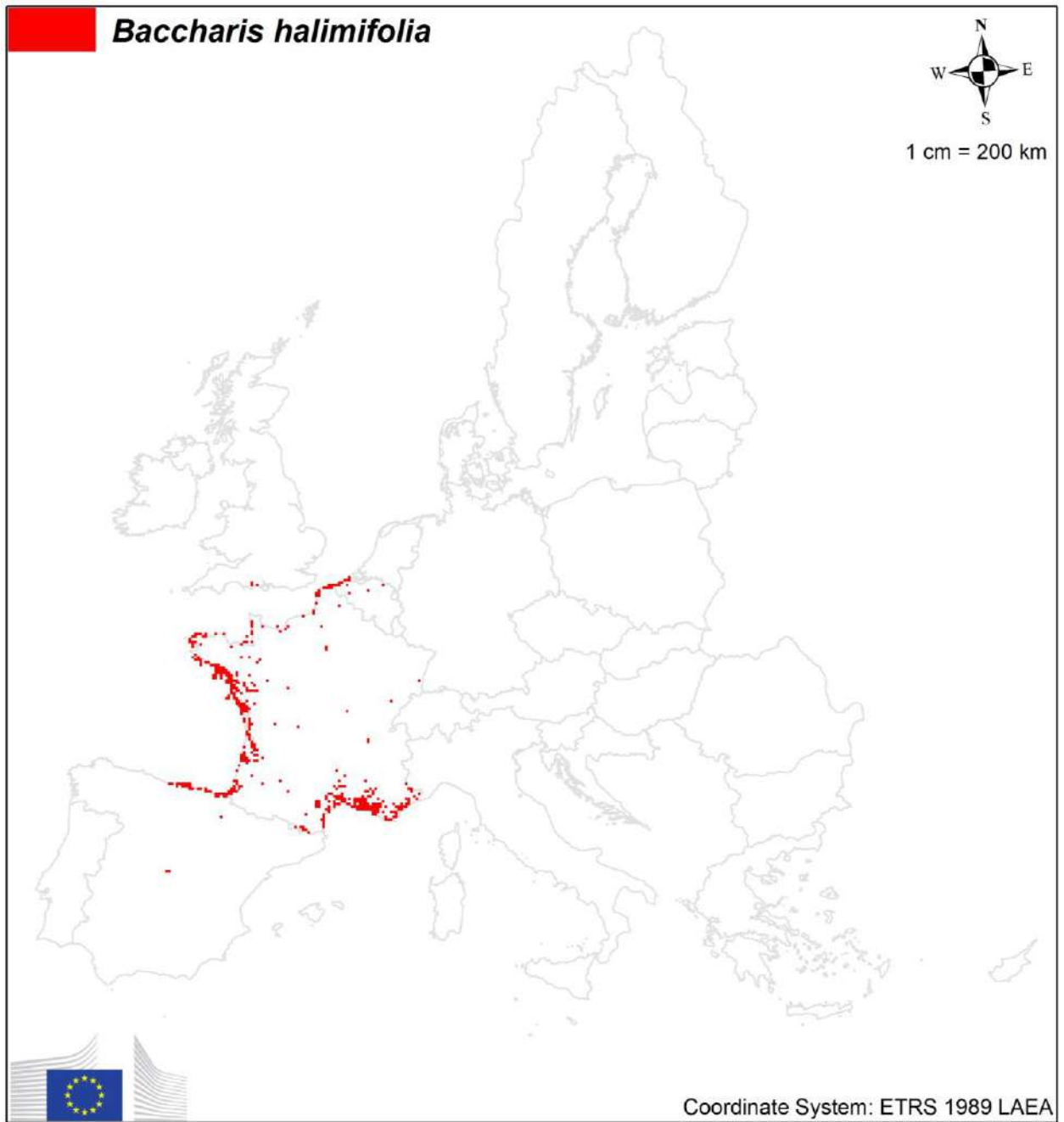


Figure 6. Grid-level (10x10 km) baseline distribution of *Baccharis halimifolia* in EU. The species is also present in IT but no georeferenced data are available.

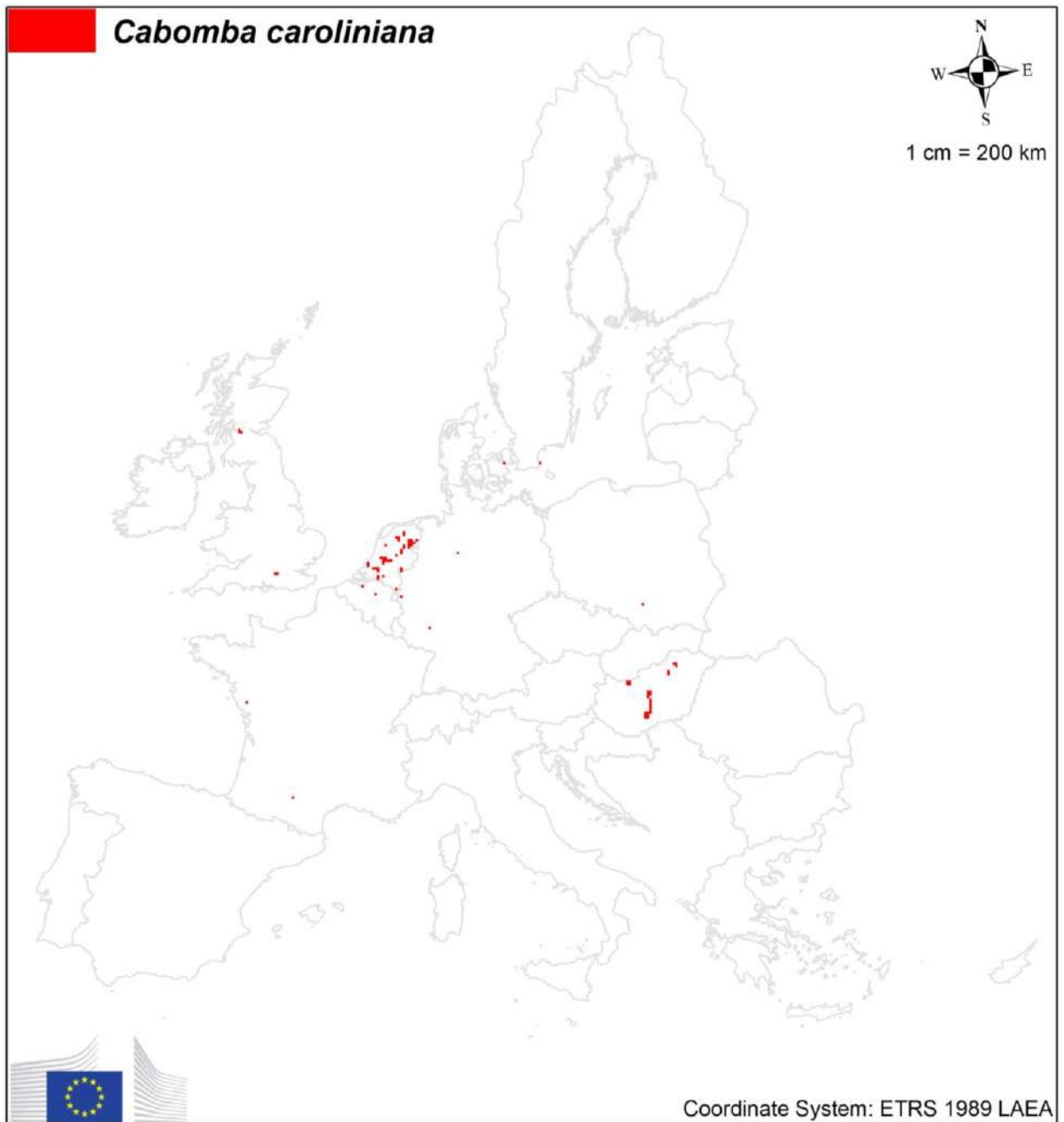


Figure 7. Grid-level (10x10 km) baseline distribution of *Cabomba caroliniana* in EU. The species is also present in AT but no georeferenced data are available.

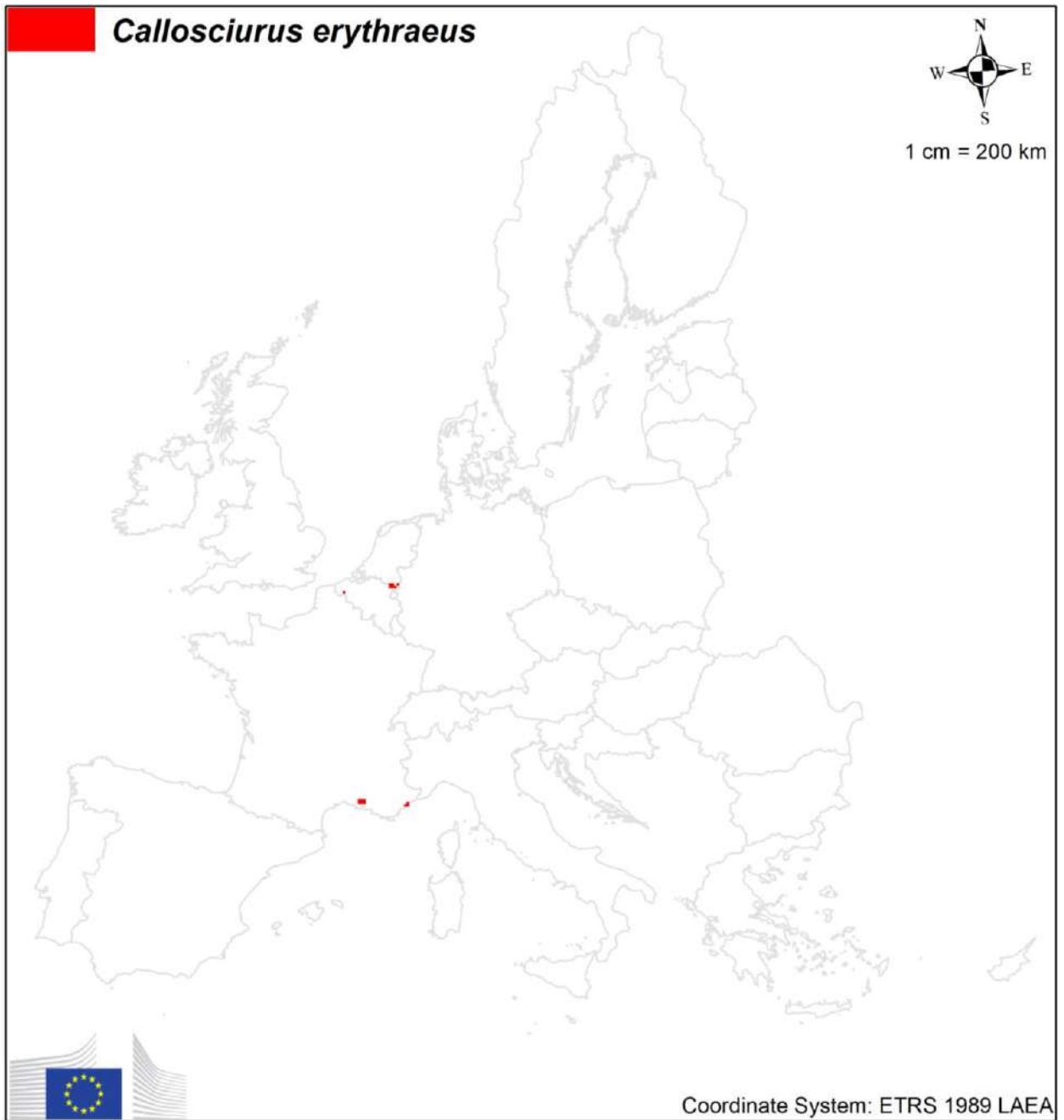


Figure 8. Grid-level (10x10 km) baseline distribution of *Callosciurus erythraeus* in EU. The species is also present in IT but no georeferenced data are available.

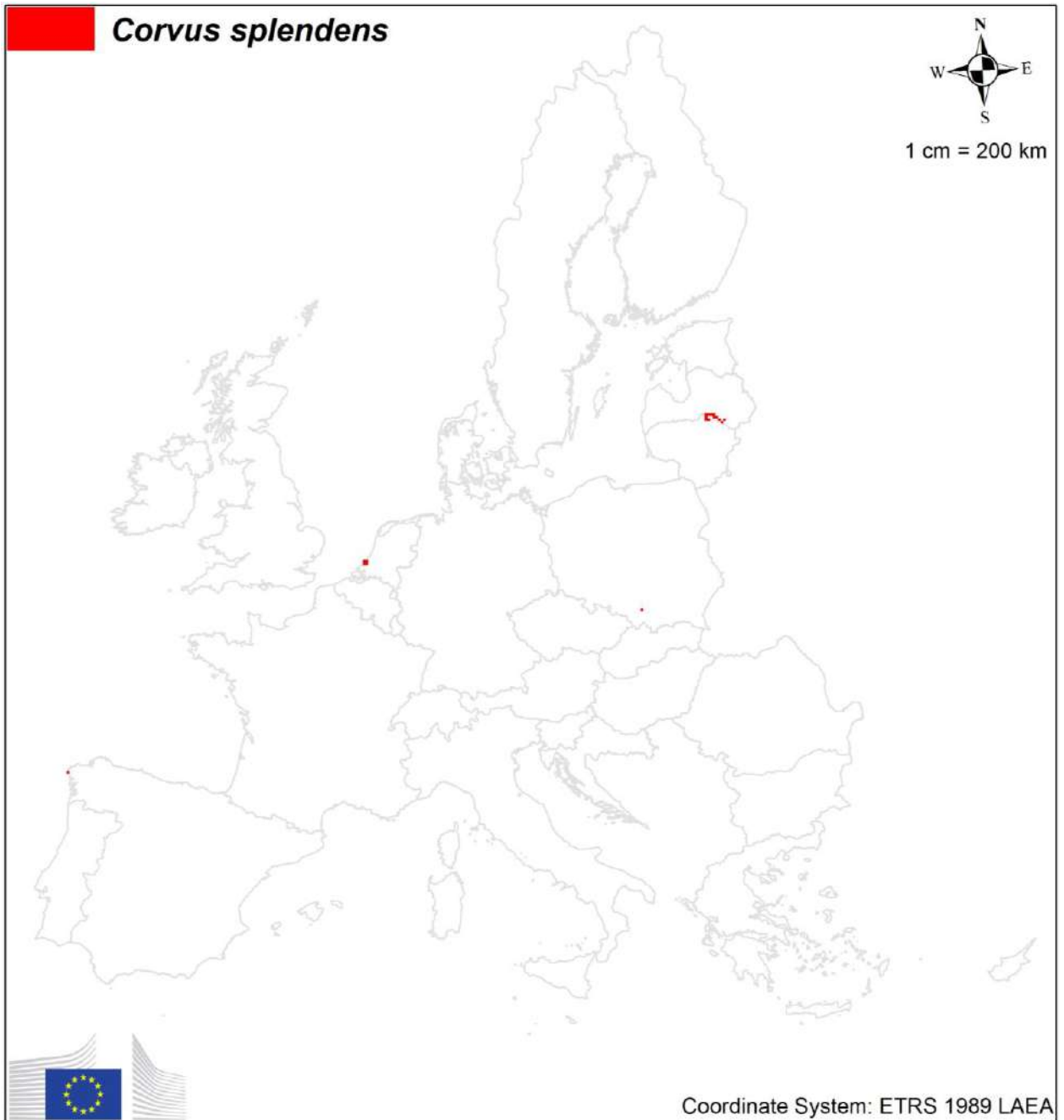


Figure 9. Grid-level (10x10 km) baseline distribution of *Corvus splendens* in EU. The species is also present in FR (Casual), EL and HU but no georeferenced data are available.

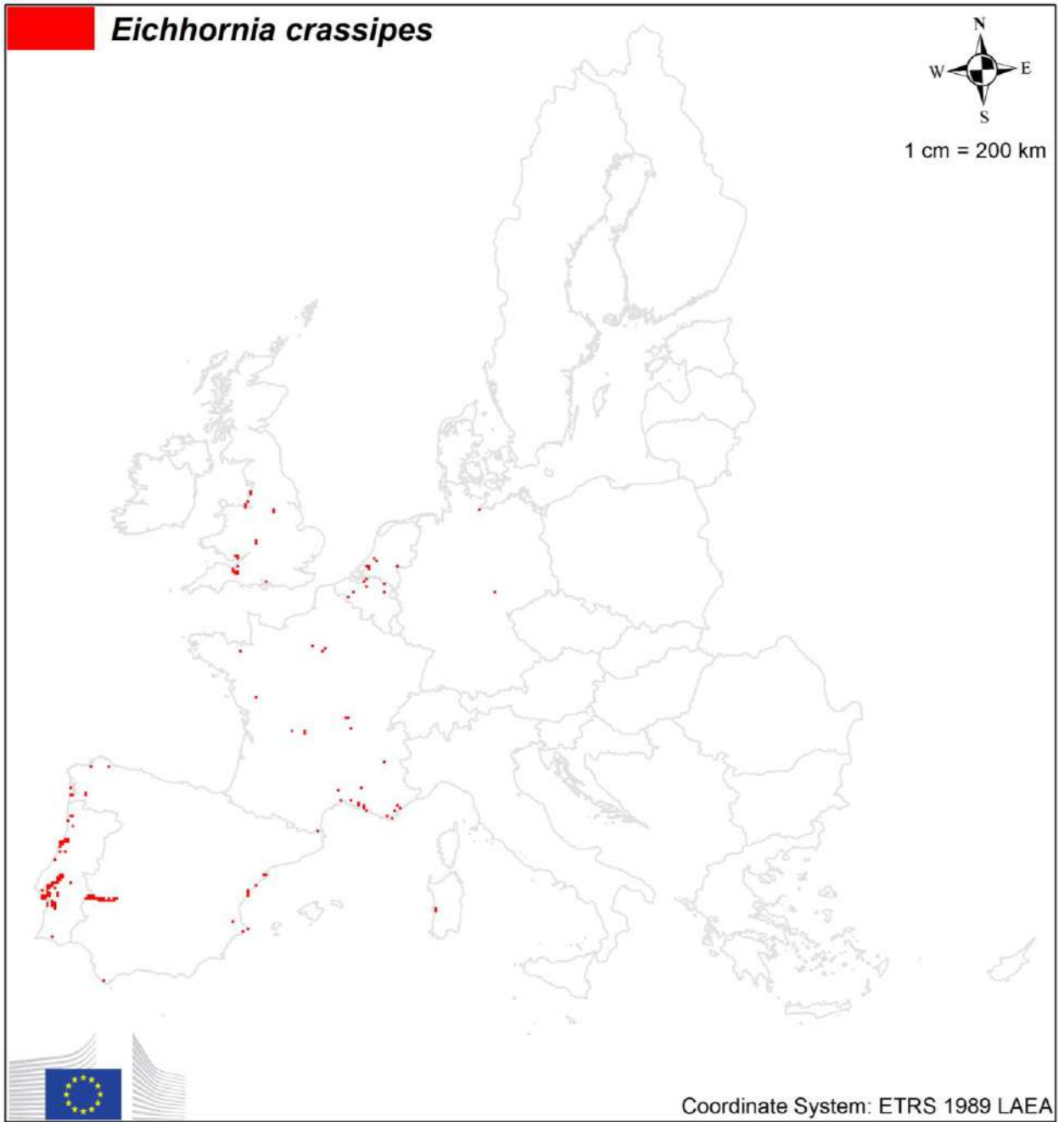


Figure 10. Grid-level (10x10 km) baseline distribution of *Eichhornia crassipes* in EU. The species is also present in CZ, HU and RO but no georeferenced data are available.

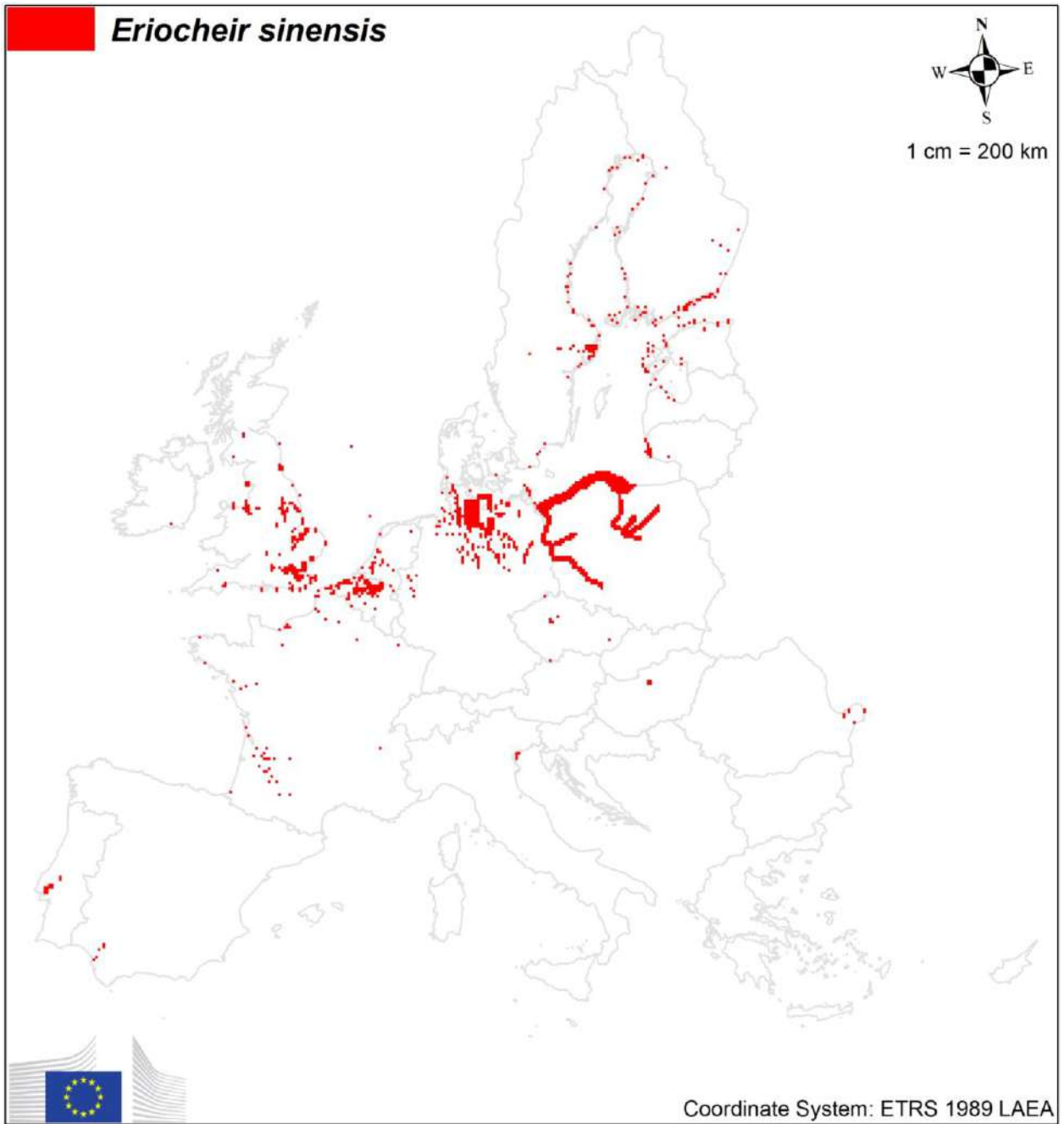


Figure 11. Grid-level (10x10 km) baseline distribution of *Eriocheir sinensis* in EU. The species is also present in AT (Casual), LU and SK but no georeferenced data are available.

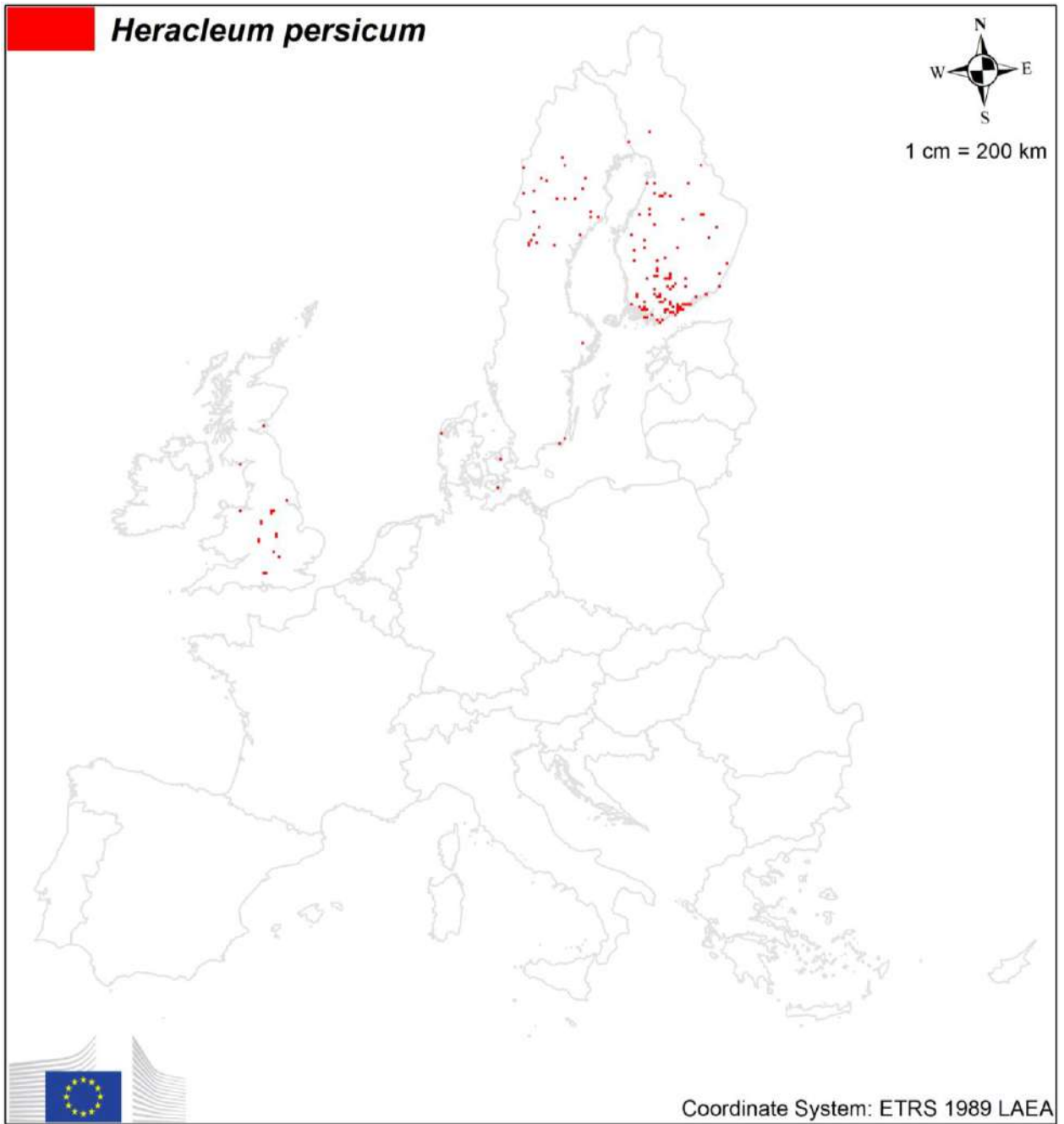


Figure 12. Grid-level (10x10 km) baseline distribution of *Heracleum persicum* in EU. The species is also present in CZ and EE but no georeferenced data are available.

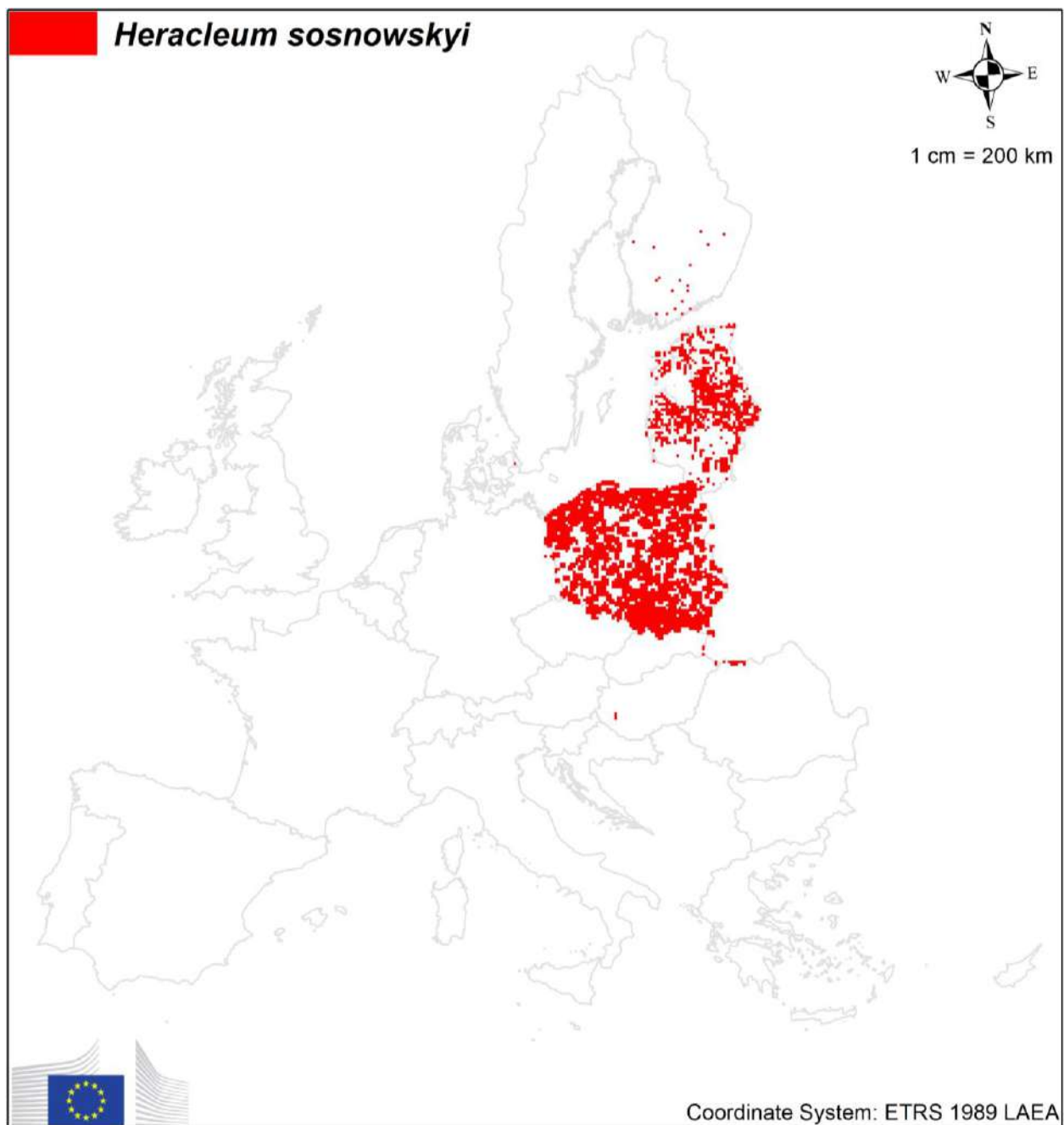


Figure 13. Grid-level (10x10 km) baseline distribution of *Heracleum sosnowskyi* in EU.

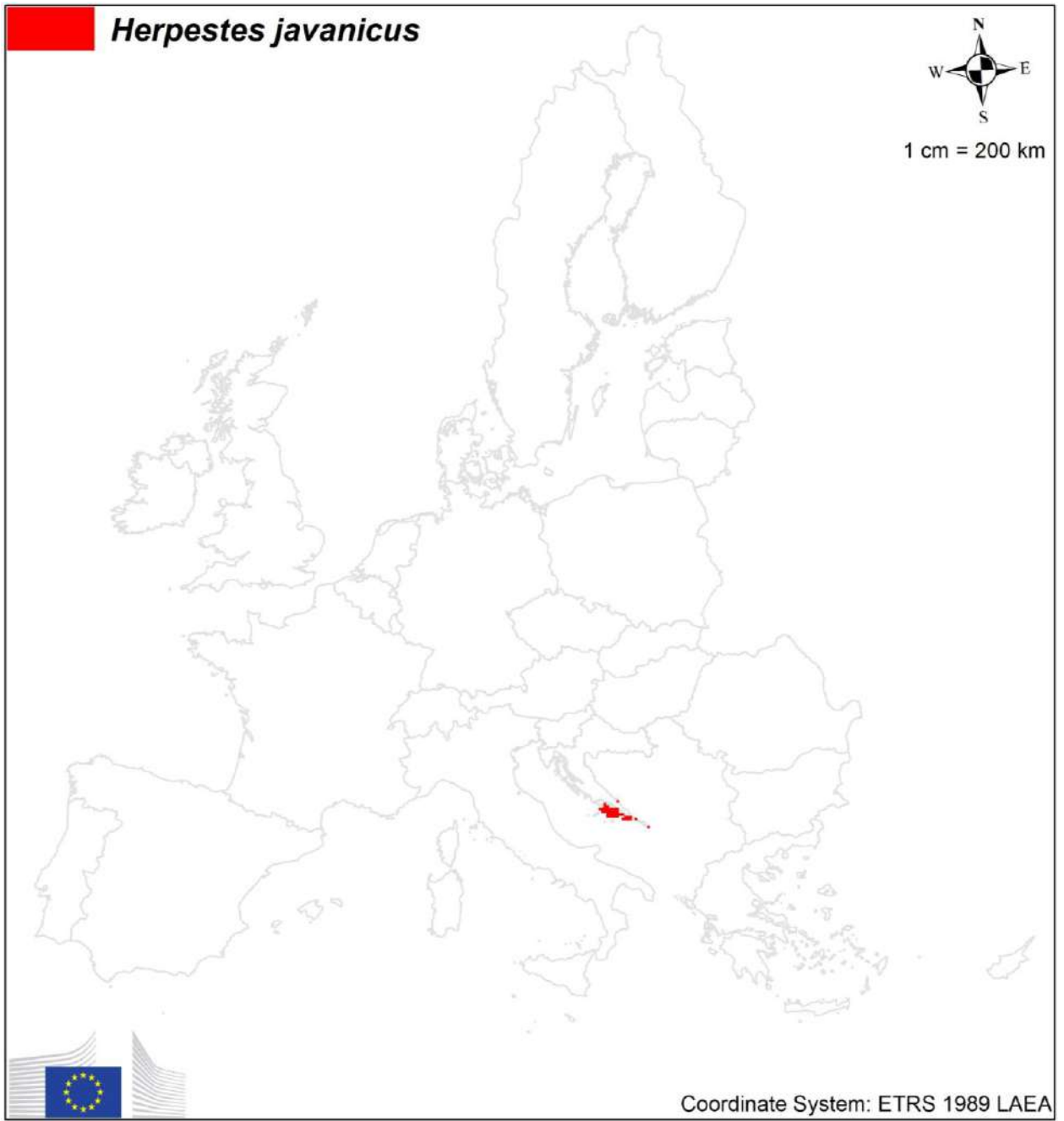


Figure 14. Grid-level (10x10 km) baseline distribution of *Herpestes javanicus* in EU.

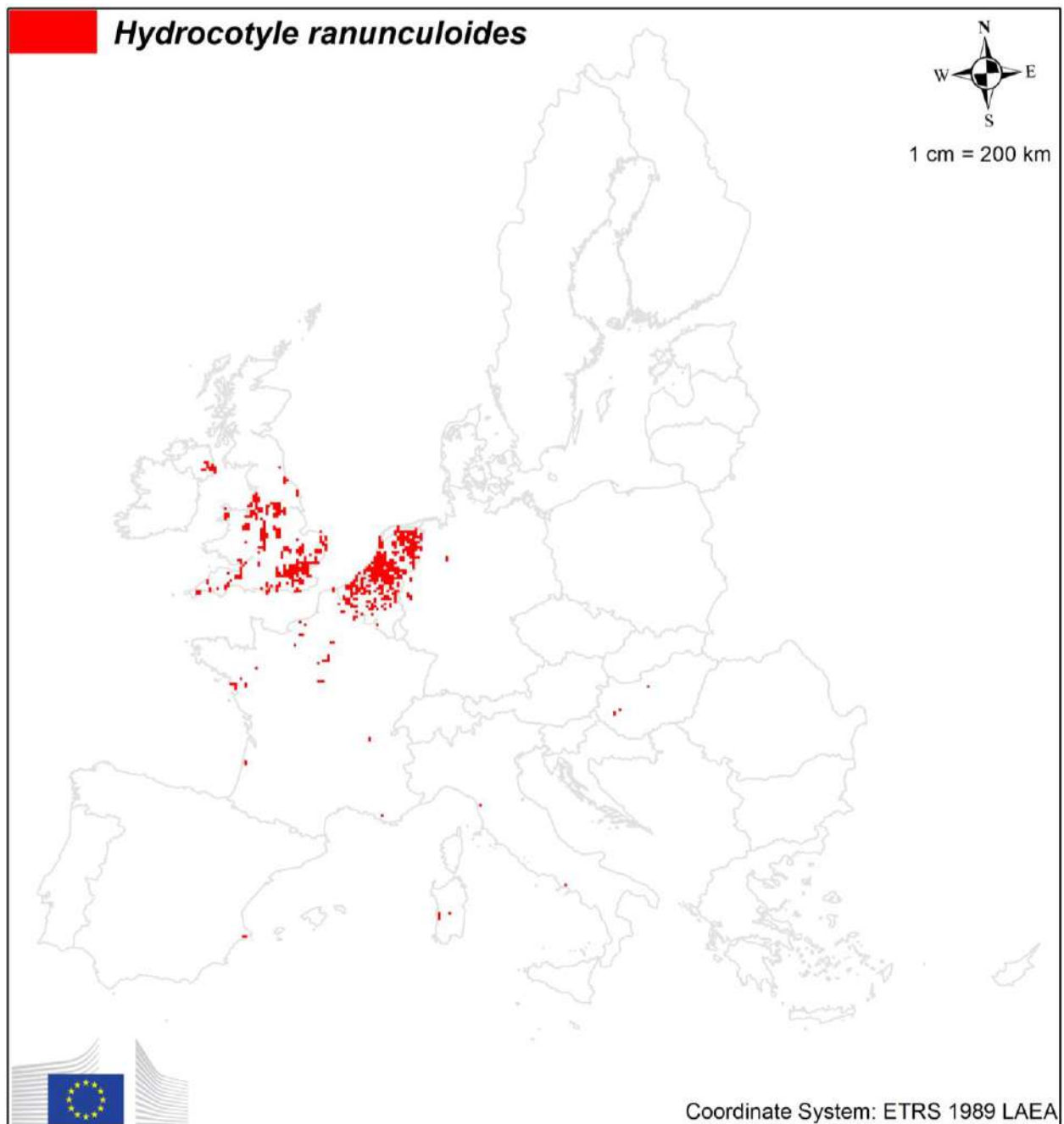


Figure 15. Grid-level (10x10 km) baseline distribution of *Hydrocotyle ranunculoides* in EU.

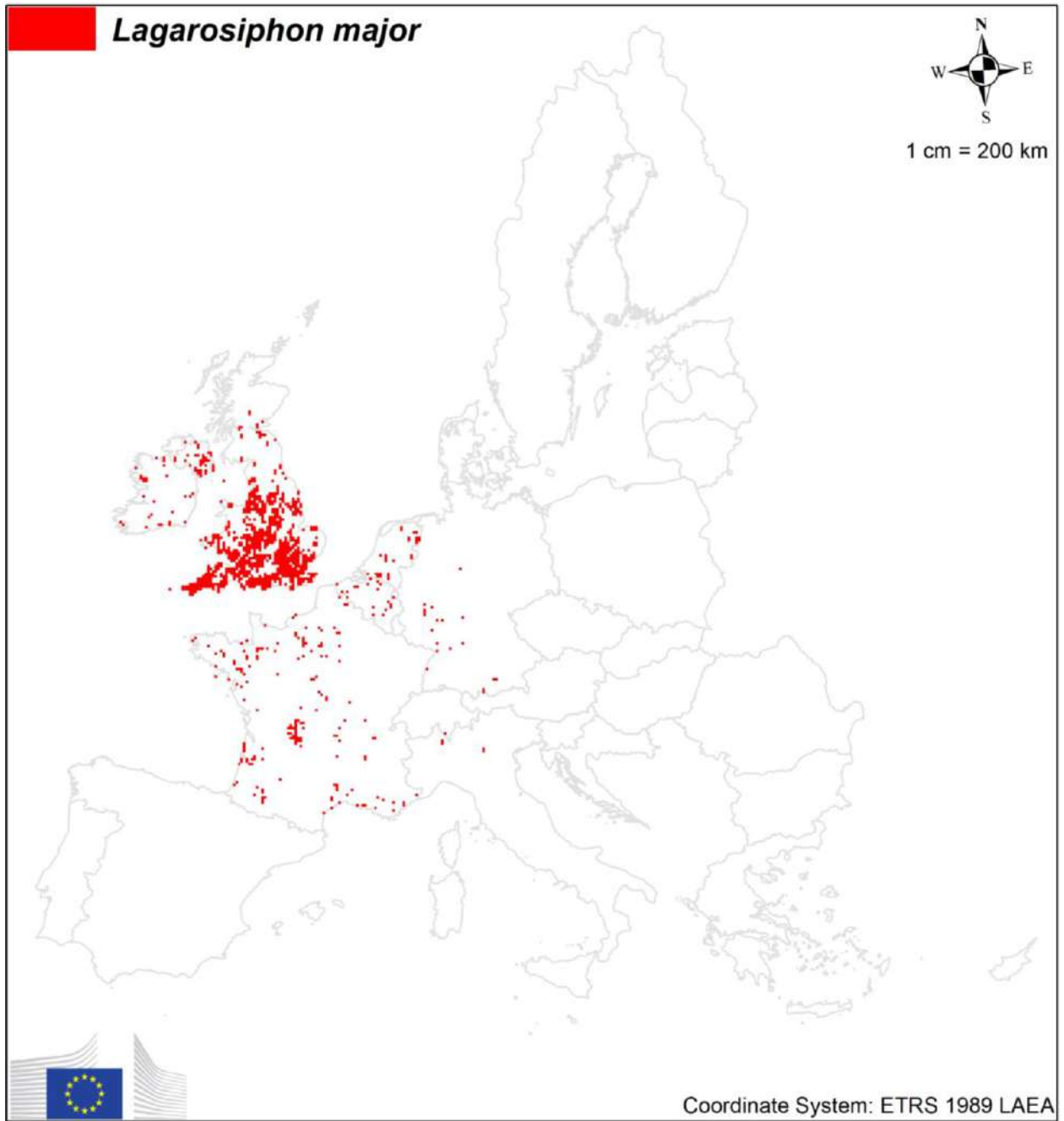


Figure 16. Grid-level (10x10 km) baseline distribution of *Lagarosiphon major* in EU. The species is also present in AT, HU, PT and ES but no georeferenced data are available.

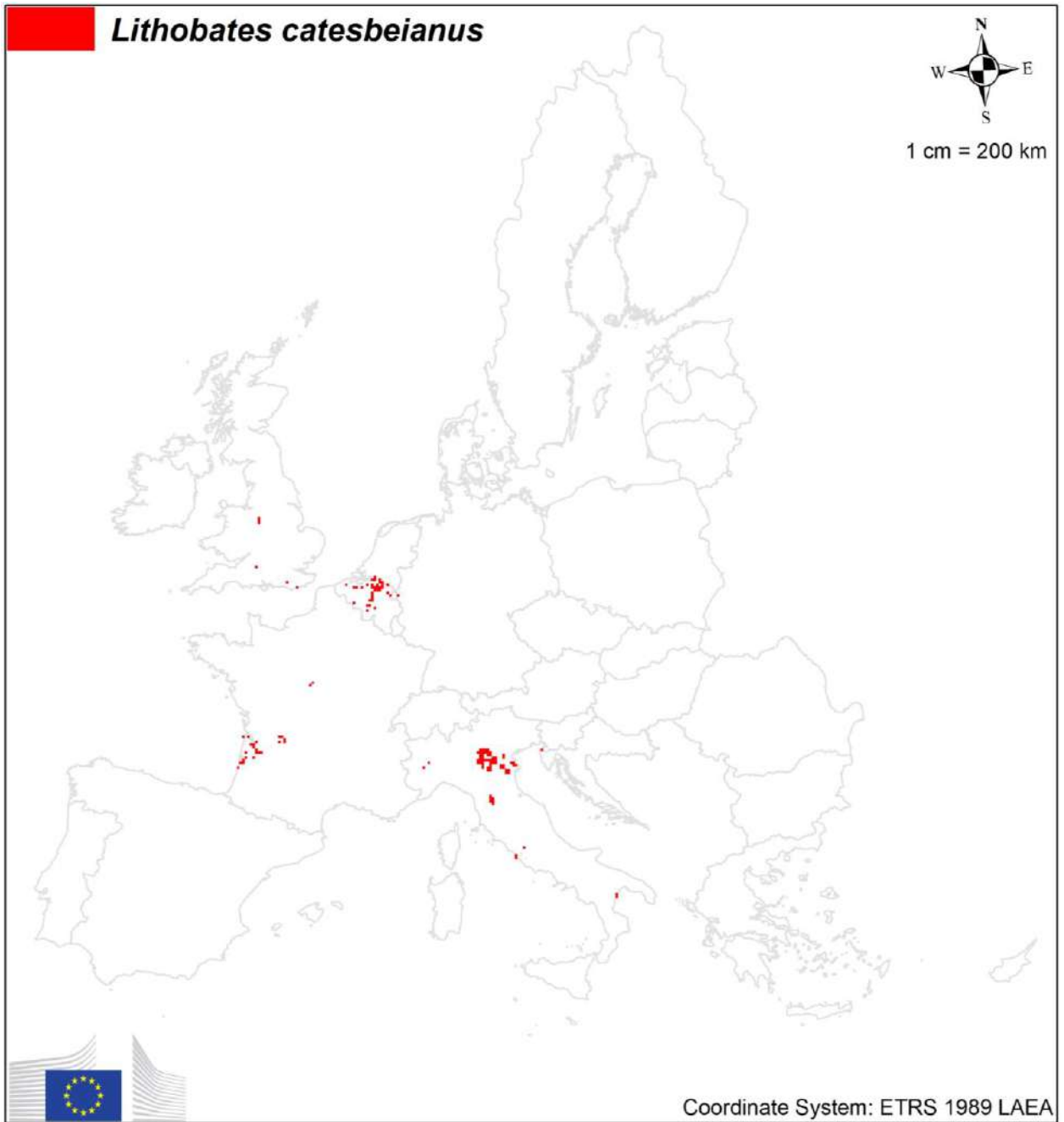


Figure 17. Grid-level (10x10 km) baseline distribution of *Lithobates catesbeianus* in EU. The species is also present in EL but no georeferenced data are available.

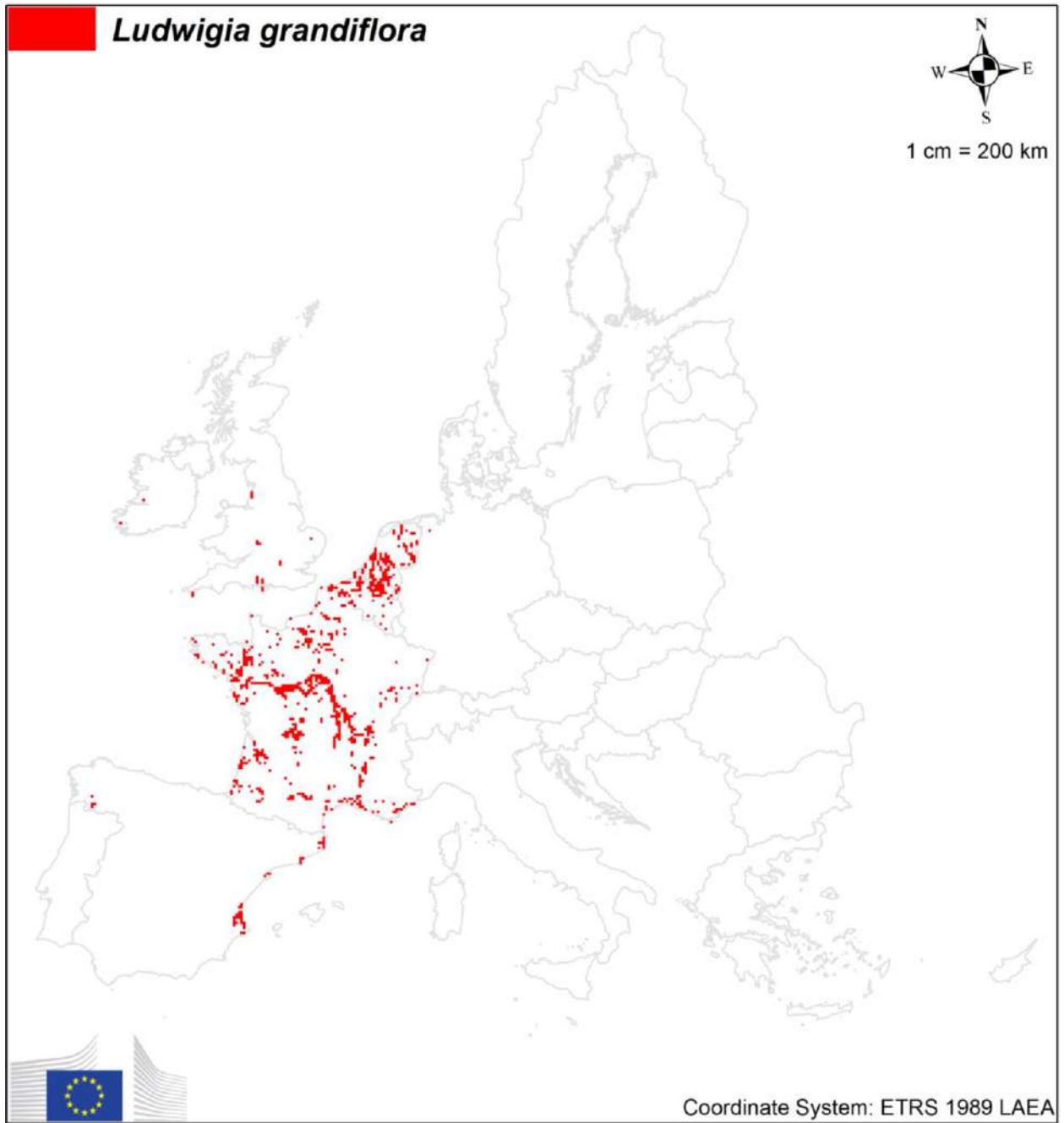


Figure 18. Grid-level (10x10 km) baseline distribution of *Ludwigia grandiflora* in EU. The species is also present in IT and HU but no georeferenced data are available.

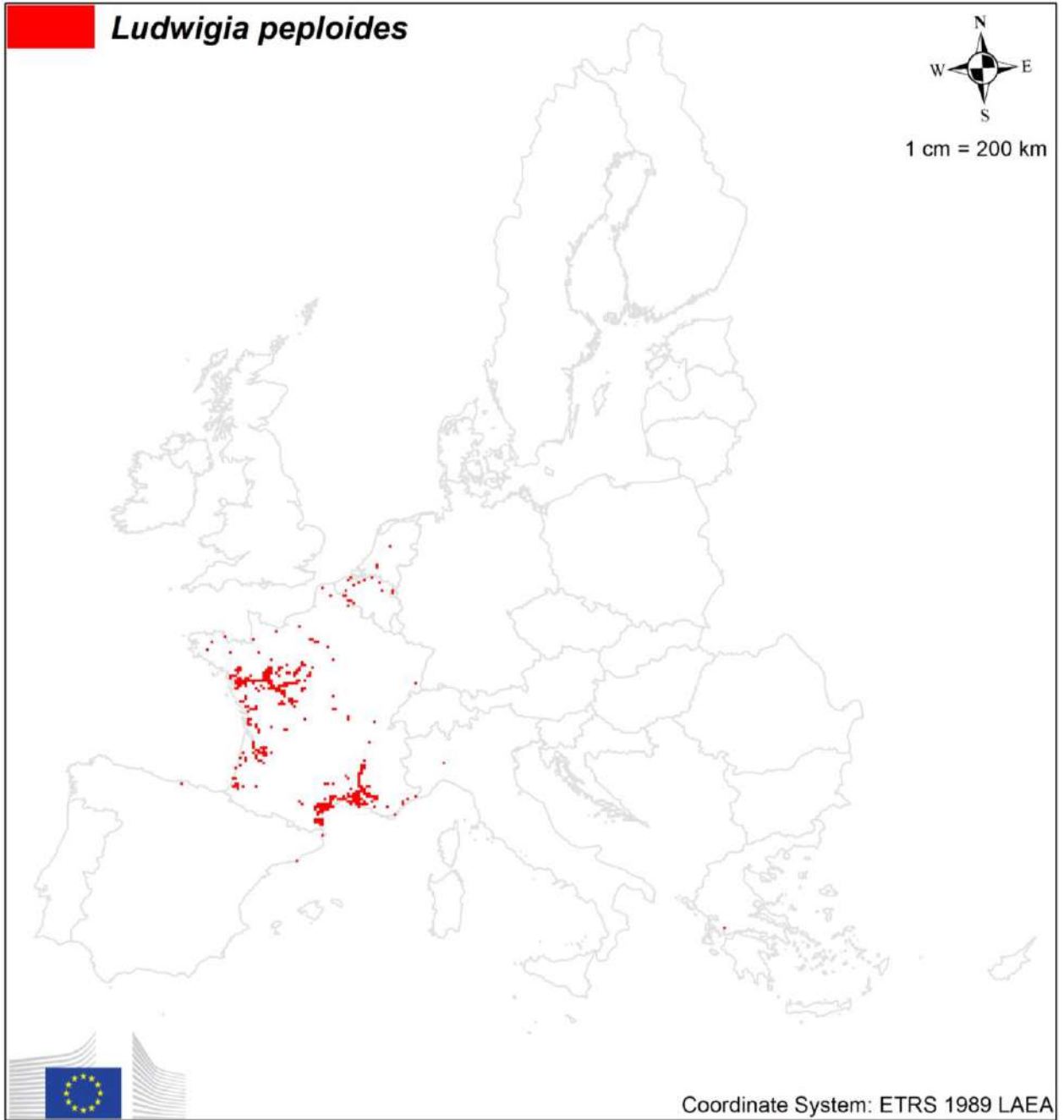


Figure 19. Grid-level (10x10 km) baseline distribution of *Ludwigia peploides* in EU.

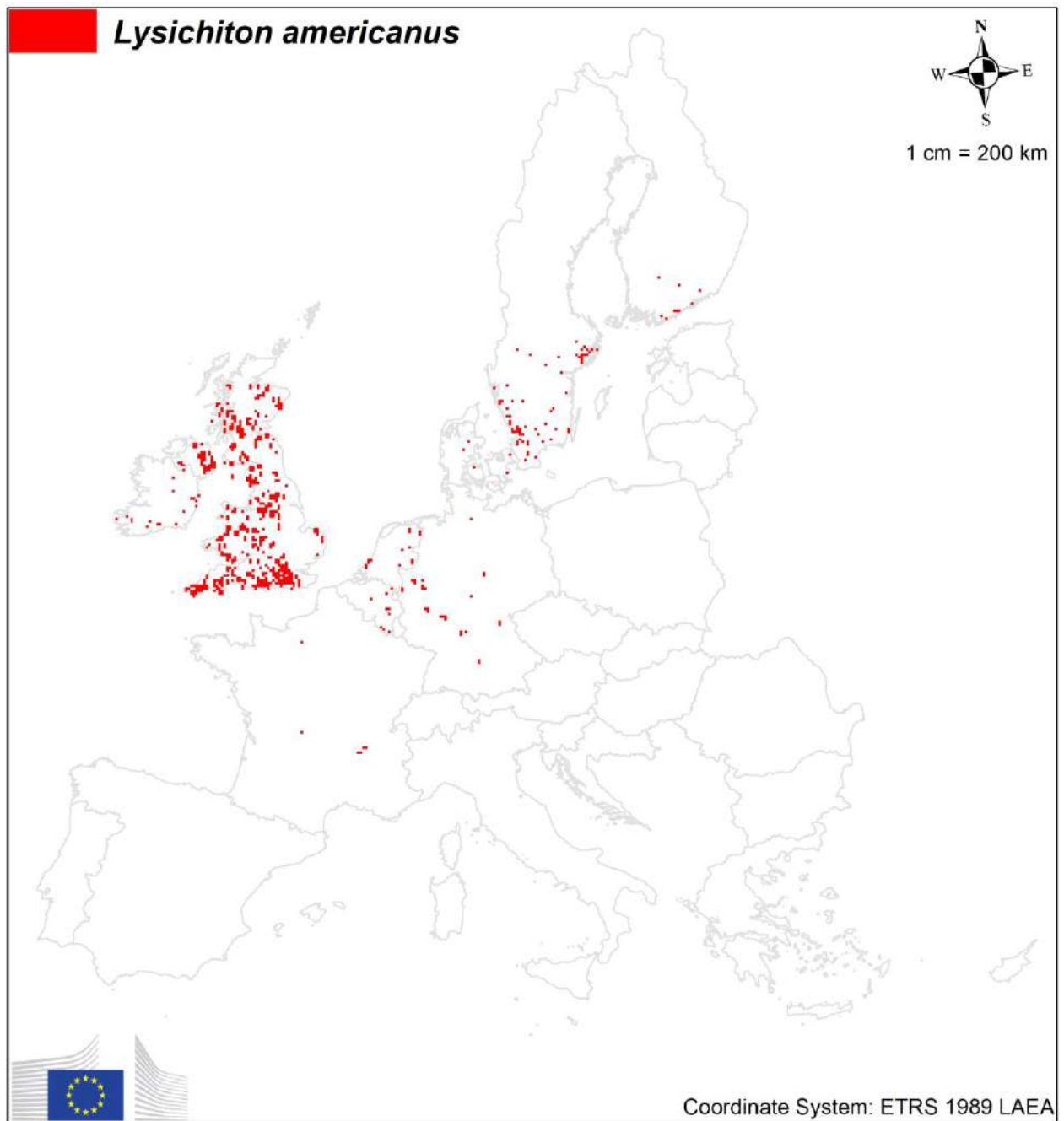


Figure 20. Grid-level (10x10 km) baseline distribution of *Lysichiton americanus* in EU. The species is also present in EE (Casual) but no georeferenced data are available.

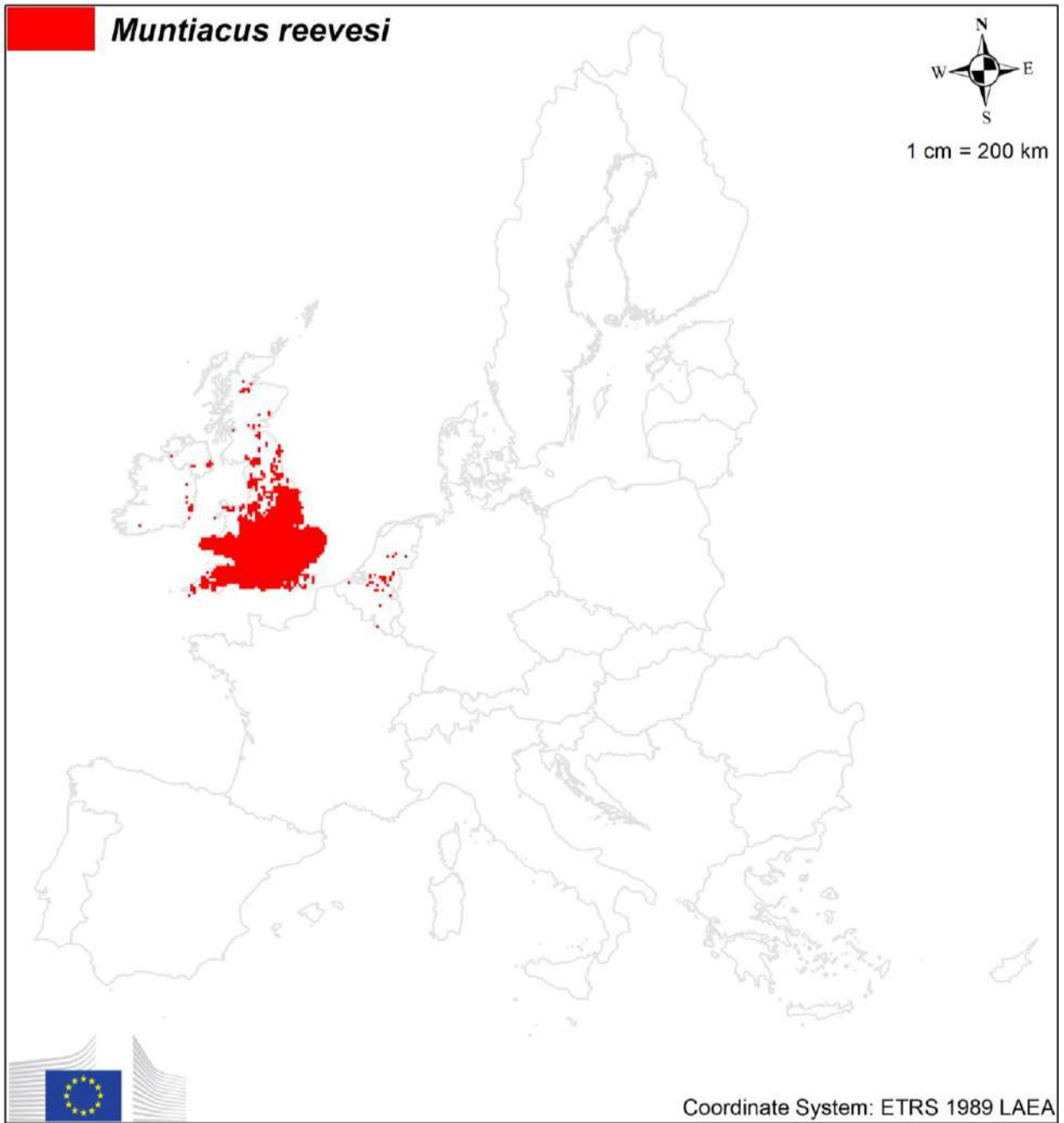


Figure 21. Grid-level (10x10 km) baseline distribution of *Muntiacus reevesi* in EU. The species is also present in DK but no georeferenced data are available.

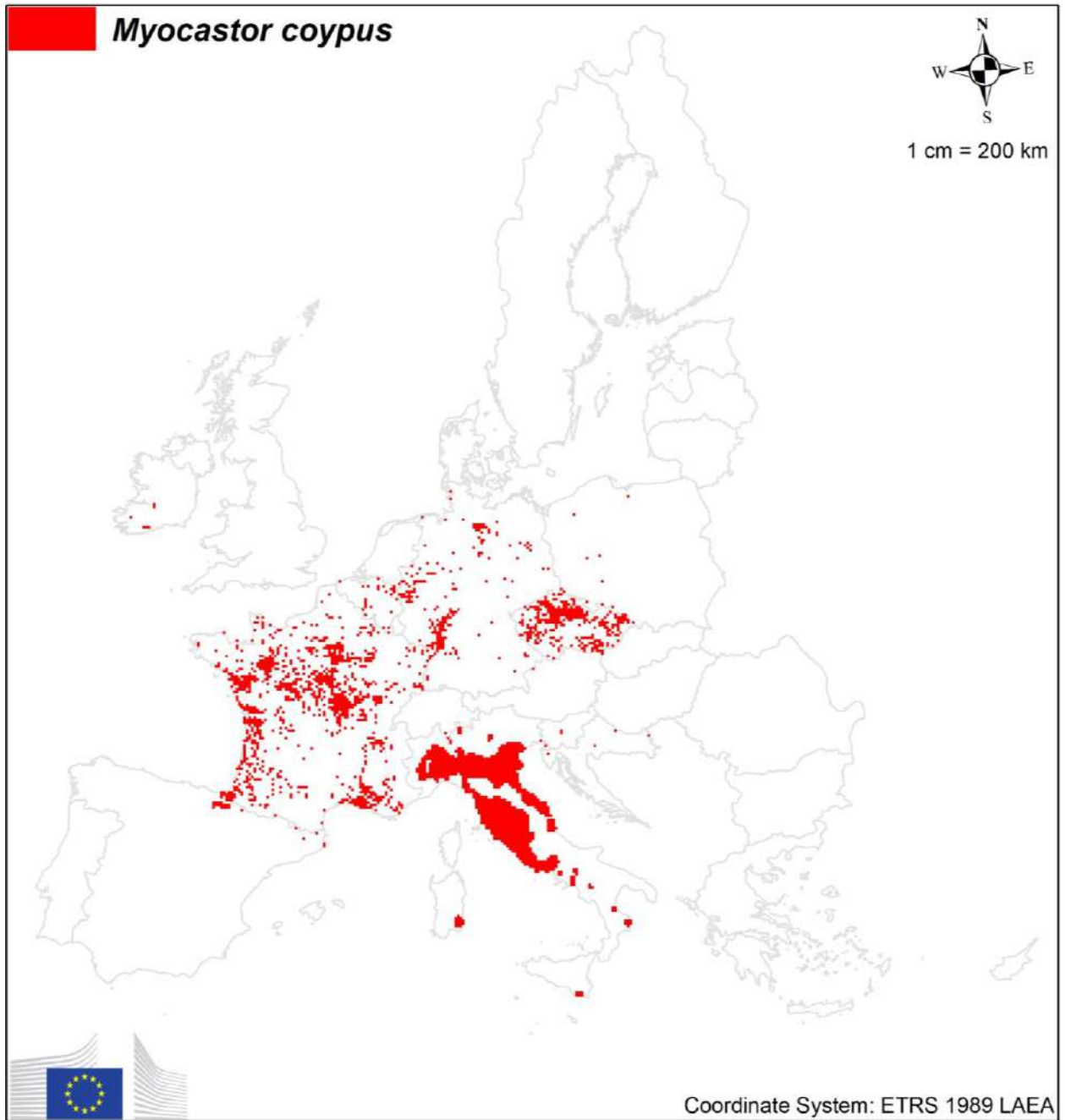


Figure 22. Grid-level (10x10 km) baseline distribution of *Myocastor coypus* in EU. The species is also present in AT, BG, DK, HU, EL, RO and SK but no georeferenced data are available.

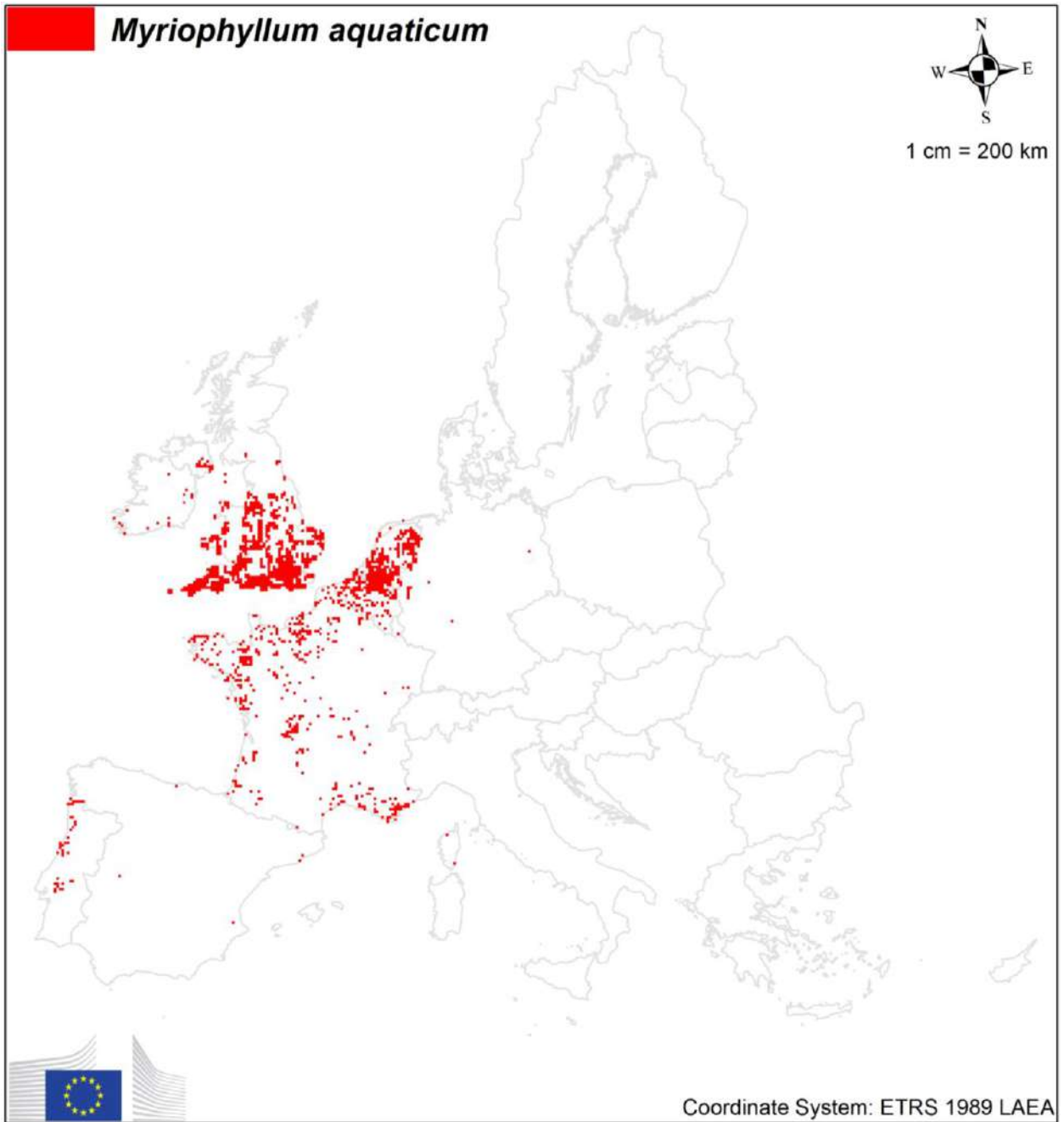


Figure 23. Grid-level (10x10 km) baseline distribution of *Myriophyllum aquaticum* in EU. The species is also present in AT, HU, IT and RO but no georeferenced data are available.

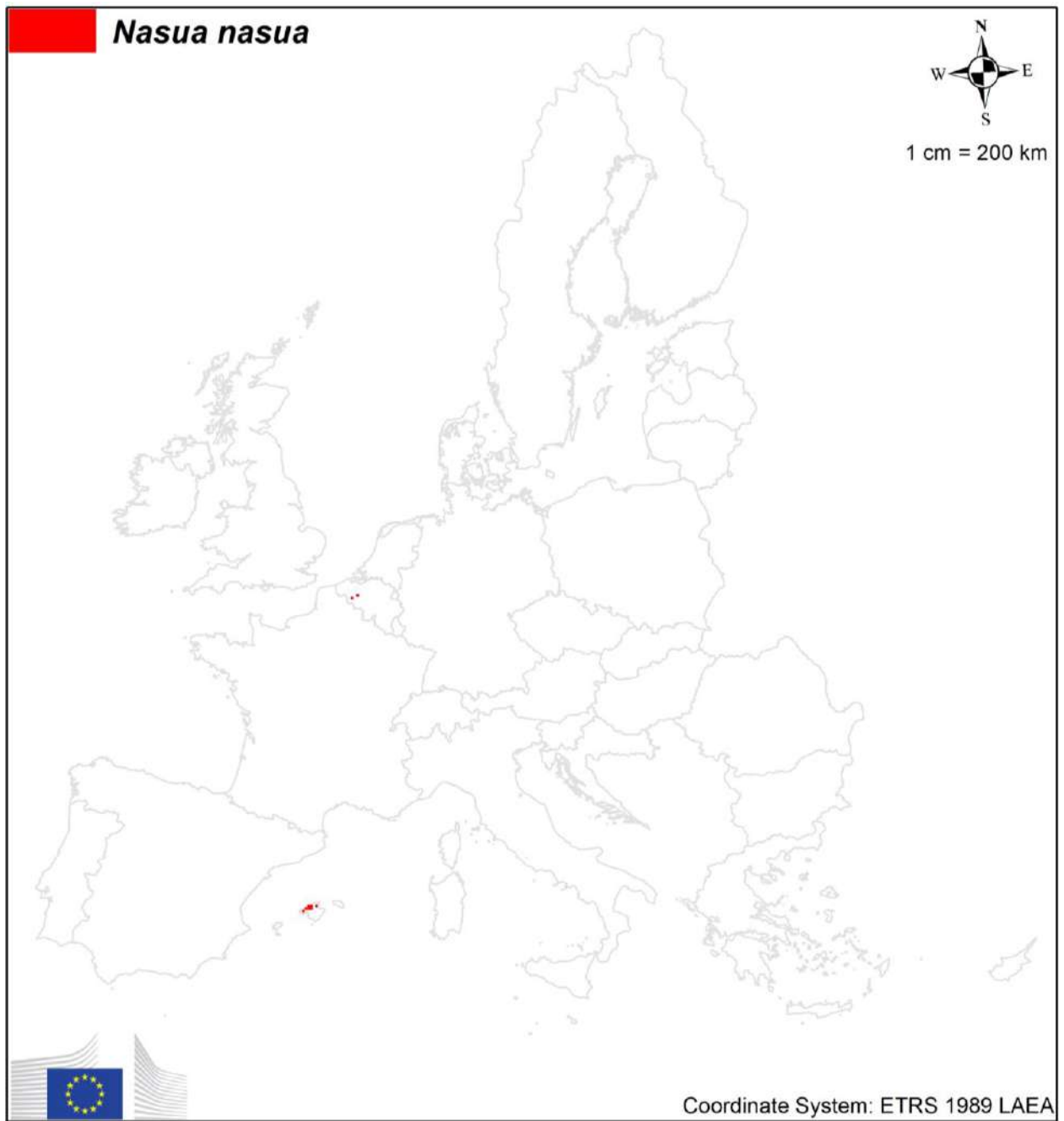


Figure 24. Grid-level (10x10 km) baseline distribution of *Nasua nasua* in EU. The species is also present in FR and DE but no georeferenced data are available.

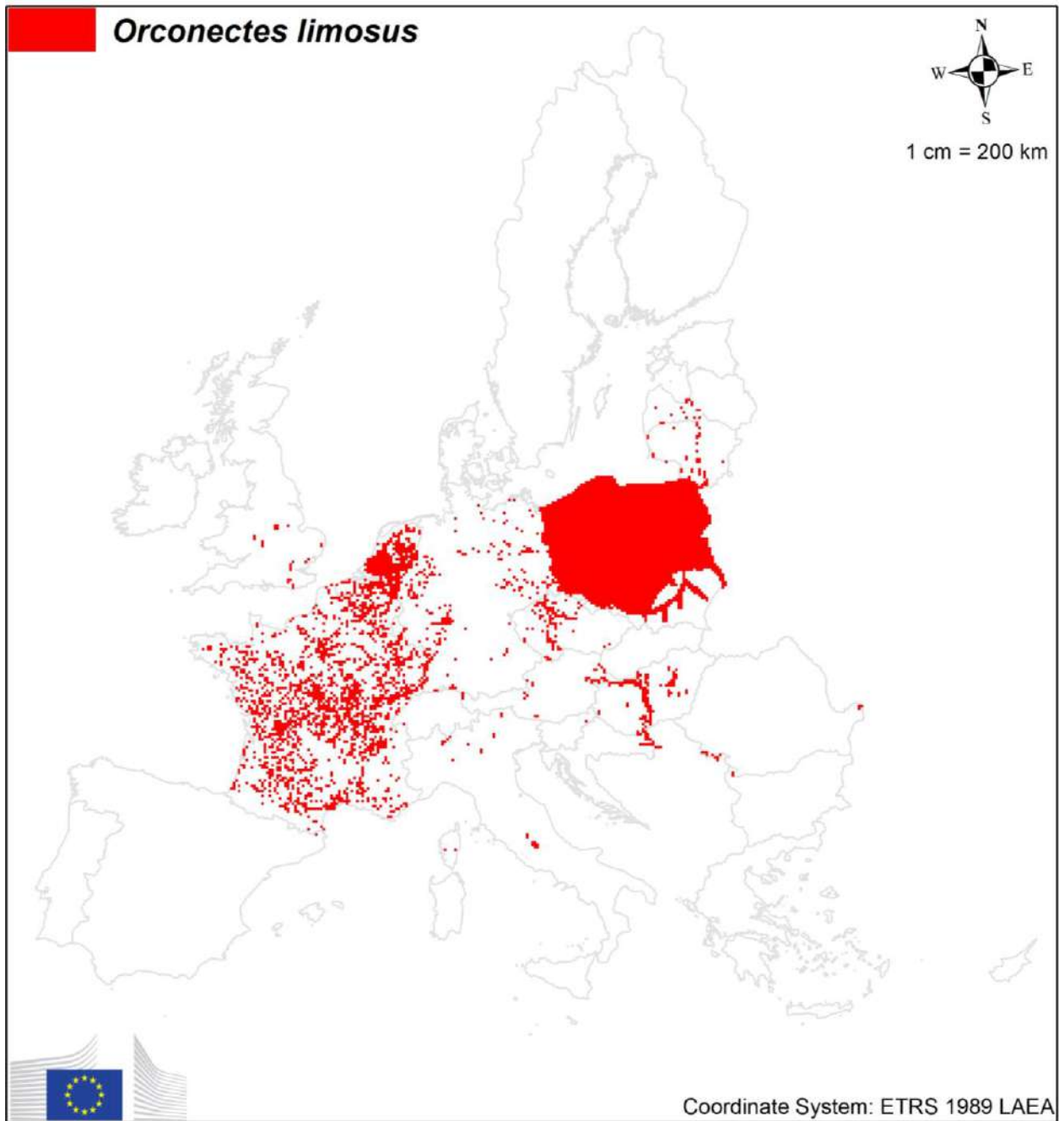


Figure 25. Grid-level (10x10 km) baseline distribution of *Orconectes limosus* in EU. The species is also present in BG and SK but no georeferenced data are available.

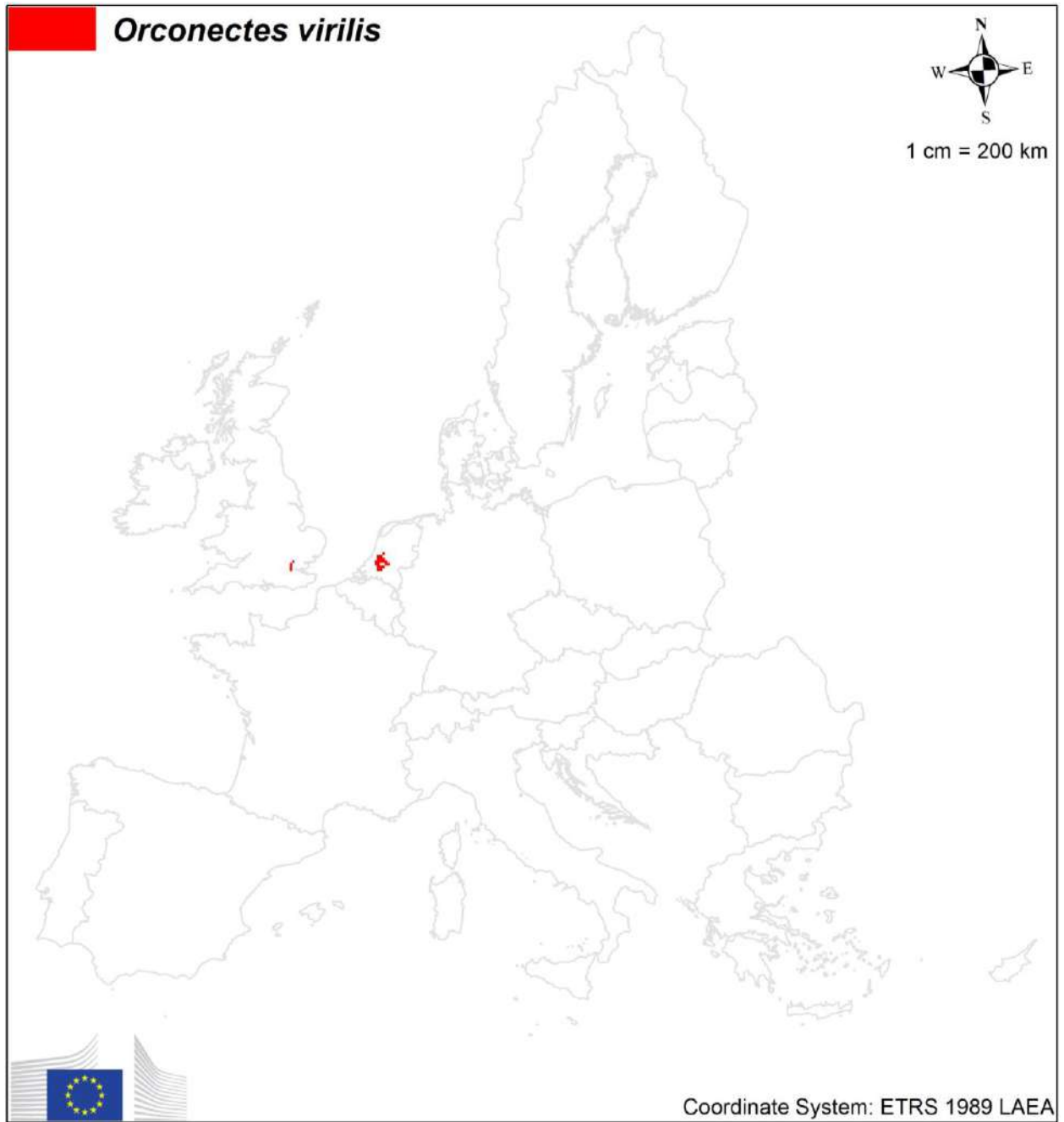


Figure 26. Grid-level (10x10 km) baseline distribution of *Orconectes virilis* in EU.

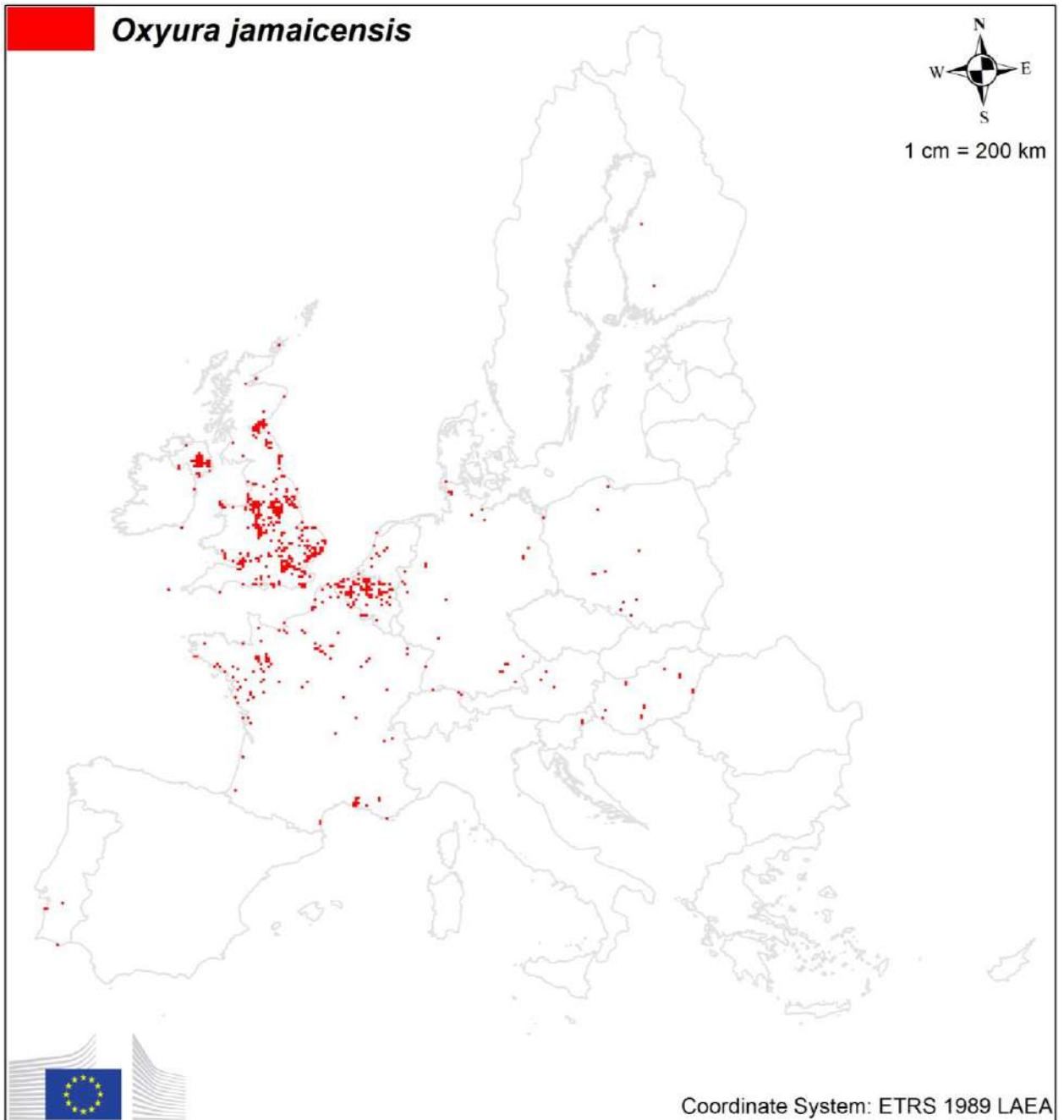


Figure 27. Grid-level (10x10 km) baseline distribution of *Oxyura jamaicensis* in EU. The species is also present in DK (Casual), CZ and IT but no georeferenced data are available.

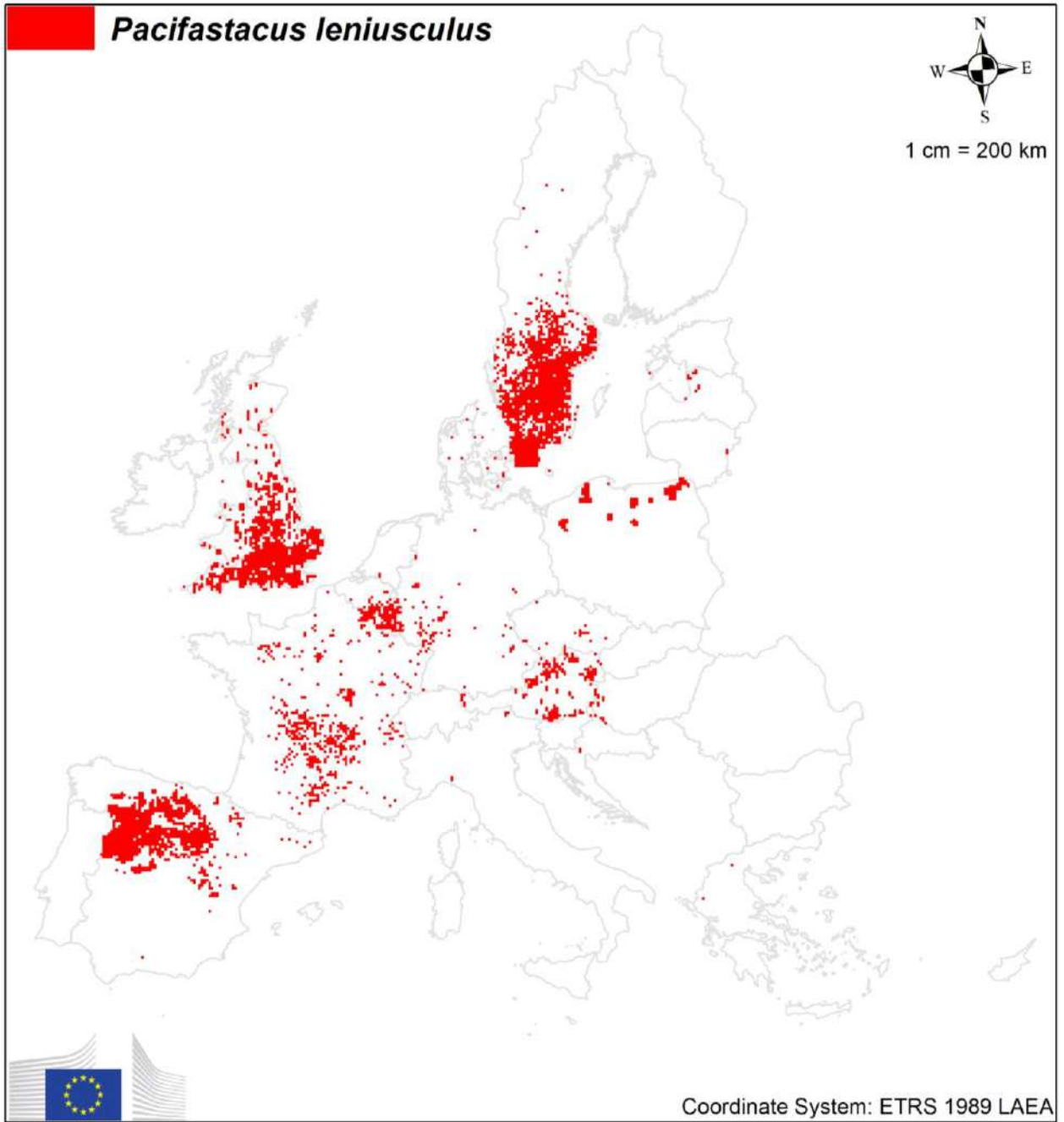


Figure 28. Grid-level (10x10 km) baseline distribution of *Pacifastacus leniusculus* in EU. The species is also present in FI and SK but no georeferenced data are available.



Figure 29. Grid-level (10x10 km) baseline distribution of *Parthenium hysterophorus* in EU.

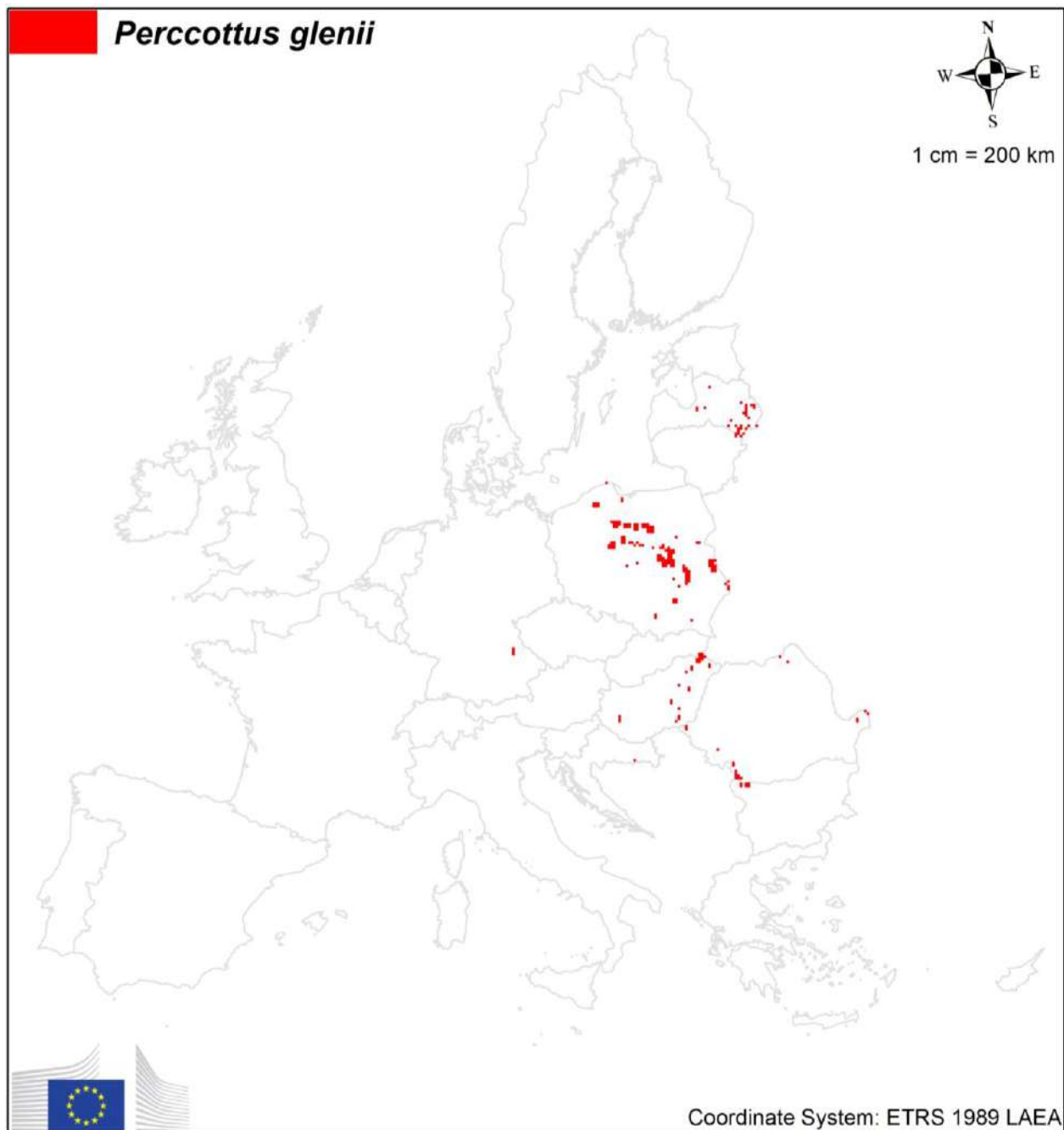


Figure 30. Grid-level (10x10 km) baseline distribution of *Perccottus glenii* in EU. The species is also present in BG and EE but no georeferenced data are available.

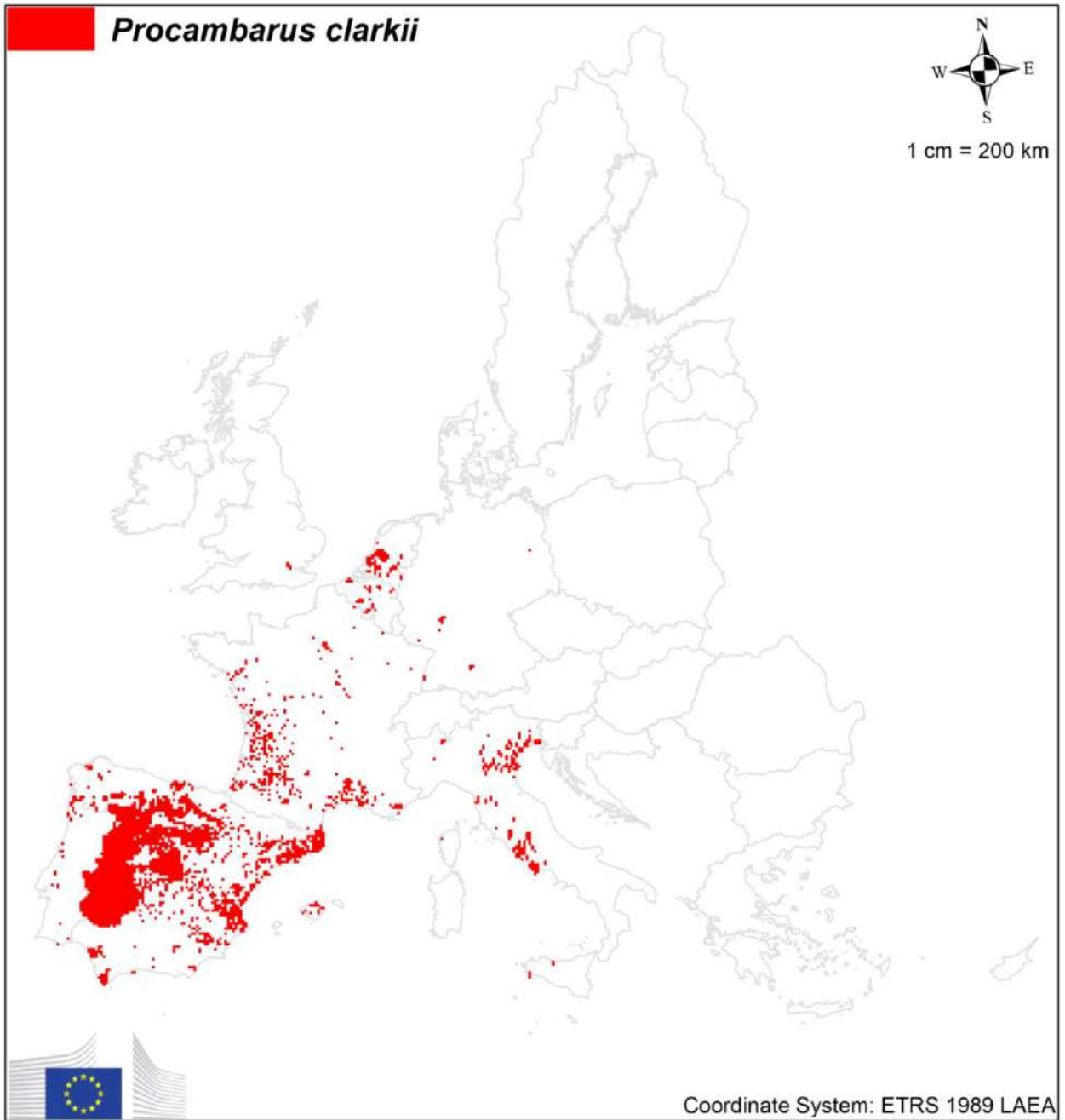


Figure 31. Grid-level (10x10 km) baseline distribution of *Procambarus clarkii* in EU. The species is also present in AT and CY but no georeferenced data are available.



Figure 32. Grid-level (10x10 km) baseline distribution of *Procambarus fallax f. virginalis* in EU. The taxon is also present in CZ and SK but no georeferenced data are available.

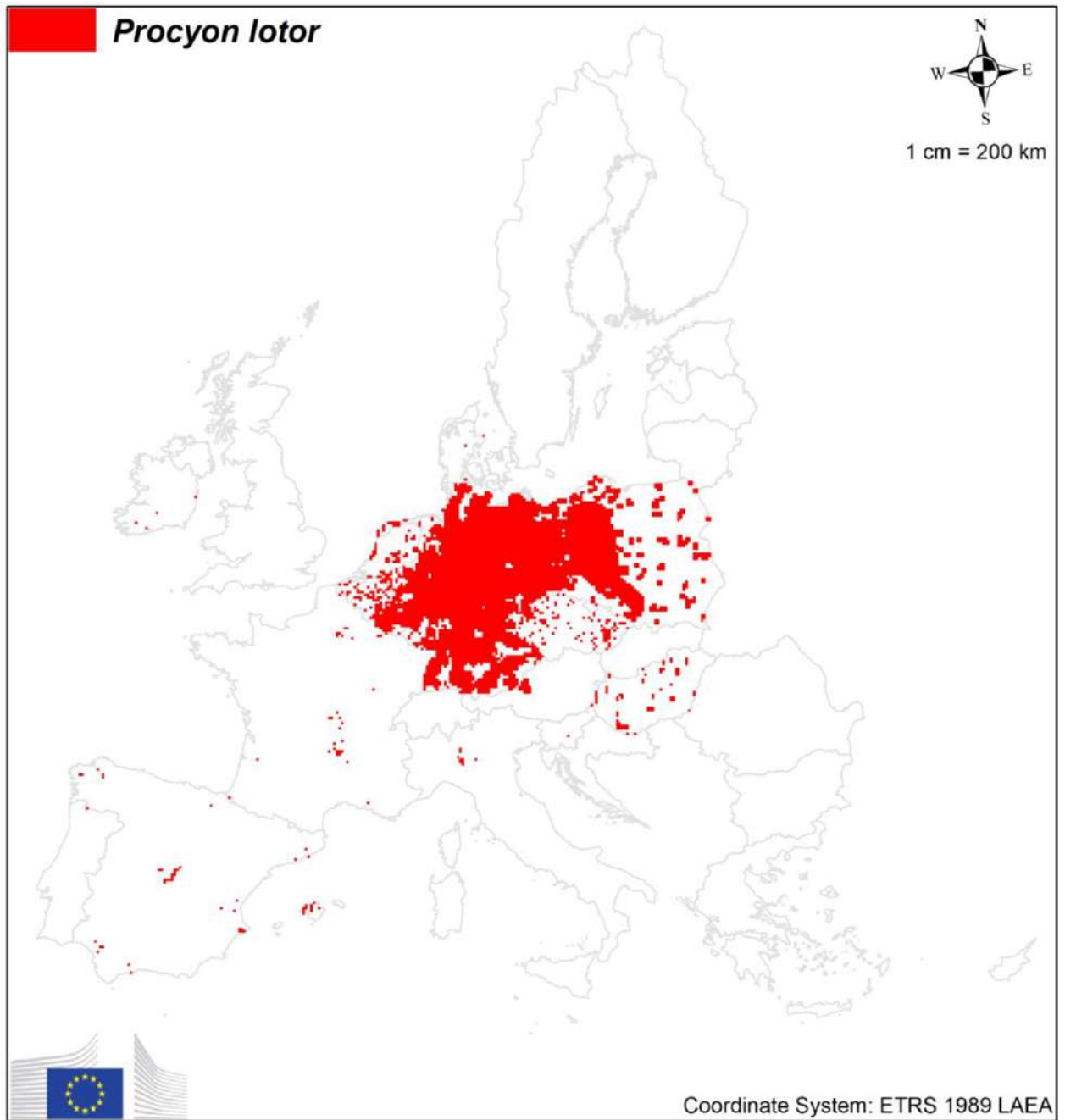


Figure 33. Grid-level (10x10 km) baseline distribution of *Procyon lotor* in EU. The species is also present in LT, RO, SK and UK (Casual) but no georeferenced data are available.

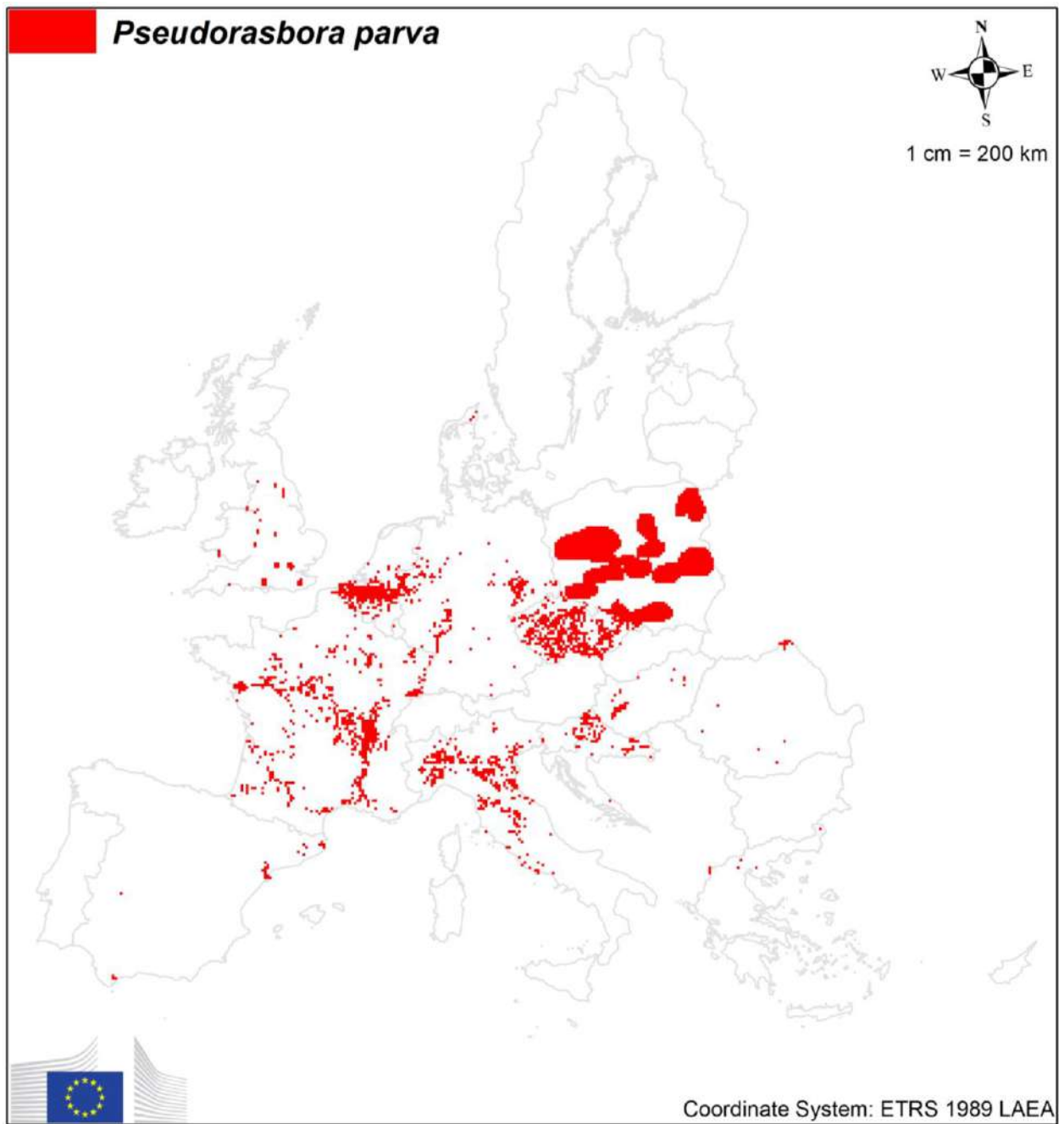


Figure 34. Grid-level (10x10 km) baseline distribution of *Pseudorasbora parva* in EU. The species is also present in AT and LT but no georeferenced data are available.

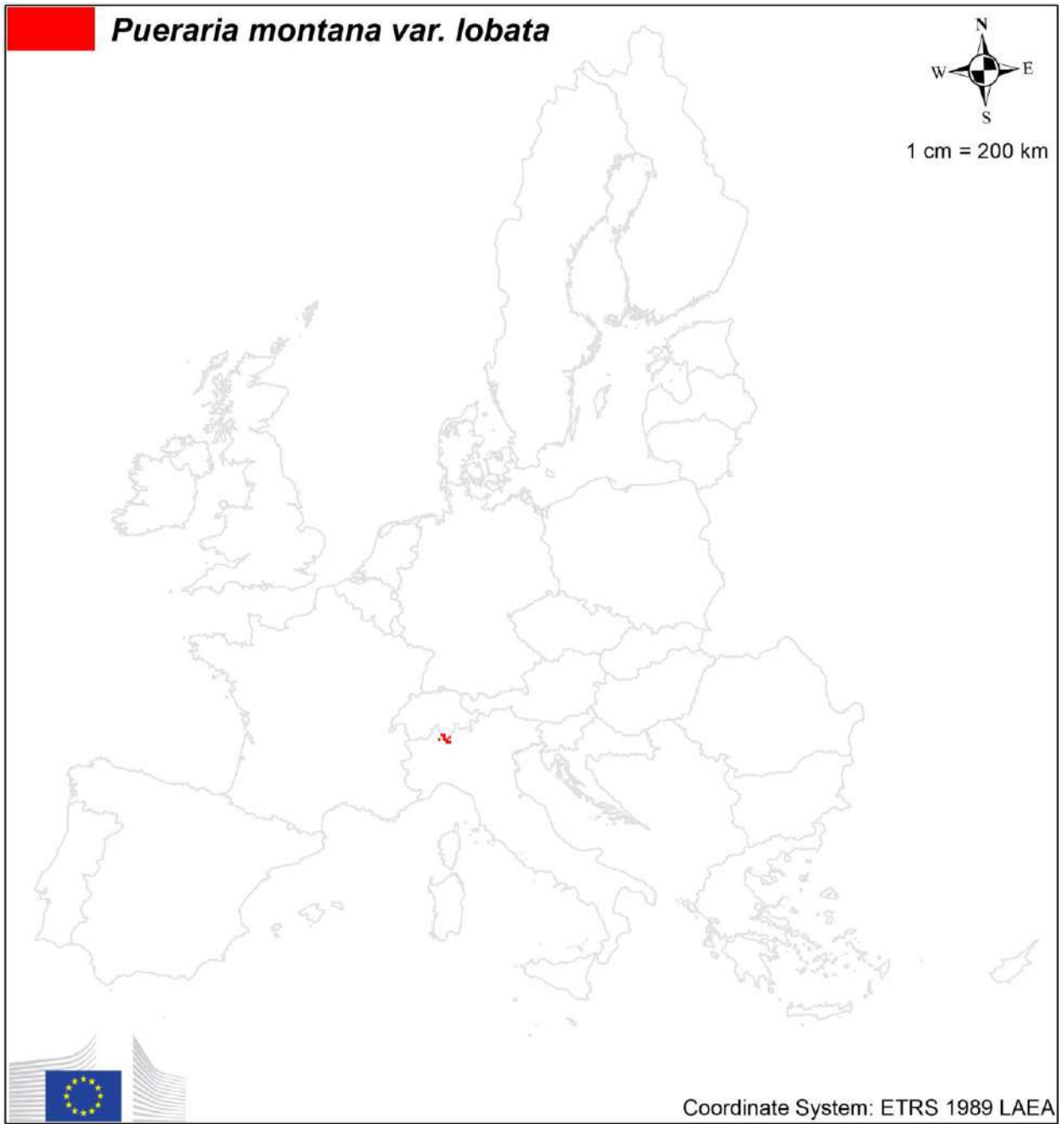


Figure 35. Grid-level (10x10 km) baseline distribution of *Pueraria montana var. lobata* in EU.

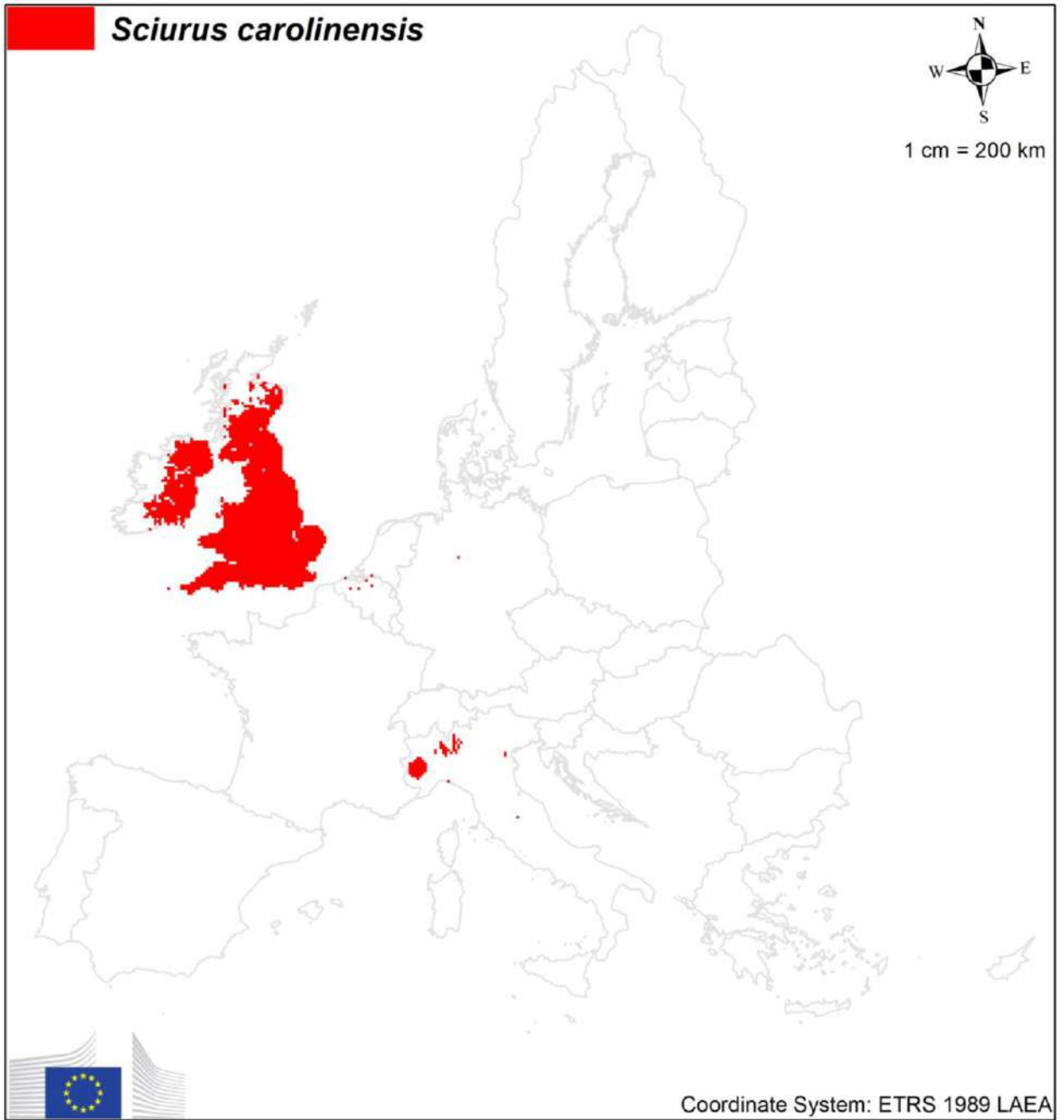


Figure 36. Grid-level (10x10 km) baseline distribution of *Sciurus carolinensis* in EU.



Figure 37. Grid-level (10x10 km) baseline distribution of *Sciurus niger* in EU.

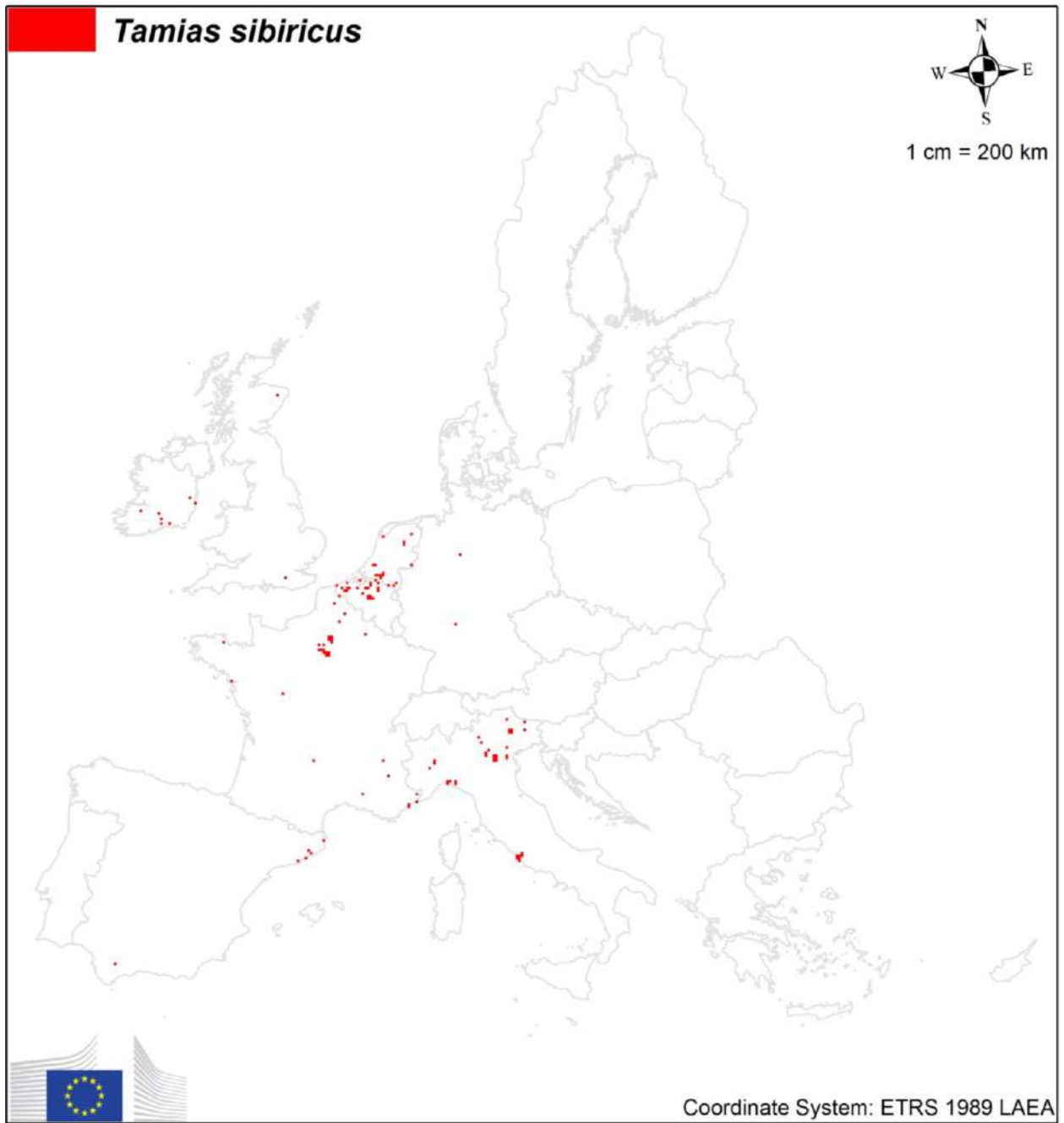


Figure 38. Grid-level (10x10 km) baseline distribution of *Tamias sibiricus* in EU.

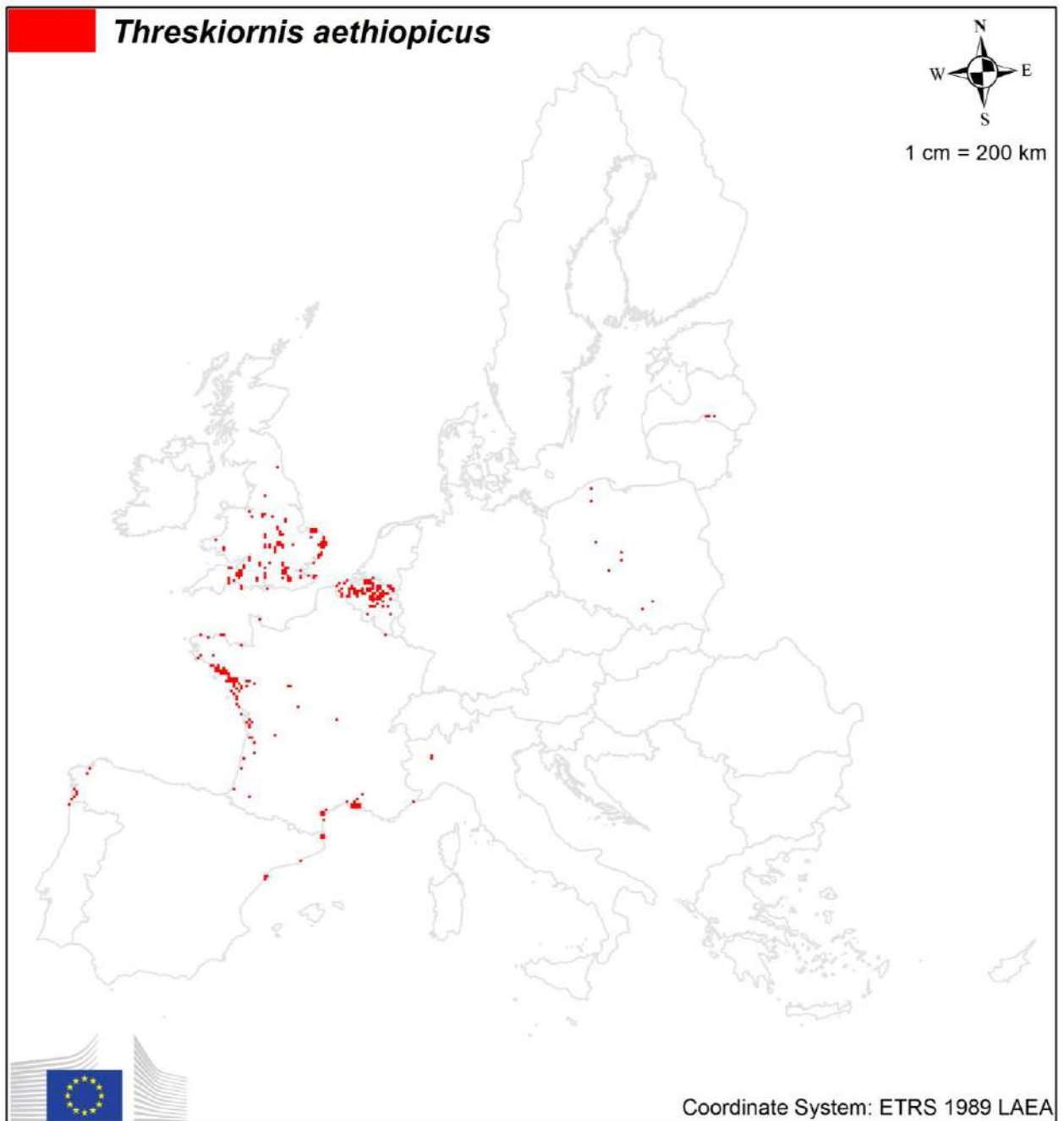


Figure 39. Grid-level (10x10 km) baseline distribution of *Threskiornis aethiopicus* in EU. The species is also present in AT (Casual), CZ (Casual), DK (Casual), DE, EL, NL (Casual) and PT but no georeferenced data are available.

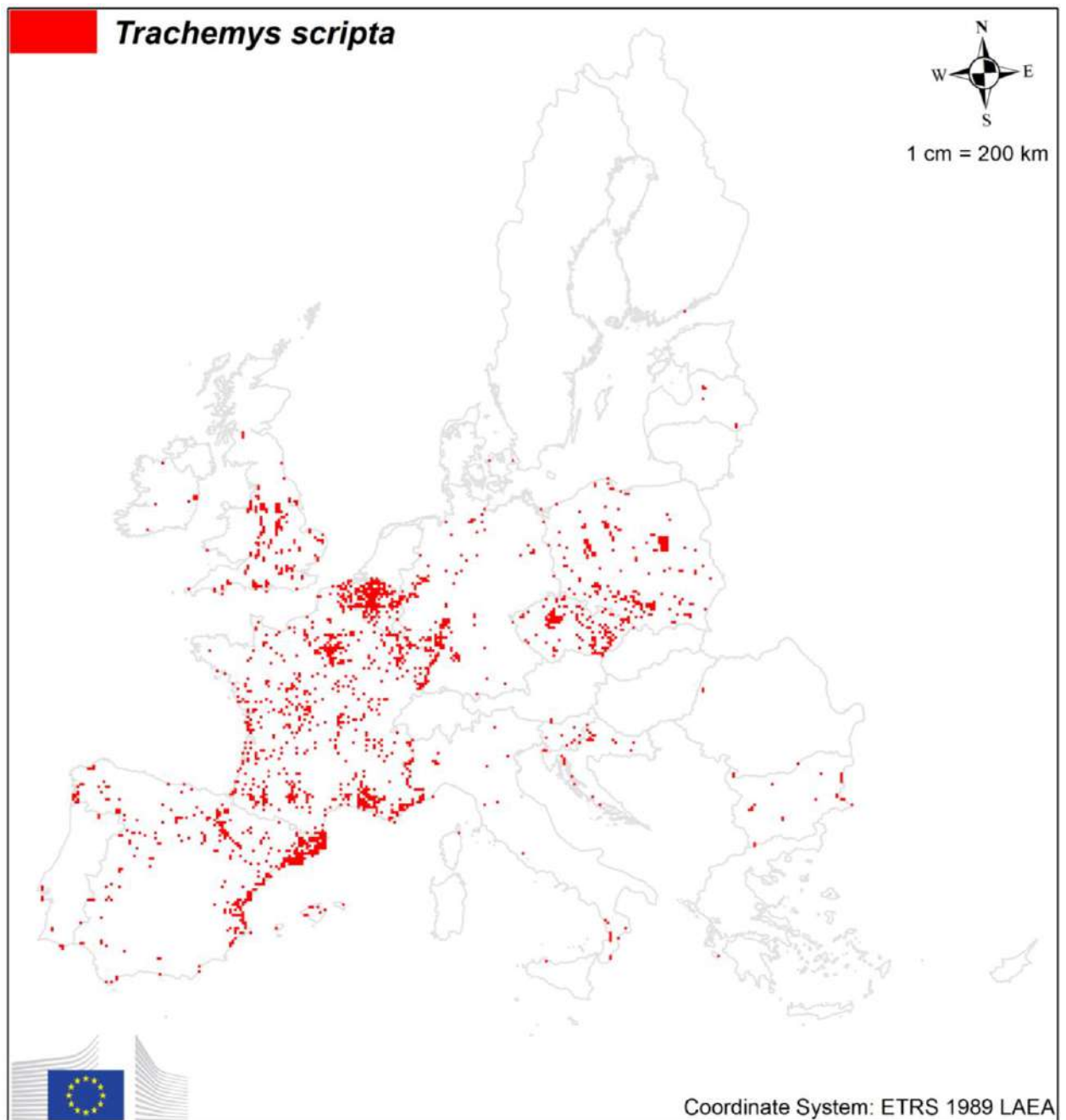


Figure 40. Grid-level (10x10 km) baseline distribution of *Trachemys scripta* in EU. The species is also present in CY, EE (Casual), NL (Casual) and SE (Casual) but no georeferenced data are available. Within the binomial *T. scripta* three subspecies are included: *T. scripta scripta*, *T. scripta elegans*, and *T. scripta troostii*.

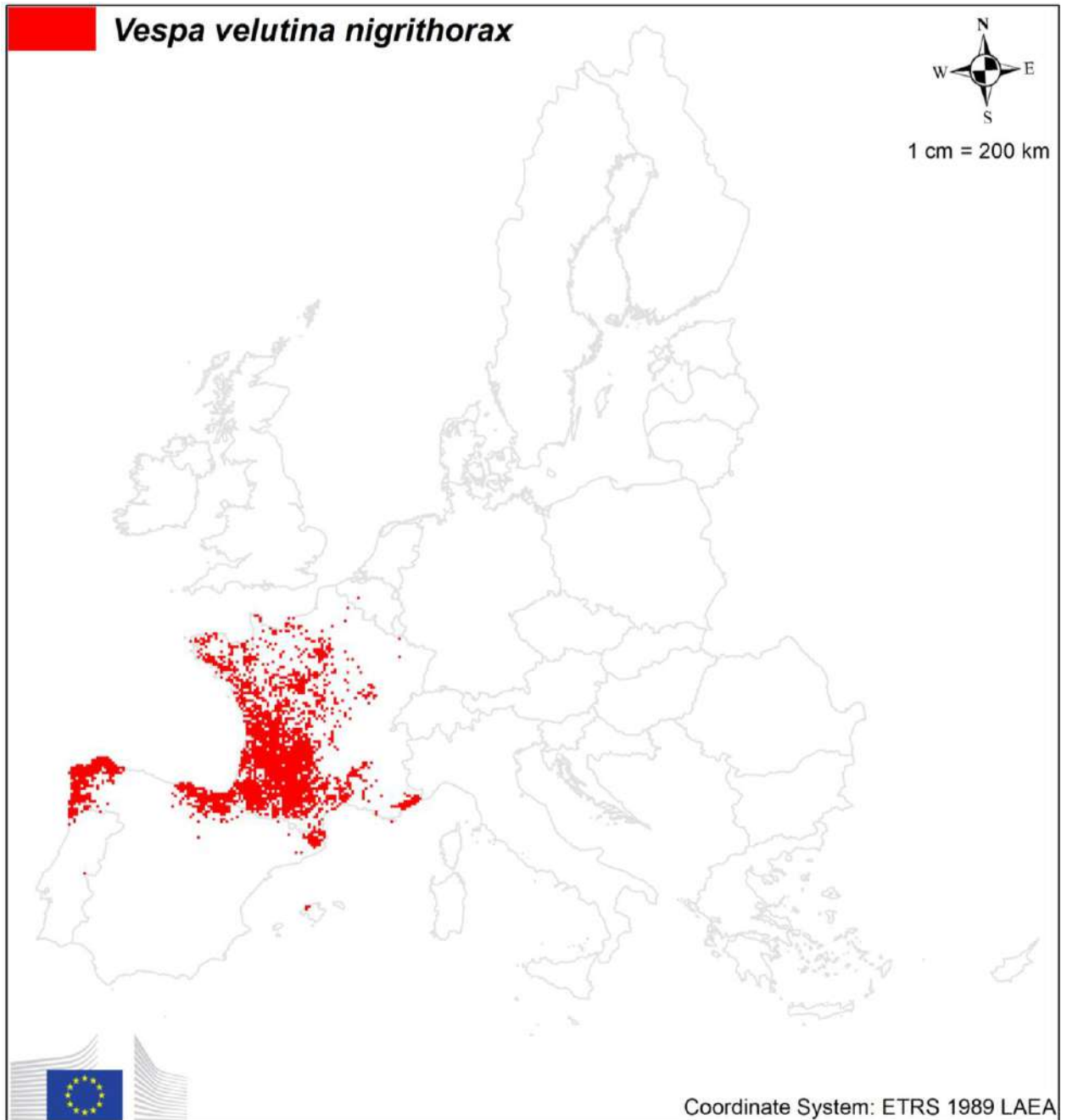


Figure 41. Grid-level (10x10 km) baseline distribution of *Vespa velutina nigrithorax* in EU. The taxon is also present in DE and IT but no georeferenced data are available.

3.3. Traits of IAS of Union concern

In Table 4, all traits of IAS of Union concern are summarized, including information regarding their reported impact.

Table 4. IAS of Union concern traits. Related information has been extracted from EASIN, Risk Assessments of the IAS Regulation and web sources (CABI, GISID, NOBANIS, DAISIE, ITIS, WORMS). For more details see sub-chapter 2.7.

Species name	Common name	Taxonomic group	Habitat	Origin	Pathway (CBD)	Year of first introduction in EU	Country of first introduction in EU	Environmental impact	Economic impact	Social impact
<i>Baccharis halimifolia</i>	Eastern Baccharis	Plant	Terrestrial	North America	ESCAPE FROM CONFINEMENT: Ornamental purpose other than horticulture	1683	FR	(-) rapidly colonize new areas and outcompete native saltmarsh species for water and nutrients		(-) air-borne pollen potential allergen
<i>Cabomba caroliniana</i>	Fanwort	Plant	Freshwater	America	ESCAPE FROM CONFINEMENT: Horticulture - Pet/aquarium/terrarium species (including live food for such species)	1971	UK	(-) decreases the biodiversity of native aquatic plants	(-) clogs drainage canals and freshwater streams interfering with agricultural (+) used in horticulture	(-) negative effects to recreational and aesthetic uses
<i>Callosciurus erythraeus</i>	Pallas's squirrel	Mammal	Terrestrial	South-East Asia	ESCAPE FROM CONFINEMENT: Botanical garden/zoo/aquaria (excluding domestic aquaria) - Pet/aquarium/terrarium species (including live food for such species)	1974	FR	(-) severe debarking of trees (-) outcompetes native squirrels for food and nest sites	(-) damage to forestry	
<i>Corvus splendens</i>	House crow	Bird	Terrestrial	Indian Subcontinent	TRANSPORT - STOWAWAY: Hitchhikers on ship/boat (excluding ballast water and hull fouling)	1974	IE	(-) risk to native avifauna	(-) food/crop theft	(-) noise nuisance (-) possibly carrier of human and animal disease
<i>Eichhornia crassipes</i>	Water hyacinth	Plant	Freshwater	South America	ESCAPE FROM CONFINEMENT: Botanical garden/zoo/aquaria (excluding domestic aquaria) - Pet/aquarium/terrarium species (including live food for such species)	1917	NL	(-) can alter the ecosystem and result in environmental degradation and native biodiversity loss	(-) negative effects to water transport, irrigation systems (+) used in horticulture	(-) negative effects to tourism, fishing
<i>Eriocheir sinensis</i>	Chinese mitten crab	Malacostraca	Freshwater, Marine, Oligohaline	East Asia	ESCAPE FROM CONFINEMENT: Pet/aquarium/terrarium species (including live food for such species) – Live food and live bait TRANSPORT - STOWAWAY: Ship/boat ballast water - Ship/boat hull fouling RELEASE IN NATURE: Release in nature for use (other than	1912	DE	(-) outcompetes native species through predation and overlapping dietary (-) its burrowing activity leads to the erosion of river banks	(-) damage to fishing	(-) intermediate host of lung flukes in East Asia (+) used for consumption

					above, e.g., fur, transport, medical use)					
<i>Heracleum persicum</i>	Persian hogweed	Plant	Terrestrial	South-West Asia	ESCAPE FROM CONFINEMENT: Ornamental purpose other than horticulture TRANSPORT – CONTAMINANT: Transportation of habitat material (soil, vegetation) TRANSPORT - STOWAWAY: Machinery/equipment - People and their luggage/equipment (in particular tourism) - Vehicles (car, train, ...)	1777	EE	(-) outcompetes native plants (-) erosion of river banks	(+) used in horticulture	(-) its bristles can cause eczema after physical contact
<i>Heracleum sosnowskyi</i>	Sosnowski's hogweed	Plant	Terrestrial	West Asia	TRANSPORT – CONTAMINANT: Transportation of habitat material (soil, vegetation) TRANSPORT - STOWAWAY: Machinery/equipment - People and their luggage/equipment (in particular tourism) - Vehicles (car, train, ...) ESCAPE FROM CONFINEMENT: Agriculture (including Biofuel feedstocks) - Ornamental purpose other than horticulture - Horticulture	1946	LV	(-) overwhelms native species (-) riverbank erosion	(+) used in horticulture	(-) skin burning after physical contact
<i>Herpestes javanicus</i>	Small Indian mongoose	Mammal	Terrestrial	Asia	RELEASE IN NATURE: Biological control	1910	HR	(-) can lead to decline of native mammals, birds, reptiles, and amphibians through predation	(-) severe damages to crops and poultry, but not reported from Europe yet	(-) carrier of human and animal diseases, including rabies and leptospirosis
<i>Hydrocotyle ranunculoides</i>	Floating pennywort	Plant	Freshwater	North and South America	ESCAPE FROM CONFINEMENT: Ornamental purpose other than horticulture - Botanical garden/zoo/aquaria (excluding domestic aquaria) - Pet/aquarium/terrarium species (including live food for such species)	1987	FR	(-) can outcompete native aquatic plants	(-) blocks water control structures and leading to flooding events (+) used in horticulture	(-) problems to boat navigation and water recreational uses

					RELEASE IN NATURE: Introduction for conservation purposes or wildlife management					
<i>Lagarosiphon major</i>	African elodea	Plant	Freshwater	South and Central Africa	ESCAPE FROM CONFINEMENT: Ornamental purpose other than horticulture - Botanical garden/zoo/aquaria (excluding domestic aquaria) - Pet/aquarium/terrarium species (including live food for such species)	1944	UK	(-) displacing native plant species	(-) blocking hydroelectric intakes (+) used in horticulture	(-) impeding recreational activities (-) diminishing aesthetic value
<i>Lithobates catesbeianus</i>	North American bullfrog	Amphibia	Freshwater	North-East America	RELEASE IN NATURE: Release in nature for use (other than above, e.g., fur, transport, medical use) - Biological control ESCAPE FROM CONFINEMENT: Pet/aquarium/terrarium species (including live food for such species) - Farmed animals (including animals left under limited control)	1900	FR	(-) outcompetes native amphibians (-) vector of the chytrid fungus (-) can alter the structure and function of native communities		(-) noise pollution due to the chorusing of large males (+) used for consumption (+) used as a pet
<i>Ludwigia grandiflora</i>	Water primrose	Plant	Freshwater	Central and South America	ESCAPE FROM CONFINEMENT: Ornamental purpose other than horticulture - Botanical garden/zoo/aquaria (excluding domestic aquaria) TRANSPORT- STOWAWAY: Other means of transport UNAIDED: Natural dispersal across borders of invasive alien species that have been introduced through pathways 1 to 5	1830	FR	(-) outcompetes native plant species (-) reduces water oxygenation levels	(-) blocks water bodies and drainage systems (+) used in horticulture	(-) impacts navigation and recreational activities
<i>Ludwigia peploides</i>	Floating primrose-willow	Plant	Freshwater	South America	ESCAPE FROM CONFINEMENT: Ornamental purpose other than horticulture - Botanical garden/zoo/aquaria (excluding domestic aquaria) UNAIDED: Natural dispersal	1830	FR	(-) outcompetes native plant species (-) reduces water oxygenation levels	(-) blocks water bodies and drainage systems (+) used in horticulture	(-) creates a breeding habitat for mosquitoes (-) impacts navigation and recreational

					across borders of invasive alien species that have been introduced through pathways 1 to 5					activities
<i>Lysichiton americanus</i>	American skunk-cabbage	Plant	Terrestrial	North-West America	ESCAPE FROM CONFINEMENT: Ornamental purpose other than horticulture RELEASE IN NATURE: Landscape/flora/fauna "improvement" in the wild TRANSPORT- STOWAWAY: Other means of transport UNAIDED: Natural dispersal across borders of invasive alien species that have been introduced through pathways 1 to 5	1901	UK	(-) can outcompete native mosses and orchid species	(+) used in horticulture	
<i>Muntiacus reevesi</i>	Muntjac deer	Mammal	Terrestrial	South-East Asia	ESCAPE FROM CONFINEMENT: Botanical garden/zoo/aquaria (excluding domestic aquaria) RELEASE IN NATURE: Hunting	1894	UK	(-) grazing can effect diversity of plant species, with indirect effects on fauna	(-) damage to crops and horticulture (-) reservoir of diseases for livestock	(-) vehicle collisions (+) hunting
<i>Myocastor coypus</i>	Coypu	Mammal	Terrestrial / Freshwater	South America	ESCAPE FROM CONFINEMENT: Fur farms RELEASE IN NATURE: Release in nature for use (other than above, e.g., fur, transport, medical use) UNAIDED: Natural dispersal across borders of invasive alien species that have been introduced through pathways 1 to 5	1882	FR	(-) declines native plants through herbivory (-) can destroy bird nests and preys on eggs (-) damage river banks, dykes	(-) damage to irrigation facilities (-) damage to agriculture	(-) implicated in leptospirosis
<i>Myriophyllum aquaticum</i>	Parrot's feather	Plant	Freshwater	South America	ESCAPE FROM CONFINEMENT: Ornamental purpose other than horticulture - Botanical garden/zoo/aquaria (excluding domestic aquaria) - Pet/aquarium/terrarium species	1960	UK	(-) outcompetes native aquatic plants (-) can cause water deoxygenation	(-) blocks water bodies and drainage systems (+) used in horticulture	(-) provides habitat for mosquitos (-) impacts navigation and recreational

					(including live food for such species)					activities
<i>Nasua nasua</i>	South American coati	Mammal	Terrestrial	South America	ESCAPE FROM CONFINEMENT: Botanical garden/zoo/aquaria (excluding domestic aquaria) - Pet/aquarium/terrarium species (including live food for such species)	2009	ES	(-) no environmental impacts in EU are known but it could become an important predator or competitor with native species		
<i>Orconectes limosus</i>	Eastern crayfish	Malacostraca	Freshwater	North America	ESCAPE FROM CONFINEMENT: Aquaculture / mariculture - Pet/aquarium/terrarium species (including live food for such species) - Live food and live bait RELEASE IN NATURE: Biological control TRANSPORT – CONTAMINANT: Contaminant on animals (except parasites, species transported by host/vector)	1890	DE	(-) can outcompete native crayfish species (-) carrier of the crayfish plague (-) decimates aquatic macrophytes (-) its burrows may destabilize river banks	(-) damage to fishing gear	(+) used for consumption
<i>Orconectes virilis</i>	Virile crayfish	Malacostraca	Freshwater	North America	ESCAPE FROM CONFINEMENT: Pet/aquarium/terrarium species (including live food for such species)	2004	UK	(-) declines macroinvertebrate and macrophyte abundance and biodiversity (-) carrier of crayfish plague (-) its burrows may destabilize river banks		(+) used for consumption
<i>Oxyura jamaicensis</i>	Ruddy duck	Bird	Terrestrial / Freshwater	North and Central America	ESCAPE FROM CONFINEMENT: Botanical garden/zoo/aquaria (excluding domestic aquaria) - Pet/aquarium/terrarium species (including live food for such species)	1949	UK	(-) threat to the endangered white-headed duck (<i>Oxyura leucocephala</i>) through hybridization and competition		
<i>Pacifastacus leniusculus</i>	Signal crayfish	Malacostraca	Freshwater	North-West America	TRANSPORT – CONTAMINANT: Contaminant on animals (except parasites, species	1959	SE	(-) significant grazing pressure on macrophytes, aquatic	(-) damage noble crayfish stocks	(-) threat to noble crayfish, which has a

					transported by host/vector) ESCAPE FROM CONFINEMENT: Aquaculture / mariculture - Live food and live bait RELEASE IN NATURE: Fishery in the wild (including game fishing)			insects, snails, benthic fishes and amphibian larvae (-) carrier of the crayfish plague fungus (-) habitat modification (-) food web impairment	(+) used in fisheries	cultural significance
<i>Parthenium hysterophorus</i>	Parthenium weed	Plants	Terrestrial	North and South America	TRANSPORT – CONTAMINANT: Seed contaminant - Food contaminant (including of live food)	1938	PL	(-) replaces native flora due to allelopathy (-) habitat change (+) could efficiently reduce heavy metal pollution in soil	(-) severe damages to crops (-) damage upon pastures (-) consumption by livestock can taint meat	(-) pollen contains allergens that can cause reactions such as dermatitis and hay fever
<i>Perccottus glenii</i>	Amur sleeper	Actinopterygii	Freshwater	Asia	ESCAPE FROM CONFINEMENT: Aquaculture / mariculture - Pet/aquarium/terrarium species (including live food for such species) TRANSPORT – CONTAMINANT: Contaminant on animals (except parasites, species transported by host/vector)	1985	LT	(-) negative effects to native freshwater fish, amphibians, invertebrates	(-) may reduce production of economically important fish species	
<i>Persicaria perfoliata</i>	Mile-a-minute weed	Plant	Terrestrial	East Asia				(-) can smother native vegetation and climb into the tree canopy where it restricts light availability to plants below	(-) can be a pest plant on tree farms and horticultural crops	(+) used in Chinese medicine
<i>Procambarus clarkii</i>	Red swamp crayfish	Malacostraca	Freshwater	North America	ESCAPE FROM CONFINEMENT: Live food and live bait - Pet/aquarium/terrarium species (including live food for such species)	1973	ES	(-) significant grazing pressure on macrophytes, aquatic insects, snails, benthic fishes and amphibian larvae	(-) damage to rice production (-) damages to irrigation facilities (+) used for	(-) impacting angling (-) accumulates heavy metals and toxins produced by Cyanobacteria, and

								(-) carrier of the crayfish plague (-) habitat alteration (-) food web impairment	consumption (+) aquarium trade	can transfer them to its consumers, including humans
<i>Procambarus fallax f. virginialis</i>	Marbled crayfish	Malacostraca	Freshwater	North America	ESCAPE FROM CONFINEMENT: Pet/aquarium/terrarium species (including live food for such species)	2003	DE	(-) no documented impacts but possibly similar to <i>P. clarkii</i>	(+) aquarium trade	
<i>Procyon lotor</i>	Raccoon	Mammal	Terrestrial	North and Central America	ESCAPE FROM CONFINEMENT: Botanical garden/zoo/aquaria (excluding domestic aquaria) - Pet/aquarium/terrarium species (including live food for such species) - Fur farms RELEASE IN NATURE: Hunting UNAIDED: Natural dispersal across borders of invasive alien species that have been introduced through pathways 1 to 5	1927	DE	(-) damages native fauna through predation and competition	(-) can damage gardens, crops	(-) carrier of several pathogens (-) causing nuisance around houses (+) popular pet
<i>Pseudorasbora parva</i>	Stone moroko	Actinopterygii	Freshwater	East Asia	ESCAPE FROM CONFINEMENT: Aquaculture / mariculture - Pet/aquarium/terrarium species (including live food for such species) RELEASE IN NATURE: Other intentional release TRANSPORT – CONTAMINANT: Contaminant on animals (except parasites, species transported by host/vector) - Contaminated bait CORRIDOR: Interconnected waterways/basins/seas	1960	SK	(-) feeds on juvenile stages of many locally valuable native fish species (-) vector of infectious diseases threatening native fish	(-) can reduce aquaculture production (+) pet trade	(-) loss of recreational angling opportunities
<i>Pueraria montana var. lobata</i>	Kudzu vine	Plant	Terrestrial	South-East Asia	ESCAPE FROM CONFINEMENT: Ornamental purpose other than horticulture	1995	IT	(-) kills mostly all plants that it overgrows (-) reduces native	(-) can cover and smother plantation crops	(-) can cover human facilities

								species biodiversity (-) completely modifies the ecosystem	(+) used in bioethanol production	
<i>Sciurus carolinensis</i>	American grey squirrel	Mammal	Terrestrial	North America	ESCAPE FROM CONFINEMENT: Botanical garden/zoo/aquaria (excluding domestic aquaria) RELEASE IN NATURE: Landscape/flora/fauna "improvement" in the wild	1876	UK	(-) can damage trees by stripping the bark, exposing them to fungi and insects (-) causes local extinction of the red squirrel through competition and diseases	(-) damage to forestry	
<i>Sciurus niger</i>	Fox squirrel	Mammal	Terrestrial	North America	ESCAPE FROM CONFINEMENT: Pet/aquarium/terrarium species (including live food for such species)	2014	BE	(-) can outcompete native squirrels (-) affect the reproduction of some trees	(-) damage to forestry (+) pet trade	(-) may transfer diseases to humans
<i>Tamias sibiricus</i>	Siberian chipmunk	Mammal	Terrestrial	Asia	ESCAPE FROM CONFINEMENT: Pet/aquarium/terrarium species (including live food for such species) - Botanical garden/zoo/aquaria (excluding domestic aquaria) / RELEASE IN NATURE: Landscape/flora/fauna "improvement" in the wild	1957	AT	(-) may impact on forest nut production (-) possible predation on breeding birds	(-) may damage gardens and crops (+) pet trade	
<i>Threskiornis aethiopicus</i>	Sacred ibis	Bird	Terrestrial / Freshwater	Africa	ESCAPE FROM CONFINEMENT: Botanical garden/zoo/aquaria (excluding domestic aquaria) / UNAIDED: Natural dispersal across borders of invasive alien species that have been introduced through pathways 1 to 5	1957	FR	(-) feeds on several threatened species (insects, batrachians, etc.) (-) feeds on eggs of several protected bird colonies (-) competes successfully for nest sites with native birds	(+) pet trade	(-) suspected of spreading disease since it frequently forages in rubbish dumps and slurry pits
<i>Trachemys scripta</i>	Red-eared terrapin	Reptile	Freshwater	North-East America	ESCAPE FROM CONFINEMENT: Pet/aquarium/terrarium species (including live food for such	1960	CZ	(-) outcompetes native animals, including the	(+) very popular as a pet because of its small size and low	(-) potential vector of Salmonella

					species)			endangered European pond turtle <i>Emys orbicularis</i> (-) spread diseases and parasites to native turtles and wildlife	price	(-) painful bites to humans
<i>Vespa velutina nigrithorax</i>	Yellow- legged hornet	Insect	Terrestrial	South- East Asia	TRANSPORT - STOWAWAY: Container/bulk - Organic packing material, in particular wood packaging UNAIDED: Natural dispersal across borders of invasive alien species that have been introduced through pathways 1 to 5	2004	FR	(-) highly aggressive predator of native honey bees	(-) potential damage to bee keepers (-) the possible negative effect on pollination may lead to loss of crop/fruit production	(-) may be considered a nuisance to recreational activities, cause mental and physical health issues.

Taxonomy

The first list of IAS of Union concern includes more animal (62%) than plant species (38%) (Figure 42). Animal species correspond mostly to vertebrate species, mainly mammals (Figure 43). There are also several invertebrate species, all belonging to Malacostraca, with the exception of one insect (Figure 43). All plants belong to the Division Tracheophyta.

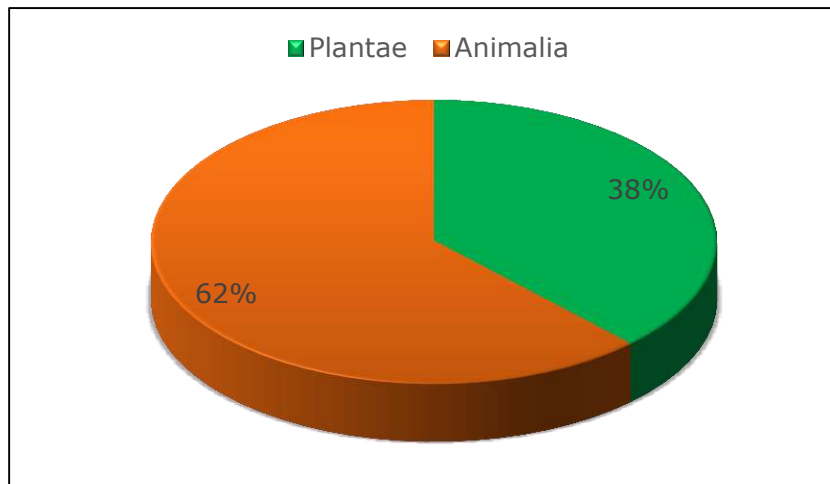


Figure 42. Proportion of animal and plant species of IAS of Union concern.

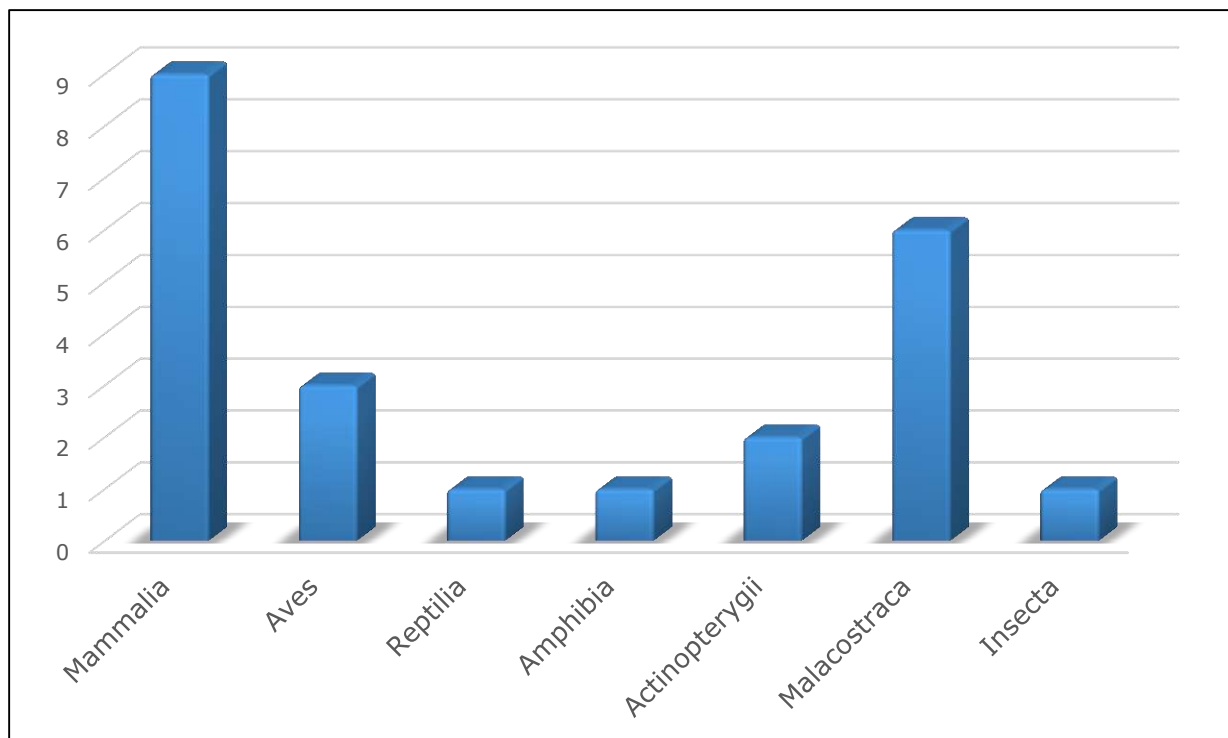


Figure 43. Fauna taxonomy IAS of Union concern.

Habitat

The first list of IAS of Union concern includes about half terrestrial and half freshwater species (Figure 44). There is one oligohaline species (*Eriochair sinensis*), while no marine species have been included in the Union list.

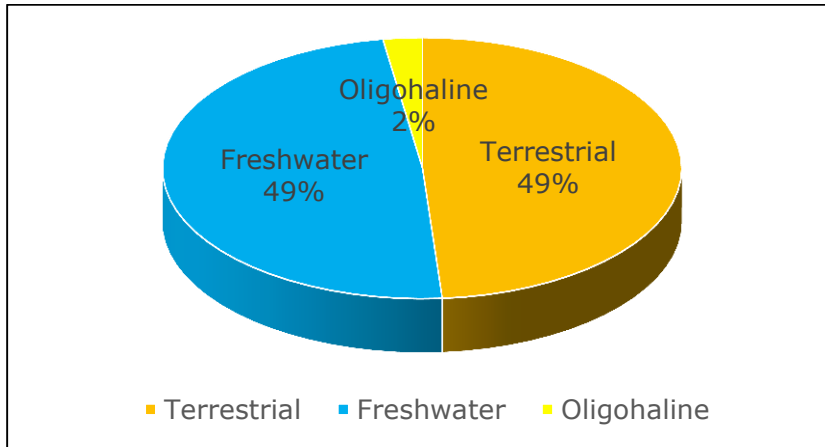


Figure 44. Environment of IAS of Union concern.

Origin

Most of the IAS of Union concern on the first list originate from America (mainly North America); the second most important area of origin is Asia, East Asia in particular (Figure 45). There are only 3 species with African origin, while no species comes from Oceania. It should be noted that all freshwater crayfish in the Union list originate from North America, and that all freshwater plants come from South America, with the exception of *Lagarosiphon major*, which has its native range in Africa.

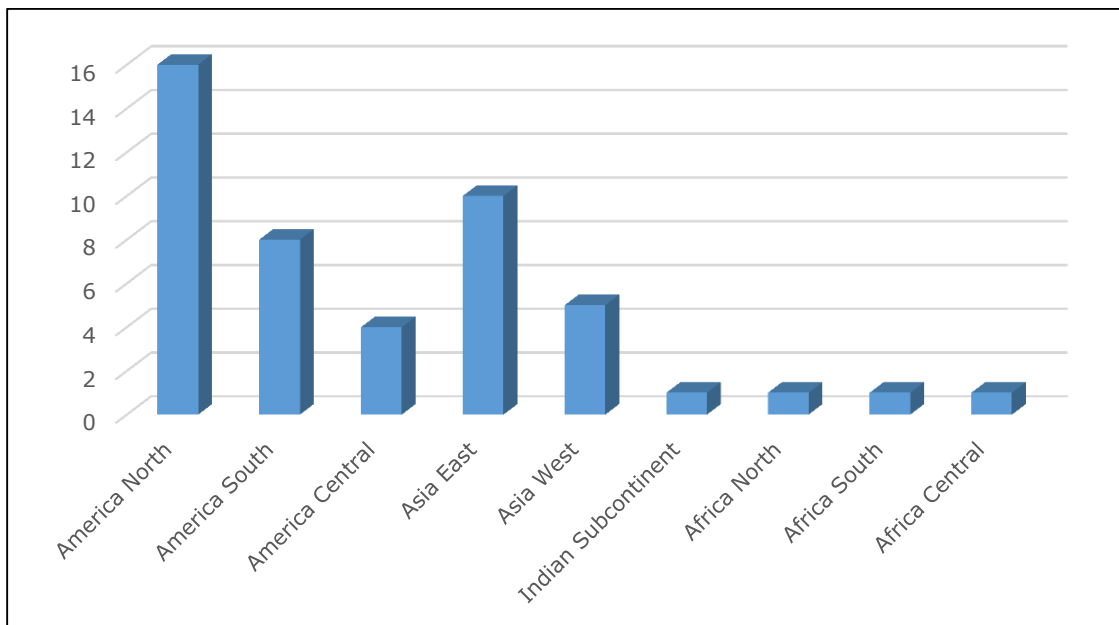


Figure 45. Origin of IAS of Union concern.

Pathways of introduction

Most IAS of Union concern on the first list have been introduced into Europe through the main CBD pathway "Escape from confinement" (56%, Figure 46). This pathway is mostly related to the sub-category "Pet/aquarium/terrarium species (including live food for such species)", "Botanical garden/zoo/aquaria (excluding domestic aquaria)" and escapes linked with "Ornamental purpose other than horticulture" (Figure 47).

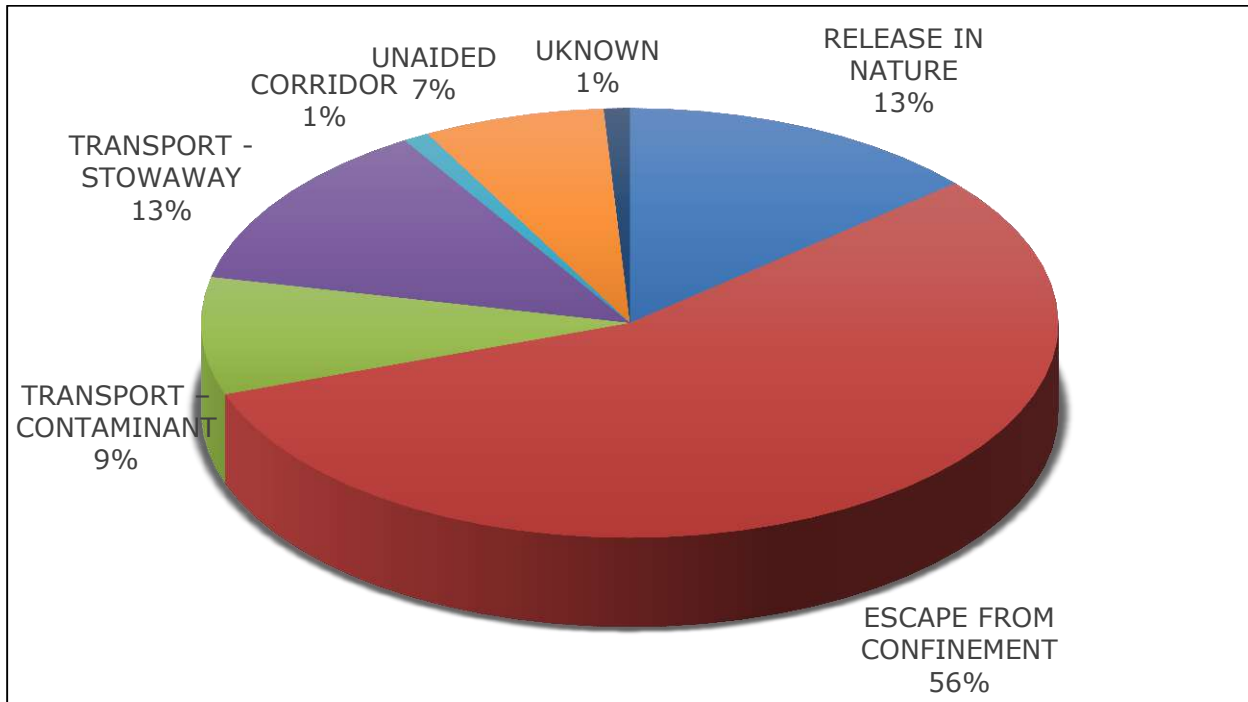


Figure 46. Main pathways of introduction of IAS of Union concern in EU, based on CBD categorization.

It should be noted that most of the Union concern plants have been introduced through "Escape from confinement: Ornamental purpose other than horticulture" and that all freshwater crayfish have been introduced via "Escape from confinement: Pet/aquarium/terrarium species (including live food for such species) and "Escape from confinement: Aquaculture / mariculture".

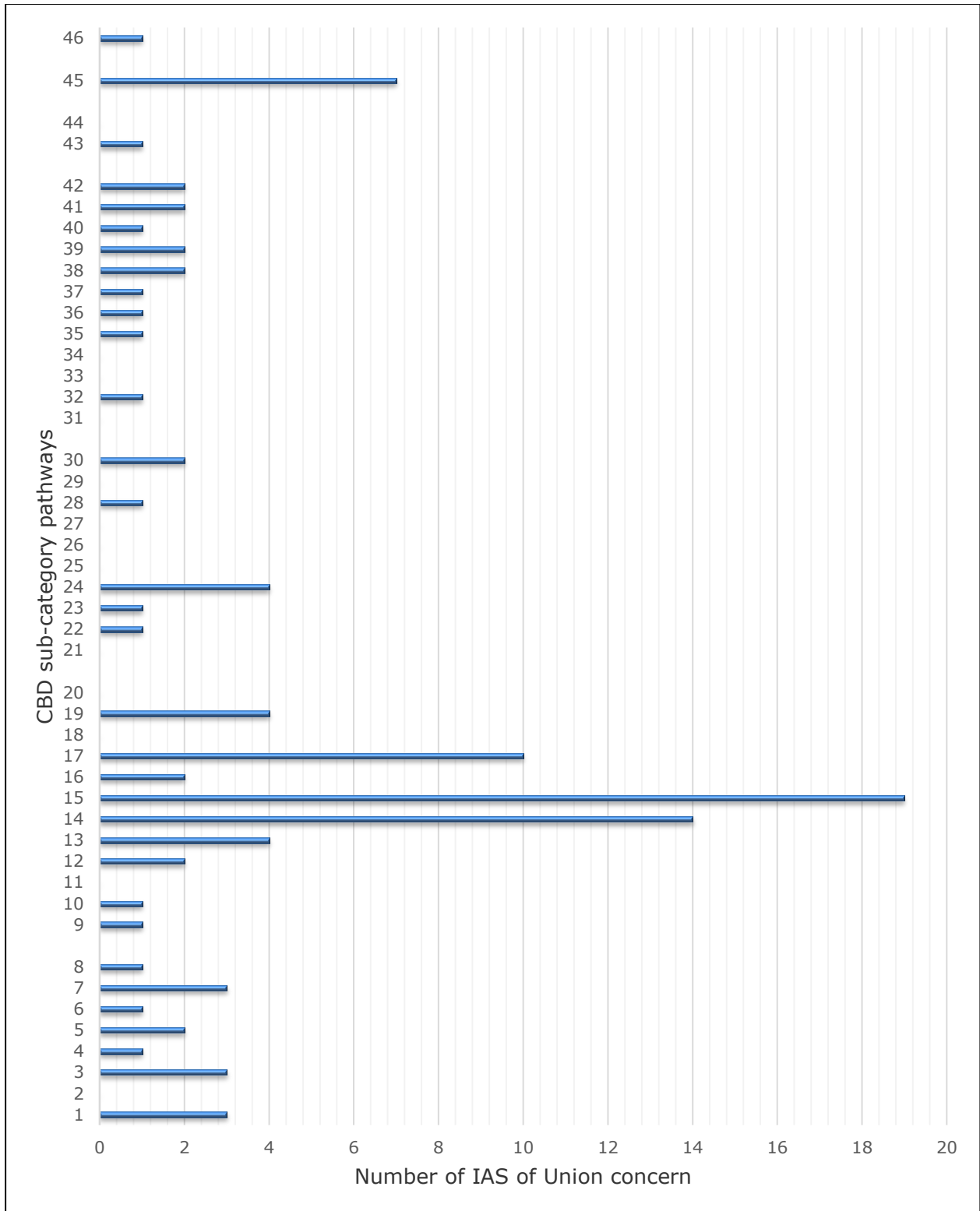


Figure 47. Sub-category pathways of introduction of IAS of Union concern in EU, based on CBD categorization. Multiple pathways for each species have been taken into consideration. CBD pathways' codes are based on Table 2 (see sub-chapter 2.7).

Year of first introduction in the EU

Most IAS of Union concern correspond to rather old introductions in EU, dating before the 1960s (Figure 48). Since then, relatively few IAS of Union concern have been introduced in the EU territory, only 5 species since the year 2000. Only one species, the plant *Persicaria perfoliata*, has not been reported as present in the EU yet.

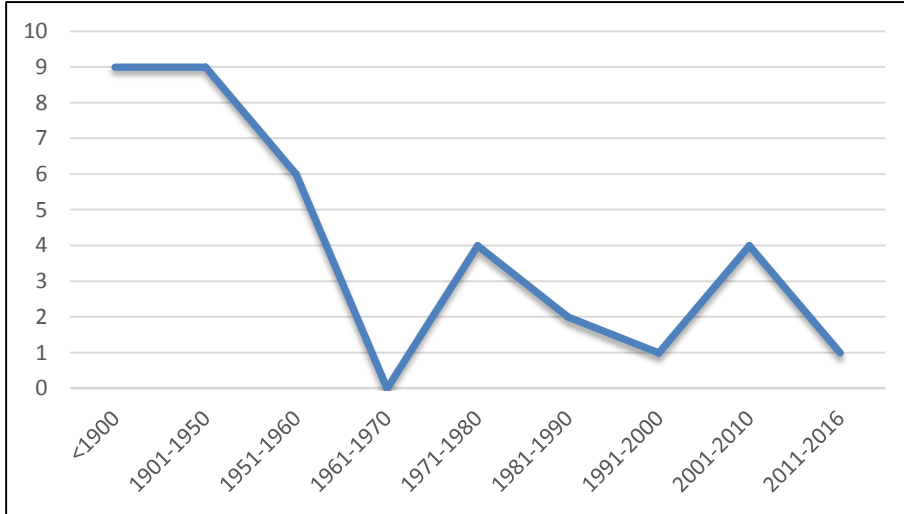


Figure 48. Timeline of first introduction events of IAS of Union concern within EU.

Country of first introduction in the EU

First introduction events of IAS of Union concern at EU level have been observed mostly in FR, UK and DE (Figure 49). No first introduction events have been observed for 11 EU MS.

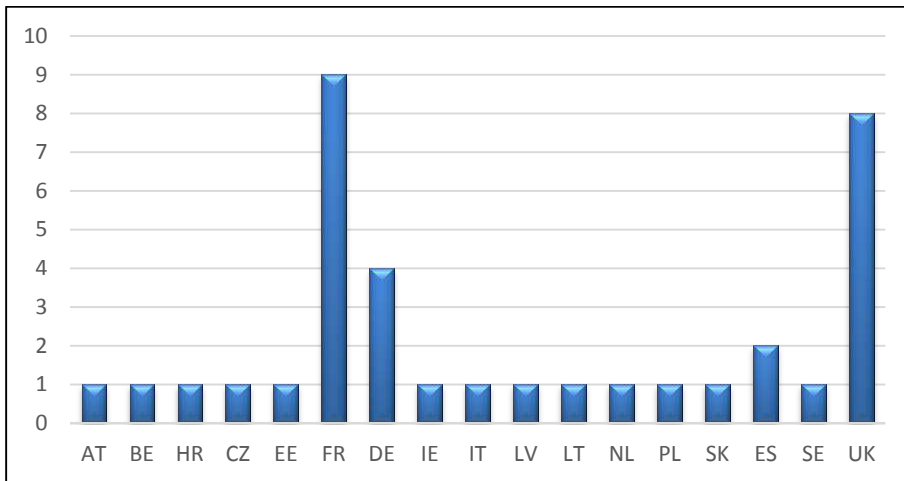


Figure 49. Countries of first introduction events of IAS of Union concern at EU scale. No first introduction events have been observed for 11 EU MS (not depicted).

4. Discussion & Conclusions

The distribution baseline of the 37 IAS of Union concern is an important tool supporting the implementation of the IAS Regulation. However, it should be noted that the present baseline has not been fully checked by all MS. For these countries the baseline information provided in the current report, coming from EASIN geodatabase, should be considered as the best available knowledge, in the absence of related information provided by the MS Competent Authorities.

Since spatial information on AS is scattered across various sources, the success of implementation of the IAS Regulation is conditioned by the availability of a dedicated system that aggregates, integrates and harmonizes related information in Europe. Addressing this challenge, EASIN offers a single aggregation point of AS spatial data and offers flexible services for mapping AS within Europe. EASIN proved to be an excellent source of information on AS spatial data for compiling the distribution baseline of the IAS of Union concern, coming from the scientific literature, online and offline databases, reports, institute collections, web sources, etc. The 10x10 km grid level scale was the most appropriate choice for depicting spatial data due to limitations of data coming from the EASIN Data Partners network. A higher spatial resolution of grid level maps is under consideration by EASIN in the near future.

MS Competent Authorities in charge of implementing the IAS Regulation were invited to check and validate the EASIN baseline data of the targeted species, at country and grid level, supplementing it with national data. The feedback received was satisfactory concerning the country level data, since 18 MS provided relevant data. However, the MS feedback was limited concerning the grid level data, with only 13 MS providing revisions of EASIN datasets. This was related with time limitations, since several MS pointed that additional time was needed to revise the baseline data. In addition, some MS highlighted that they were unable to provide feedback due to the absence of relevant digitalized data within their national repositories. Moreover, technical constraints (e.g. format of data) made difficult for some MS to compare the EASIN data with their national data concerning the grid level baseline.

The EASIN system proved to be a good source of information of IAS of Union concern distribution records within EU countries. A comparison between EASIN data and those provided by MS Competent Authorities revealed an overall good match (85%) between the two sources at country level. The mismatches observed concerned the marking of species as casual (occasional occurrences, species not reproducing and/or not overwintering) and the exclusion of certain species (historical records, eradicated species, erroneous records, misidentifications).

The distribution baseline has revealed that most IAS of Union concern have been introduced and spread across north-western EU countries (e.g. BE, DE, NL, FR, UK), while their presence is more limited in southern EU MS (e.g. MT, CY, BG). This could be related with historical reasons, since most first introductions events of the IAS of Union concern across EU took place in FR and UK, mostly before the 1960s. In addition, lack of data and limited monitoring efforts could explain the fact that for some MS only a limited reported presence and spread of the listed species has been recorded up to now.

Many IAS of Union concern are large and easily recognizable species (e.g. *Muntiacus reevesi*, *Myocastor coypus*), found in terrestrial and freshwater habitats neighbouring urban areas (e.g. *Corvus splendens* is only found close to human settlements). For this reason,

the general public, citizen-scientists in particular, could be easily involved in the reporting and monitoring of IAS of Union concern, which could help their early detections, and in the adoption of rapid response mechanisms. To this end, a dedicated smartphone application on IAS of Union concern has been recently developed by JRC (“Invasive Alien Species Europe” – Tsiamis et al. 2017). This application could act as a supplementary tool for monitoring IAS of Union concern and a way to increase public awareness and citizens’ engagement. Citizen scientist initiatives, such as the JRC/mentioned smartphone application, could benefit from the information provided by the present baseline on IAS of Union concern. More specifically, citizens can have access to the current distribution of the regulated species, which can be important for prioritizing efforts of detection of new entries and verifying observations of species already existing within their area.

As revealed by the present study, most IAS of Union concern have been introduced into EU through “escape from confinement: pet/aquarium/terrarium species and botanical garden/zoo/aquaria” and through escapes linked with “ornamental purpose other than horticulture”. Specific patterns have been revealed for plants, introduced mainly through ornamental purposes, and for all freshwater crayfish, which were introduced via aquarium trade and aquaculture. However, it should be noted that most primary introductions events took place before the 1960, related with escapes from ornamental planting, botanical gardens, and zoos. On the other hand, most recent introductions are attributed to domestic escapes from pet owners (including aquarium species – e.g. *Orconectes virilis*), and to contamination of trade commodities (containers, bulk – e.g. *Vespa velutina nigrithorax*).

Finally, it should be noted that although the current baseline offers the best available information on the IAS of Union concern within EU, it could be further enriched within all geographical Europe through the additional engagement of non-EU countries (e.g. Norway, Switzerland, several Balkan countries), revealing thus important information of the listed species outside EU territory. This would be beneficial for MS that neighbour with non-EU countries to better target monitoring and custom controls, and thus, for the effective implementation of the IAS Regulation.

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List of abbreviations and definitions

AS	Alien species as defined in Art. 3 of EU Regulation 1143/2014
CABI	Centre for Agriculture and Biosciences International (http://www.cabi.org/)
CBD	Convention on Biological Diversity (https://www.cbd.int/)
CIESM	International Commission for Scientific Exploration of the Mediterranean Sea (http://www.ciesm.org/)
DAISIE	Delivering Alien Invasive Species Inventories for Europe (http://www.europe-aliens.org/)
DG ENV	European Commission Directorate General for Environment
EASIN	European Alien System Information Network (http://easin.jrc.ec.europa.eu/)
EC	European Commission
EEA	European Environmental Agency (http://www.eea.europa.eu/)
ELNAIS	Hellenic Network on Aquatic Invasive Species (http://elnais.hcmr.gr/)
EPPO	European and Mediterranean Plant Protection Organization (https://www.eppo.int/)
EU	European Union
GBIF	Global Biodiversity Information Facility (http://www.gbif.org/)
GISID	Global Invasive Species Database (http://www.iucngisd.org/gisd/about.php)
GISIN	Global Invasive Species Information Network (http://ibis-live1.nrel.colostate.edu/DH.php?WC=/WS/GISIN/GISINDirectory/home_new.html&WebSiteID=4)
HCMR	Hellenic Centre for Marine Research (http://www.hcmr.gr/en/)
IAS	Invasive Alien Species as defined in Art. 3 of EU Regulation 1143/2014
IAS of Union concern	Species identified according to Art. 4 of the EU Regulation 1143/2014, requiring EU concerted action, published in the EU Commission Implementing Regulation 1141/2016 of 13 July 2016
IAS Regulation	Regulation (EU) No 1143/2014 of the European Parliament and of the Council of 22 October 2014 on the prevention and management of the introduction and spread of invasive alien species

ITIS	Integrated Taxonomic Information System (https://www.itis.gov/)
IUCN	International Union for Conservation of Nature (https://www.iucn.org/)
JRC	Joint Research Centre Directorate of the European Commission
MAMIAS	Marine Mediterranean Invasive Alien Species (http://www.mamias.org/)
MS	Member States
NBIC	Norwegian Biodiversity Information Centre (http://www.biodiversity.no/)
NOBANIS	European Network on Invasive Alien Species (https://www.nobanis.org/)
NOTSYS	Official notification system for detection of IAS of Union concern (https://easin-notsys.jrc.ec.europa.eu/)
REABIC	Regional Euro-Asian Biological Invasions Centre (http://www.reabic.net/)
WoRMS	World Register of Marine Species (http://www.marinespecies.org/)

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List of Annexes

Annex I. Protocol for checking EU baseline distribution of IAS of Union concern in EASIN (Regulation (EU) 1143/2014).

Introduction

This protocol intends to provide guidance to Member States (MS) on how to check the EASIN (European Alien Species Information Network: <http://easin.jrc.ec.europa.eu>) records on occurrence and distribution of each Invasive Alien Species (IAS) of Union concern in their territory, aiming to set a valid geographic baseline distribution of IAS of Union concern in European Union (EU).

Occurrence means that a species is established (reproducing in the wild and forming self-sustaining populations) or casual (few sporadic records and/or not reproducing in the wild).

Detailed and updated spatial information in relation to the IAS of Union concern in the MS territories is needed for establishing the baseline distribution of the listed species, fundamental for the implementation of the IAS Regulation. DG ENV invited MS to evaluate and endorse the baseline distribution of the IAS of Union concern in EASIN, which has been appointed as the official information support system foreseen under Art. 25 of the Regulation (EU) 1143/2014 on IAS.

EASIN, developed by the Joint Research Centre (JRC), is an online platform of interoperable web services, gathering existing information on alien species from distributed sources. Among other functionalities, EASIN aggregates, integrates and harmonizes spatial data of alien species in Europe, from a network of global, European and national databases (EASIN Data Partners: <http://easin.jrc.ec.europa.eu/Partners/Partners>) as well as from the scientific literature (EASIN-Lit: <http://easin.jrc.ec.europa.eu/EASINLits>). EASIN datasets follow internationally recognized standards and protocols, are free to the public through web services, while ownership of the data remains with its source, which is properly cited and linked to the EASIN Geodatabase.

Baseline check

MS are invited to check the EASIN records of occurrence and spatial distribution of each IAS of Union concern in their territory, and to provide revisions and/or updates of spatial data. The baseline check will need to take place in two distinct steps:

1. Country-level check
2. Grid-level check (GIS data 10x10 km)

Please note that EASIN maps show occurrence(s) of species (established or casual) based on data available coming from the network of EASIN Data Partners and EASIN-Lit. Absence from a specific area in the generated map does not necessarily indicate the non-occurrence of the species in this area.

1. Country-level check

This check should follow the following procedure:

- Go to the EASIN homepage website: <http://easin.jrc.ec.europa.eu>
- Click on "Services – Species search and mapping".

The screenshot shows the EASIN homepage with the following elements:

- Header: European Commission logo, "JOINT RESEARCH CENTRE", and "European Alien Species Information Network - EASIN".
- Navigation bar: "HOME", "ABOUT EASIN", "SERVICES" (circled in red), "LEGAL FRAMEWORK", "DOCUMENTATION", "NOTSYS", "EDITORIAL BOARD".
- Main image: A grey squirrel in a snowy environment with a text overlay: "The grey squirrel (*Sciurus carolinensis*) is native to deciduous forests in the USA and has been introduced in Europe, where it is causing the local extinction of red squirrel (*Sciurus vulgaris*) populations through competition and disease. This species has been nominated as among 100 of the 'World's Worst' invaders." Credit: ©Pennsylvania State University.
- Statistics table:

SPECIES	OCCURRENCES	DATA PARTNERS
14,195	17,777,221	8
- Upcoming Events:
 - Sunday, 19 June 2016, Prague: 7th International Weed Science Congress
 - Monday, 18 July 2016, Azores: Island Biology Conference
 - Sunday, 31 July 2016, Turin: SIL 2016, 32nd Congress of the International Society of Limnology
 - Monday, 28 August 2016, Montpellier
- Footer: "Welcome to EASIN" section with introductory text and "Last Update: 05/05/2016" link.

- Type the name of an IAS of Union concern (e.g. *Lithobates catesbeianus*) in the species search field ("type scientific or common name") and press enter. Try also to type only part of the name or the common name (American bullfrog); this will lead to automatic suggestions to assist the user in selecting the desired species.
- Check on the white small box, left to the species name.
- Then, click on "Show Map" to visualize the map.

Species Search and Mapping

Basic Search | Advanced Search | Saved Searches | Terms and Conditions | About For more options please Log In | Register

Type scientific or common name
 Search

Environment: Terrestrial | FreshWater | Marine | Oligohaline | Impact: High | Low/Unknown | All | Species Status: Alien | Cryptogenic | Questionable

Query (1 selected)

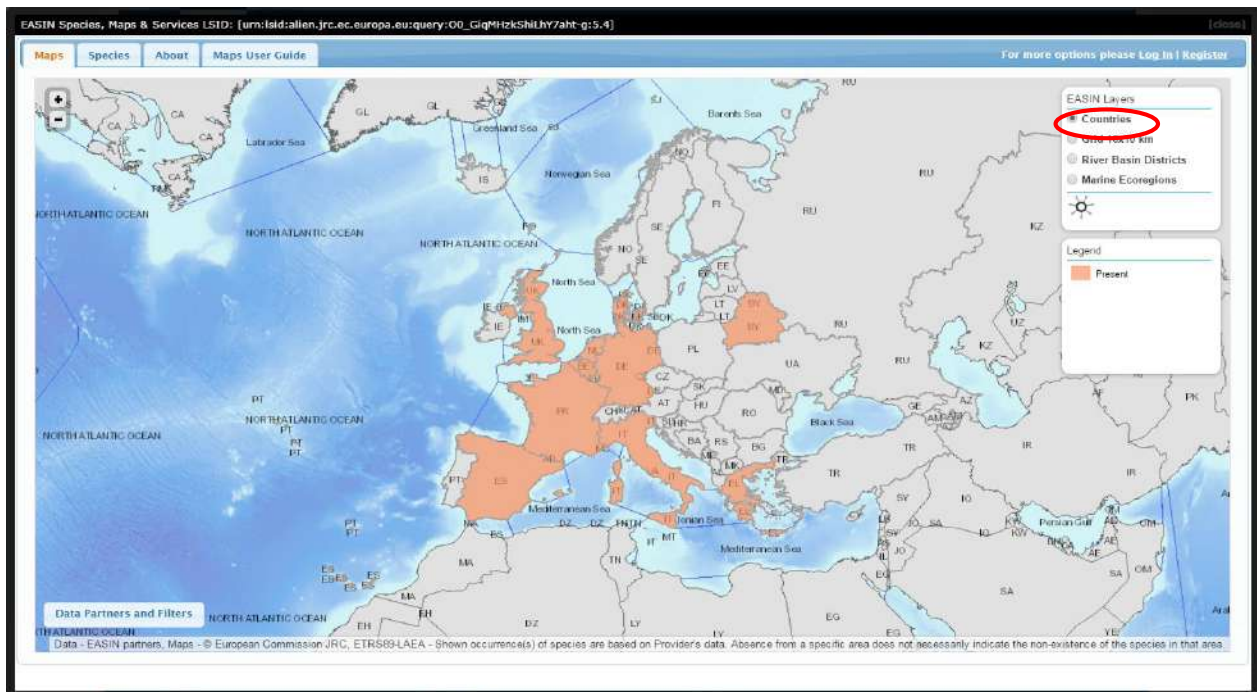
Show 10 entries

	Scientific Name	Environment	Impact
<input checked="" type="checkbox"/>	Lithobates catesbeianus	TER-FW	High

Showing 1 to 1 of 1 entries

For more detailed information about each species click the green button on the left of the names.

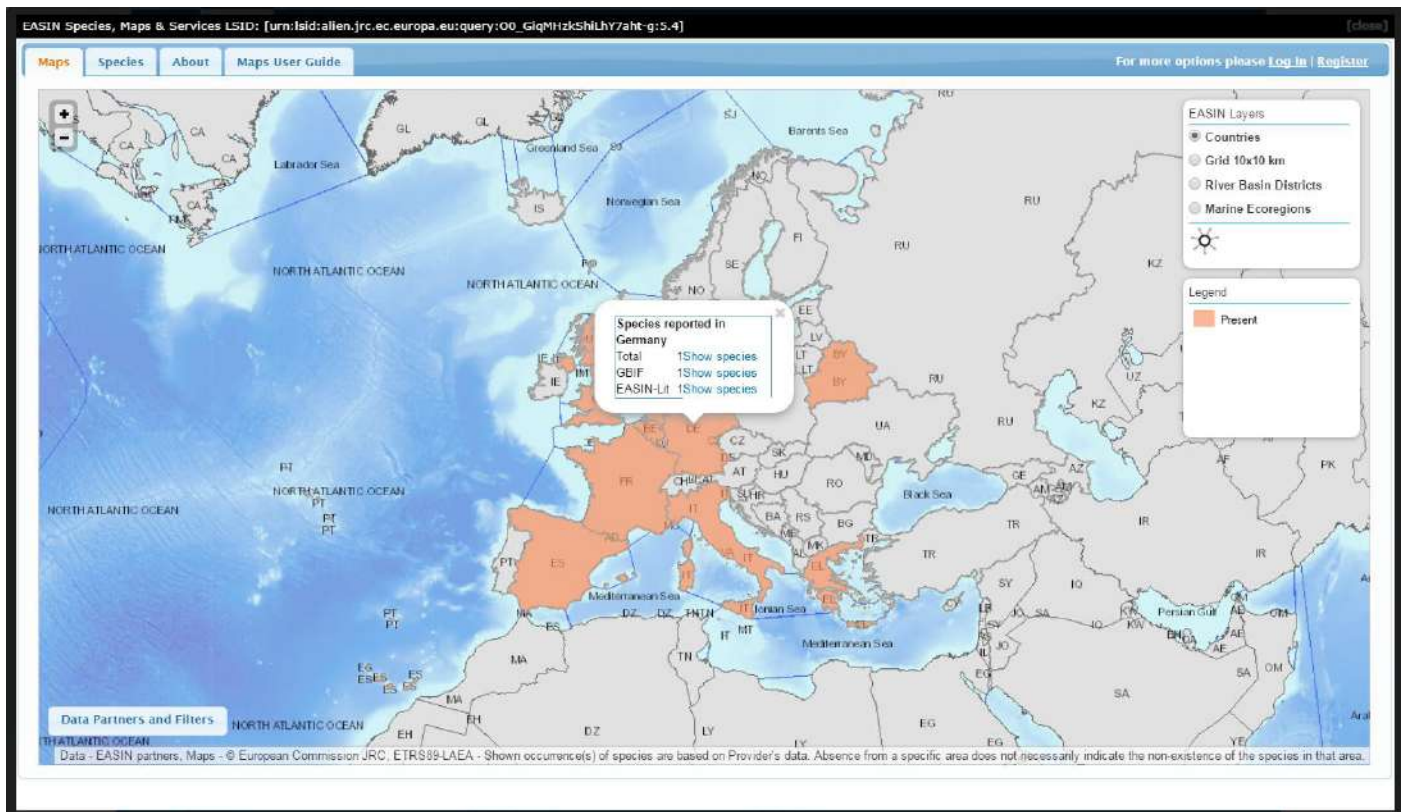
A map of Europe showing all occurrences of the species in Europe appears. Notice that the EASIN map layer is preselected to "Countries" layer.



Please note that the coloured areas of the map show the area (countries in the case of "countries layer") on which the species occurs, based on the network of EASIN Data

Partners (<http://easin.jrc.ec.europa.eu/Partners/Partners>) or the scientific literature sources of EASIN-Lit (<http://easin.jrc.ec.europa.eu/EASINLits>).

- To check the sources of the species occurrences in a specific country, click on the country of your interest on the country code (e.g. for Germany, click on "DE")
- A window will appear showing the information sources (EASIN Data Partners). In the case of *Lithobates catesbeianus* for Germany, the species is reported by GBIF and EASIN-Lit.



- By clicking on EASIN-Lit "Show species" and by clicking again on the species name (in that case: "*Lithobates catesbeianus*") you can have access to selected publications reporting the presence of the species in the specific country.



Original data provider for selected species. [close]

Original Data Providers	
Name:	Ficetola GF, Thuiller W, Maud C, 2007. Prediction and validation of the potential global distribution of a problematic alien invasive species—the american bullfrog. Diversity and Distributions 13(4):476-485.
Url (if available):	
Name:	Gollasch S, Nehring S, 2006. National checklist for aquatic alien species in Germany. Aquatic Invasions 1(4): 245-269.
Url (if available):	
Name:	Adriaens T, Devisscher S, Louette G, 2013. Risk analysis of American bullfrog <i>Lithobates catesbeianus</i> (Shaw). Risk analysis report of non-native organisms in Belgium. Rapporten van het Instituut voor Natuur- en Bosonderzoek 2013 (INBO.R.2013.41). Instituut voor Natuur- en Bosonderzoek, Brussel.
Url (if available):	http://goo.gl/cXzkMz

MS are invited to check the occurrence of each IAS of Union concern in their territory following the above procedure, and to provide revisions and/or updates of spatial data. The following table should be filled-in for the country-level check and returned by e-mail to easin@jrc.ec.europa.eu.

In addition, species considered as “casual” (rare, sporadic records, population not reproducing in the wild) in country level should be marked with an *.

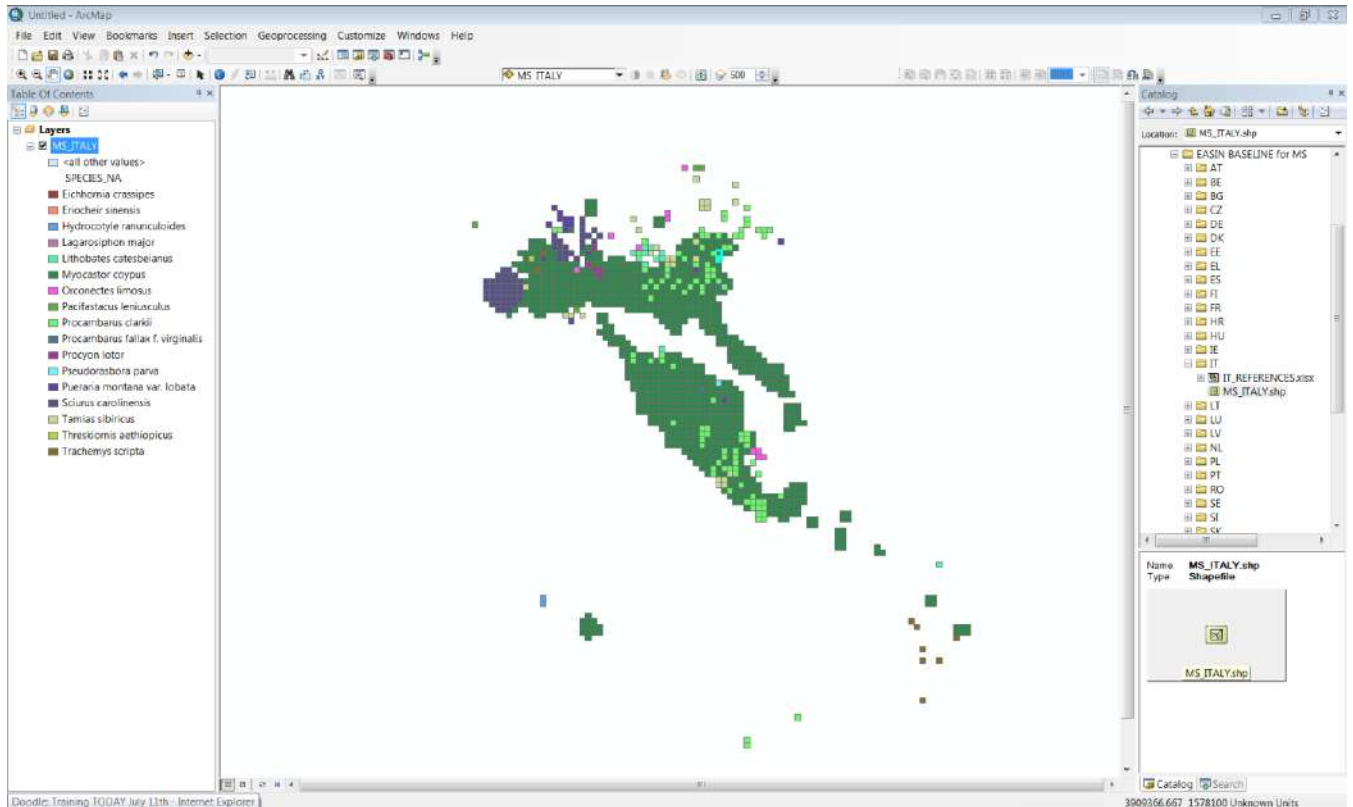
Union concern IAS	Accept EASIN country-level map for your country. Indicate "Yes" or "No"	Remarks. In case you indicate "NO" please explain the reason, citing appropriate reference(s).
<i>Baccharis halimifolia</i>		
<i>Cabomba caroliniana</i>		
<i>Callosciurus erythraeus</i>		
<i>Corvus splendens</i>		
<i>Eichhornia crassipes</i>		
<i>Eriocheir sinensis</i>		
<i>Heracleum persicum</i>		
<i>Heracleum sosnowskyi</i>		
<i>Herpestes javanicus</i>		
<i>Hydrocotyle ranunculoides</i>		
<i>Lagarosiphon major</i>		
<i>Lithobates catesbeianus</i>		
<i>Ludwigia grandiflora</i>		
<i>Ludwigia peploides</i>		
<i>Lysichiton americanus</i>		
<i>Muntingia calabura</i>		
<i>Muntiacus reevesi</i>		
<i>Myocastor coypus</i>		
<i>Myriophyllum aquaticum</i>		
<i>Nasua nasua</i>		
<i>Orconectes limosus</i>		

<i>Orconectes virilis</i>		
<i>Oxyura jamaicensis</i>		
<i>Pacifastacus leniusculus</i>		
<i>Parthenium hysterophorus</i>		
<i>Perccottus glenii</i>		
<i>Persicaria perfoliata</i>		
<i>Procambarus clarkii</i>		
<i>Procambarus fallax f. virginalis</i>		
<i>Procyon lotor</i>		
<i>Pseudorasbora parva</i>		
<i>Pueraria montana var. lobata</i>		
<i>Sciurus carolinensis</i>		
<i>Sciurus niger</i>		
<i>Tamias sibiricus</i>		
<i>Threskiornis aethiopicus</i>		
<i>Trachemys scripta</i> ¹		
<i>Vespa velutina nigrithorax</i>		

¹ This includes occurrences of any of the three sub-species *T. s. scripta*, *T. s. elegans* and *T. s. troosti*. EASIN also includes records for each of these sub-species

2. Grid-level check (GIS data 10x10 km)

Shape files⁵ including all records of occurrences of all IAS of EU concern per country are provided together with this protocol by JRC EASIN Team to MS. MS are invited to compare the data in EASIN with their national data.



The shape file for Union concern species for Italy

MS are requested to check the occurrence of each IAS of Union concern within the 10x10 km grid in their territory, and to provide revisions and/or updates of spatial data as a new shapefile, containing all files with extensions .shp, .shx, .dbf (Lat/Long, WGS84).

The shapefile provided to each MS by EASIN contains the following information (GIS Attribute Table):

- Identificator of the record (FID: a code of each EASIN record).
- Spatial information (Shape: polygon, line or dot).
- Scientific name of the species of Union concern (Species_NA).
- Name of the entity providing the original observation (EASIN Data Partner: <http://easin.jrc.ec.europa.eu/Partners/Partners>).

⁵ *The shapefile is a geospatial vector data format for storing geometric location and associate attribute information to be used in a geographic information system (GIS) software. It is developed as a (mostly) open specification for data interoperability GIS software products. The shapefile format can spatially describe vector features: points, lines, and polygons, representing, for example rivers, and lakes. Each item usually has attributes that describe it, such as name.*

- Identificator of the reference (e.g. scientific publication) (code of reference). Full citation references can be found in a separate excel file, also provided by EASIN.
- Accepted by the MS (Y/N).
- Notes: in case you indicate "N" please explain the reason, citing appropriate reference(s) when applicable.

Only the last two columns ("Accepted" and "Notes") need to be completed by the MS. The rest are already provided by EASIN. All the relevant information is depicted at the following table (Attribute Table in the GIS format).

FID	Shape *	SPECIES_NA	DATA_PARTN	REFERENCE	ACCEPTED	NOTES
0	Polygon	Eichhornia crassipes	EASIN-Lit	5000141		
1	Polygon	Eriocheir sinensis	EASIN-Lit	5000250		
2	Polygon	Eriocheir sinensis	EASIN-Lit	5000250		
3	Polygon	Eriocheir sinensis	EASIN-Lit	5000250		
4	Polygon	Eriocheir sinensis	CIESM	5622		
5	Polygon	Hydrocotyle ranunculoides	EASIN-Lit	5000141		
6	Polygon	Hydrocotyle ranunculoides	EASIN-Lit	5000141		
7	Polygon	Lagarosiphon major	EASIN-Lit	5000101		
8	Polygon	Lagarosiphon major	EASIN-Lit	5000027		
9	Polygon	Lithobates catesbeianus	EASIN-Lit	5000434		
10	Polygon	Lithobates catesbeianus	EASIN-Lit	5000434		
11	Polygon	Lithobates catesbeianus	EASIN-Lit	5000434		
12	Polygon	Lithobates catesbeianus	EASIN-Lit	5000434		
13	Polygon	Lithobates catesbeianus	EASIN-Lit	5000434		
14	Polygon	Lithobates catesbeianus	EASIN-Lit	5000434		
15	Polygon	Lithobates catesbeianus	EASIN-Lit	5000434		
16	Polygon	Lithobates catesbeianus	EASIN-Lit	5000434		
17	Polygon	Lithobates catesbeianus	EASIN-Lit	5000434		
18	Polygon	Lithobates catesbeianus	EASIN-Lit	5000434		
19	Polygon	Lithobates catesbeianus	EASIN-Lit	5000434		
20	Polygon	Lithobates catesbeianus	EASIN-Lit	5000434		
21	Polygon	Lithobates catesbeianus	EASIN-Lit	5000434		
22	Polygon	Lithobates catesbeianus	EASIN-Lit	5000434		
23	Polygon	Lithobates catesbeianus	EASIN-Lit	5000434		
24	Polygon	Lithobates catesbeianus	EASIN-Lit	5000434		
25	Polygon	Lithobates catesbeianus	EASIN-Lit	5000434		
26	Polygon	Lithobates catesbeianus	EASIN-Lit	5000283		
27	Polygon	Lithobates catesbeianus	EASIN-Lit	5000283		
28	Polygon	Lithobates catesbeianus	EASIN-Lit	5000283		
29	Polygon	Lithobates catesbeianus	EASIN-Lit	5000243		
30	Polygon	Lithobates catesbeianus	EASIN-Lit	5000434		
31	Polygon	Lithobates catesbeianus	EASIN-Lit	5000434		
32	Polygon	Lithobates catesbeianus	EASIN-Lit	5000434		
33	Polygon	Lithobates catesbeianus	EASIN-Lit	5000434		
34	Polygon	Lithobates catesbeianus	EASIN-Lit	5000434		
35	Polygon	Lithobates catesbeianus	EASIN-Lit	5000434		
36	Polygon	Lithobates catesbeianus	EASIN-Lit	5000283		
37	Polygon	Lithobates catesbeianus	EASIN-Lit	5000283		

In addition, an Excel file is provided by EASIN containing the related full references mentioned in the shapefile (reference code and associated citation). References are the sources (e.g. scientific publications, datasets) from which the information about the species occurrences have been extracted and processed by EASIN.

New spatial data entries can be provided by the MS using the same shape file provided by EASIN (adding new features in the Attribute Table in the GIS environment) or creating new shape files following the same structure. New spatial data entries should contain all the relevant information included in the Attribute Table:

- Identificator of the record (FID). Please use the next available serial number for each new entry.
- Spatial information (choose among: polygon, line or dot).
- Scientific name of the species of Union concern (Species_NA).
- Name of the entity providing the record (the official name of the MS national authority organization).
- Identificator of the reference (provide a code of reference). Add the new code and the full citation reference in the excel file provided by EASIN.

Please return all new or revised files by email to easin@jrc.europa.eu.

Notes:

- The coordinate system and projection of the spatial information are the European Terrestrial Reference System 1989 and Lambert azimuthal equal-area projection (ETRS89/ETRS-LAEA, EPSG:3035, <http://spatialreference.org/ref/epsg/etrs89-etrs-laea>).
- Shapefiles can be opened and manipulated by GIS software as ArcGIS, QGIS, GRASS.
- Member States Competent Authorities should avoid shapefiles overlapping with adjoining MS borders or countries not belonging to the European Union and stretching into coastal waters.

Annex II. Detailed spatial information at grid level 10x10 km as well as original sources are provided for each IAS of Union concern and for each EU country through ARC GIS digital files.

Important Note: Due to the huge number of ARC GIS files (>350), the information is directly provided through a web-link in the EASIN website (<https://easin.jrc.ec.europa.eu/>).

The related information is also available on request by the EASIN team (jrc-easin@ec.europa.eu).

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