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Baseline distribution of invasive alien species added to the Union list by Comm. Impl. Reg. (EU) 2022/1203

Data to benchmark the progress of Regulation (EU) 1143/2014

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Contents

Abstract

Commission Implementing Regulation 2022/1203/EC added 22 invasive alien species of Union concern (IAS of UC) to the Union List set under EU Regulation (EU) 1143/2014 (IAS Regulation). IAS of UC are alien species whose adverse impact has been deemed so severe to require concerted action at Union level. Towards this aim, high-quality and updated data on the new IAS of UC is crucial for their management.

This report provides the baseline distribution of 13 IAS of UC out of 22 added to the Union list, which are currently present in the EU territory and to which the IAS Regulation applies. This data constitutes the reference baseline at European level. 18 EU Member States (MS) Competent Authorities contributed to the definition of the baseline by revising and supplementing spatial data harvested from the European Alien Species Information Network (EASIN).

In addition to the species spatial distribution for each IAS of UC, the report contains information on the taxonomic group, origin, first introduction in the EU, main pathway of introduction in the EU, habitat, and ecosystems impact. To this end, the pressure caused by the 13 IAS of UC on terrestrial and freshwater ecosystems across the EU is assessed in this report.
Results show that 77% of these IAS of UC are from the Kingdom Animalia and the Infraclass Teleostei (31%). 50% of freshwater and terrestrial IAS of UC were introduced in Europe through the primary pathway "Escape from confinement" and 20% by intentional introductions: "Biological control" (10 %) or "Other intentional release" (10%). The distribution of the 13 species subject of the baseline shows their highest number of established occurrences in France and Spain, i.e., 8 and 7 respectively, and the lowest in Denmark, Luxemburg, Sweden and Slovakia. Six species are more frequent across EU: A*meiurus melas, Gambusia holbrooki, Koenigia polystachya,* and *Gambusia affinis*. Croplands ecosystems show the highest percentage of invaded area and the highest average of cumulative pressure by IAS of UC, suggesting negative impacts on agroecosystems. On the opposite side, the lowest pressure is recorded in grassland areas.

This baseline will support MS in the implementation of the IAS Regulation. It will help adapting the surveillance and monitoring systems and is an essential reference to the application of "Early detection Notifications" and will also support the review of the IAS Regulation. In addition, this data is key for fostering MS cooperation and coordination across borders or within shared biogeographical regions.

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ES- Spain	*Dirección General de Biodiversidad, Bosques y Desertificación. Ministerio para la Transición Ecológica y el Reto Demográfico*
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Executive summary

This report collects spatial data on 13 invasive alien species (IAS) out of 22 added to the Union list on 12 July 2022 by Commission Implementing Regulation 2022/1203/EC. IAS records for this baseline were retrieved from the European Alien Species Information Network (EASIN) and submitted to EU Member States (MS) Competent Authorities for revision. IAS data were revised and validated by experts of 18 MS and is currently available in EASIN at country and cell (10 km x 10 km) scales.

The EU Regulation 1143/2014/EC (herein IAS Regulation) on the prevention and management of the introduction and spread of IAS aims to prevent, minimise and mitigate the adverse impacts of IAS on biodiversity and ecosystem services and limit social and economic damage. The list of IAS of Union concern (IAS of UC) is at the core of the IAS Regulation. IAS are defined in Art 3 (3) of the IAS Regulation as "alien species whose introduction or spread has been found to threaten or adversely impact upon biodiversity and related ecosystem services". The Union list and its updates are adopted by implementing acts, subject to the positive opinion of the Committee on IAS (Art. 27 of the IAS Regulation).

This report constitutes the baseline distribution of 13 IAS of UC added to the Union list in 2022, whose presence has been recorded in the EU territory to which the IAS Regulation currently applies. Nine species were excluded from the analysis of this report either because not yet present in Europe (i.e., *Faxonius rusticus, Limnoperna fortunei, Morone americana, Solenopsis invicta, Solenopsis richteri*), or because subject to a transition period (i.e., *Celastrus orbiculatus* and *Pistia stratiotes*) or deferred from the Union list until 2024 (i.e., *Xenopus laevis, Fundulus heteroclitus*).

Results show that 77% of the IAS of UC are from the Kingdom Animalia and the Infraclass Teleostei (31%). 50% of freshwater and terrestrial IAS of UC were introduced in Europe through the primary pathway "Escape from confinement" and 20% by intentional introductions: "Biological control" (10 %) or "Other intentional release" (10%). The highest number of the established 13 IAS of UC covered by this report is in France and Spain, i.e., 8 and 7 respectively, and the lowest in Denmark, Luxemburg, Sweden and Slovakia. Six species are more frequent across EU: A*meiurus melas, Gambusia holbrooki, Koenigia polystachya,* and *Gambusia affinis*. Croplands ecosystems show the highest percentage of invaded area and the highest average of cumulative pressure by IAS of UC, suggesting negative impacts on agroecosystems. On the opposite side, the lowest pressure is recorded in grassland areas.

This baseline **supports the implementation of the IAS Regulation** by providing **timely and precise information on IAS of UC** that is key to **strengthen surveillance systems and focus monitoring systems** of the EU MS. It is an **essential reference to the application of "Early detection Notifications" requirements and for the review of the IAS Regulation**. This data can also help **national and local governments in the development of action plans** against IAS of UC and develop new strategies **to address priority pathways** of IAS and prevent their unintentional introduction and spread. **A shared European baseline is of particular importance to take measures along country borders and in shared river basins or protected areas**. Finally, this baseline is key to **benchmark progress towards** the commitment to manage established IAS and **decrease the number of Red List species they threaten by 50% by 2030, as set by the EU biodiversity strategy to 2030.**

1 Introduction

The European Alien Species Information Network (EASIN) was asked to compile the distribution baseline of the 22 invasive alien species (IAS) added to the Union list on 2 August 2022 (Commission Implementing Regulation (Comm. Impl. Reg.) 2022/1203/EC) (Box 1). IAS are at the core of the EU Regulation (EU) 1143/2014 (IAS Regulation), which focuses on the prevention and management of the introduction and spread of IAS aiming to prevent, minimise and mitigate their adverse impacts on biodiversity and ecosystem services and limit social and economic damage. The adoption of the IAS Regulation was a major step forward for the EU biodiversity policy; it fulfilled Action 16, Target 5 of the EU Biodiversity Strategy to 2020 (COM, 2011) and the Aichi Target 9 of the strategic plan on biodiversity 2011-2020 under the Convention on Biological Diversity[1].The implementation of the IAS Regulation will continue enabling achievements towards reducing threats to biodiversity at European, i.e. the Biodiversity Strategy 2030[2], and at global, i.e. Kunming-Montreal Global Biodiversity Framework (Target 6[3]), scales.

IAS are defined by Art 3 (3) of IAS Regulation as "alien species whose introduction or spread has been found to threaten or adversely impact upon biodiversity and related ecosystem services". Concrete actions at Union level are required for a list of species as defined by Art. 4, i.e., the Union list of IAS of Union concern. The Union list and its updates are adopted by implementing acts, subject to the positive opinion of the Committee on IAS (Art. 27 of the IAS Regulation). The first Union list entered into force on 3 August 2016 and contained 37 species (Comm. Impl. Reg. 2016/1141/EC). A first and a second update of the list entered into force on 2 August 2017 and on 15 August 2019 (Comm. Impl. Reg. 2017/1263/EC; Comm. Impl. Reg. 2019/1262/EC). These updates added 12 and 17 species, respectively. A third update of the Union was adopted on 12 July 2022 and entered into force on 2 August 2022 (Comm. Impl. Reg. 2022/1203/EC) with 22 new species (Annex 1, Figure A.1). The total number of IAS of Union concern is currently 88 (Box 2).

Box 1. European Alien Species Information Network - EASIN

EASIN is the official information system of the IAS Regulation (Art. 25), which collects, manages, and stores alien species data across Europe and makes it available through web tools for data analysis, open sharing, and reporting. EASIN works together with EU MS to strengthen surveillance systems, sharing data and for data quality check.

The quality of data inputs in EASIN is assured by thematic specialists (i.e., Editorial Board members and experts[4]) (Tsiamis et al., 2016). Before being stored in the EASIN databases, the data is cleansed and standardised (spatial data accordingly to the INSPIRE Framework Directive 2007/2/EC (EU, 2007), Darwin Core Standard[5]; Wieczorek et al., 2012). Data is released under the CC-BY licence enabling reuse with attribution to the original sources. IAS of UC and their traits (i.e., taxonomy, environment, origin) and invasion-related factors (i.e., year and country of first introduction, and pathways of introduction) is stored in the EASIN Catalogue database (version 10.0)[6], which currently hosts approximately 14,300 alien taxa in Europe. EASIN has been used for pan-European and regional assessments of alien and IAS invasions (e.g., Arianoutsou et al., 2021, Magliozzi et al., 2020, Tsiamis et al. 2020), and for the baseline of IAS of UC for the first Union list and updates up to 2019 (Tsiamis et al., 2017, 2019a, 2019b, 2021).

[1] https://www.cbd.int/decision/cop/?id=12268
[2] https://eur-lex.europa.eu/resource.html?uri=cellar:a3c806a6-9ab3-11ea-9d2d-01aa75ed71a1.0001.02/DOC_1&format=PDF
[3] https://www.cbd.int/doc/c/e6d3/cd1d/daf663719a03902a9b116c34/cop-15-l-25-en.pdf
[4] https://easin.jrc.ec.europa.eu/eb
[5] Darwin Core. Darwin Core quick reference guide. https://dwc.tdwg.org/terms/ (2018)
[6] https://easin.jrc.ec.europa.eu/easin/Catalogue

This report presents the analysis of the spatial data of 13 IAS of UC listed by the Comm. Impl. Reg. 2022/1203/EC, present in Europe and for which IAS Regulation currently applies, that were collated by EASIN, revised and supplemented by the EU MS Competent Authorities. Spatial data on IAS of UC are presented at country and cell scale (10 km x 10 km), while taxon traits (i.e., taxonomy, environment, origin) and invasion related factors (i.e., year and country of first introduction, and pathways of introduction) are provided for each species. The last section presents a case study, where the pressure of IAS of UC in European ecosystems is assessed by using an indicator linking the number of IAS of UC to the extent of the ecosystem potentially affected. This section includes links with other policies (EU Biodiversity Strategy 2030[7]; Nature Restoration[8]). Finally, the report concludes with a reflection on the status of IAS of UC data and avenues for improvement.

Box 2. Overview of the traits and invasion related factors of 88 IAS of UC in the Union List

The 88 IAS of UC comprise 47 animal and 41 plants *(Figure Box 2.1)*.
Most of IAS of UC are terrestrial (53%) and freshwater (44%), and only two species are from the marine habitat, i.e., *Plotosus lineatus* and *Rugulopteryx okamurae (Figure Box 2.1)*.

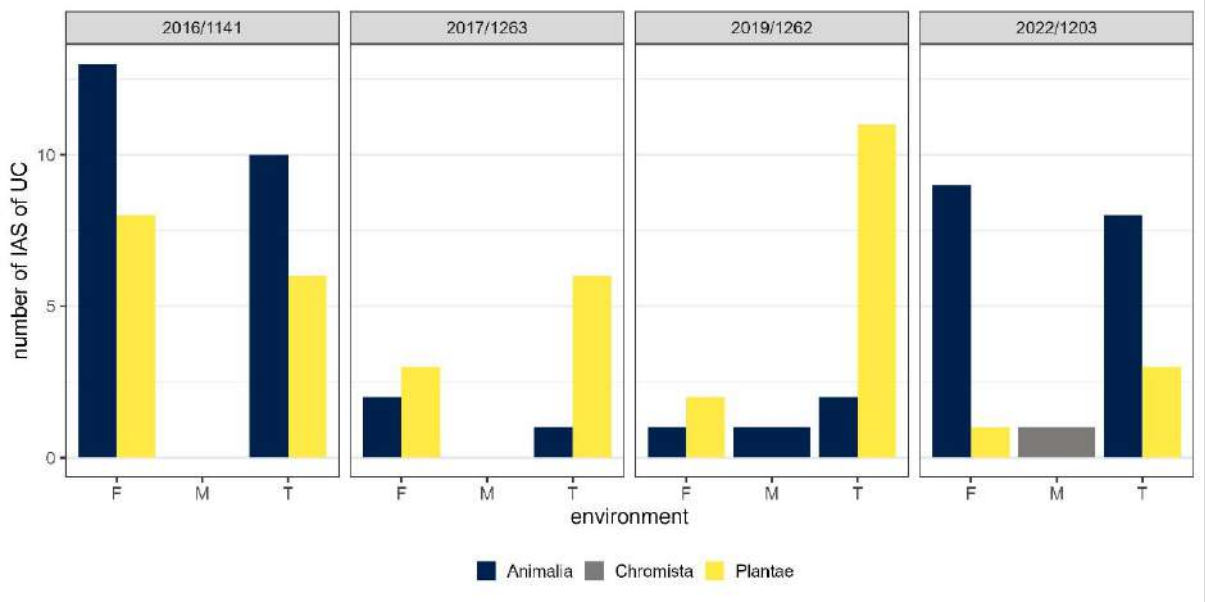

Figure Box 2.1: Number of IAS of UC for each Kingdom and across environment (freshwater (F), marine (M), terrestrial (T)) added to the Union list over time.

[7] COM(2020) 380 final
[8] COM(2022) 304 final

Box 2. (continued)

The most common primary pathway of introduction for the 88 IAS of UC is "Escape from confinement" (Figure Box 2.2). This pathway is mostly related to "Ornamental purpose other than horticulture" and "Pet/aquarium/terrarium species" subcategories (Figure Box 2.2).

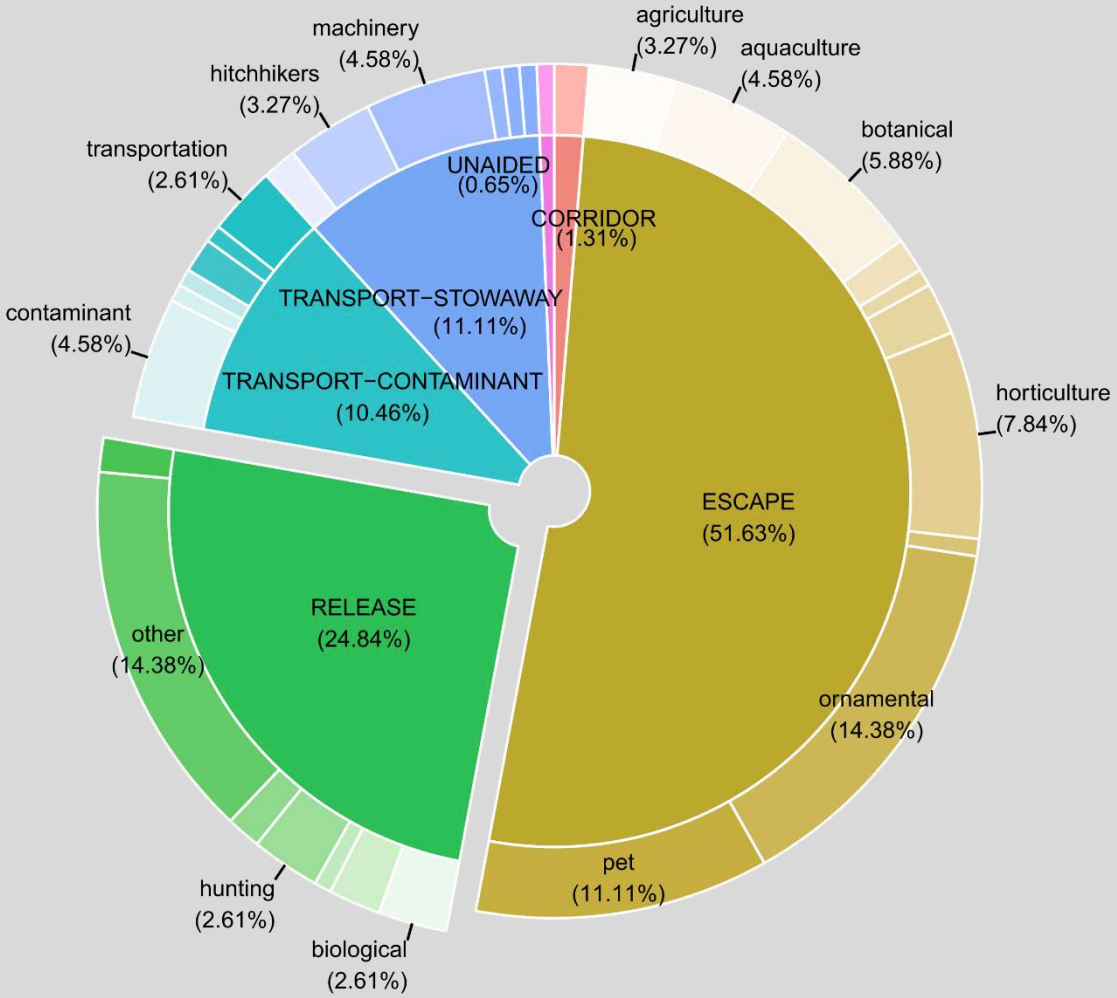

Figure Box 2.2: Primary pathways of introduction for the 88 IAS of UC in the Union List. Within each main pathway category, the name and percentage of species introduced is provided only for the main pathway subcategories. Subcategory with percentages less than 2 % are not displayed.

2 Methodology

IAS of UC data was retrieved through a two-step process following the protocol[9] of Tsiamis et al. (2021).

The first step was the harvesting of IAS occurrences from EASIN. The JRC conducted a thorough review of the spatial occurrences in Europe of the 22 IAS of UC based on existing scientific literature, which supplemented spatial data from the EASIN network of data partners[10], and was integrated in the EASIN geodatabase (Box 1, Section 3.2). Sources encompassed international scientific and grey literature, online and offline national databases, reports, and institutes collections. EASIN records of IAS of UC were extracted in two data formats for revision by MS Competent Authorities: Excel Binary File Format (.xls) and ESRI Shapefile (.shp). This data was aggregated at two spatial scales, i.e., Country (presence in the MS territory) and 10 km x 10 km cell size[11]. Spatial data was provided in the ETRS889-LAEA Europe coordinate reference system (EPSG: 3035).

The data shared with MS for revision contained the following information:

- EASIN record identifier[12]
- Scientific name of the species
- Country code[13]
- Reference area code[11]
- Year of the record
- Reference of the record and link

The second step included the revision by MS of the 22 IAS of UC data provided by EASIN and the supplement with new records. Twenty-seven MS were invited on 10th August 2022 to review EASIN data by 17th October 2022, deadline extended until the 16th January 2023, according to the protocol[9]. During the data revision, MS also provided information on whether the species present in their country was 'established' or 'casual' (Box 3). Data tagged as 'not reviewed by MS' indicates records not reviewed by MS Competent Authorities.

For this baseline, only 13 species IAS of UC out of 22 added to the Union list in 2022 were analysed (Annex 1, Figure A.1). Nine species were excluded from the baseline either because not yet present in Europe (i.e., *Faxonius rusticus, Limnoperna fortune, Morone americana, Solenopsis invicta, Solenopsis richteri*), or because subjected to a transition period (i.e., *Celastrus orbiculatus* and *Pistia stratiotes*) or deferred from the Union list until 2 August 2024 (i.e., *Xenopus laevis, Fundulus heteroclitus*).

The revised data on *Celastrus orbiculatus, Pistia stratiotes, Xenopus laevis*, and *Fundulus heteroclitus* was, however, integrated into EASIN geodatabase because it can support the planning of surveillance and other activities in view of future implementation.

[9] https://easin.jrc.ec.europa.eu/easin/Documentation/Baseline
[10] https://easin.jrc.ec.europa.eu/easin/Partners/Partners
[11] EEA reference grid, which is recognised by the INSPIRE Framework Directive 2007/2/EC – EU 2007 (INSPIRE 2013): https://www.eea.europa.eu/data-and-maps/data/eea-reference-grids-2
[12] https://easin.jrc.ec.europa.eu/easin/Catalogue/Protocol
[13] ISO 3166-1 Alpha-2 code of European or neighbouring Country

Box 3. Definition of IAS of UC status

The data collected in this report for IAS of UC shows its current distribution, as present and established. Therefore, historical records were excluded. Species were indicated as casual when occasionally occurring in the MS territory but not reproducing in the wild nor overwintering (e.g., *Salvinia molesta* in the Netherlands).

Data was indicated as 'not reviewed by MS' when not reviewed by MS.

IAS of UC in gardens and greenhouses were excluded from the baseline.

2.1 Case study: IAS of UC cumulative pressure on European ecosystems

For the case study on IAS of UC cumulative pressure on ecosystems, the methodology of Polce et al. (2020) (Box 4) was applied to 11 IAS of UC. Two species of the 13 IAS of UC analysed for the baseline, were excluded in the analysis: *Channa argus* which records are not available at cell scale (Table 1), and *Rugulopteryx okamurae*, the only marine species for which cumulative pressure cannot be calculated.

The distribution and extent of ecosystem types, classification of types according to Maes et al. (2020), was derived from the 2018 version of CORINE[14]. For the freshwater ecosystem, the dataset of Grizzetti[15] was used and comprised rivers, lakes and riparian land. The calculation of IAS of UC pressure on the ecosystem was based on the IAS traits listed in Tables A.2, A.3 and A.4. For each 10 km x 10 km cell, where an IAS was recorded, pressure was quantified as the cumulative extent of all ecosystems potentially affected by its presence. The cumulative pressure is computed as the relative extent of each ecosystem that could be affected by any IAS recorded on that cell (Box 4).

Box 4. Formula for calculating IAS of UC cumulative pressure on European Ecosystems (Polce et al., 2020)

$$Ic=\sum_{s=1}^{S}\sum_{e=1}^{E} O_s H_e w_{s,e}$$

Where:

I_c= Cumulative pressure for cell c (0 to S);
s = Invasive Alien Species;
e = Ecosystem type;
O_s= Occurrence of species in cell c (0, 1);
He = Proportion, share, of ecosystem type e within cell c (0 to 1);
$w_{s,e}$= Evidence of pressure of species s on the ecosystem type e (0, 1).

[14] https://land.copernicus.eu/pan-european/corine-land-cover/clc2018?tab=metadata
[15] http://data.europa.eu/89h/6ff6cc93-2e34-4696-9ef6-91e0d83bf1bb.

3 Distribution of IAS of Union concern across EU

Eighteen MS could revise EASIN spatial data on IAS of UC occurrences at country and at cell scale and supplemented it with more data (Annex 2). For each of the 13 IAS of UC considered, spatial distributions were mapped in Annex 3. The highest number of established species is recorded in FR and ES with eight and seven species respectively, whereas the lowest is in DK, LU, SE and SK (Figure 1).

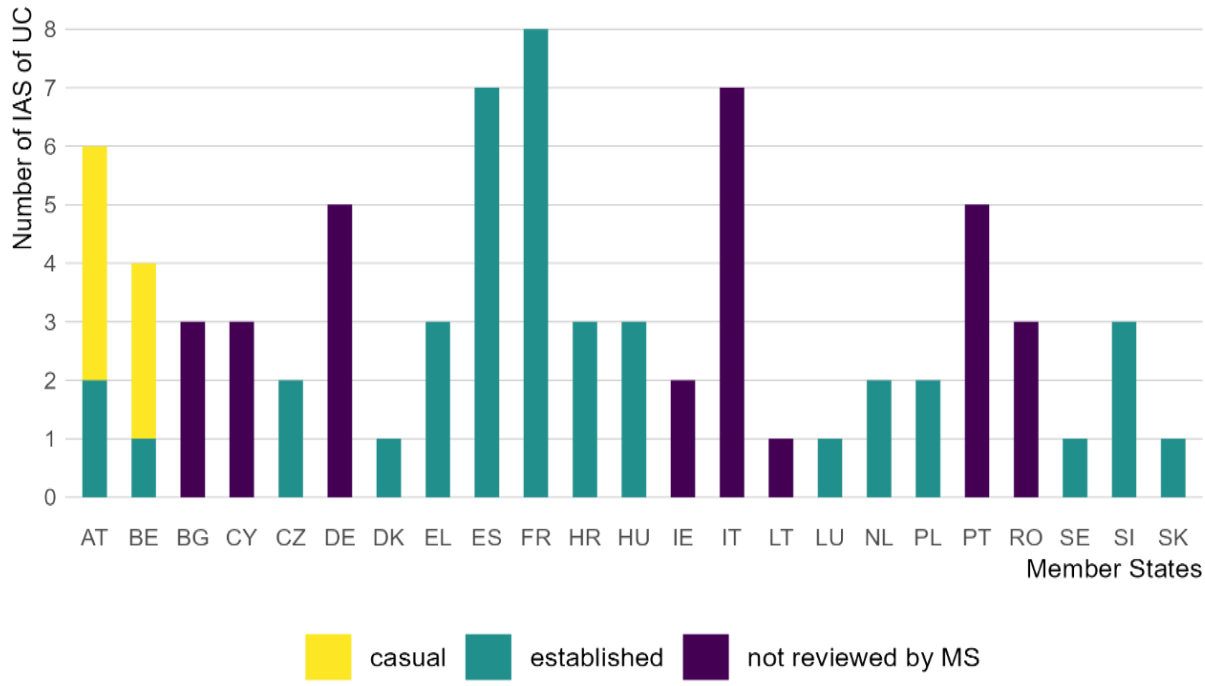

Figure 1: Number of IAS of UC across EU MS out of the 13 IAS of UC considered. For each MS casual and established species (Box 3) are indicated. The class "not reviewed by MS" indicates species records that were not reviewed by MS by MS. The data source for "not reviewed by MS" records is EASIN.

Two MS indicated the presence of casual species (Figure 1) occupying between 10% and 100% of the records in their territories (Figure 2). Casual records were recorded for *Pycnonotus cafer*, *Callosciurus finlaysonii, Lampropeltis getula,* and *Channa argus* across one or two MS (Table 1). The latter species was recorded only at country scale in AT (Table 1).

Records at cell scale that were not reviewed by MS represent between 90% and 100% of the observations for two species respectively, i.e., *Callosciurus finlaysonii and Hakea sericea* (Figure 2), while comprise less than 30% of the total number of observations for the remaining 10 IAS of UC (Figure 2).

Species Name	Total cells ↓	Established	Casual	Not reviewed by MS
Ameiurus melas	2,468	90%	0%	10%
Gambusia holbrooki	1,695	80%	0%	20%
Koenigia polystachya	567	90%	0%	10%
Gambusia affinis	349	100%	0%	0%
Hakea sericea	133	0%	0%	100%
Rugulopteryx okamurae	49	100%	0%	0%
Axis axis	20	90%	0%	10%
Callosciurus finlaysonii	10	0%	10%	90%
Pycnonotus cafer	5	80%	20%	0%
Wasmannia auropunctata	3	100%	0%	0%
Lampropeltis getula	3	0%	100%	0%
Solenopsis geminata	1	100%	0%	0%

Figure 2: Count of cells where IAS of UC are reported, and relative percentages of occurrence on the three categories (established, casual and not reviewed by MS). Occurrence of Channa argus at cell scale is missing.

The majority of IAS of UC is occurring in less than five EU MS, while four species occur more frequently (10 MS) (Figure 3). The fishes *Ameiurus melas, Gambusia holbrooki* and *Gambusia affinis* are the commonest freshwater IAS of UC across EU, recorded in 17, 13 and 10 MS respectively (Figure 3). Similarly terrestrial IAS, i.e., *Koenigia polystachya,* was recorded in 11 MS (Figure 3).

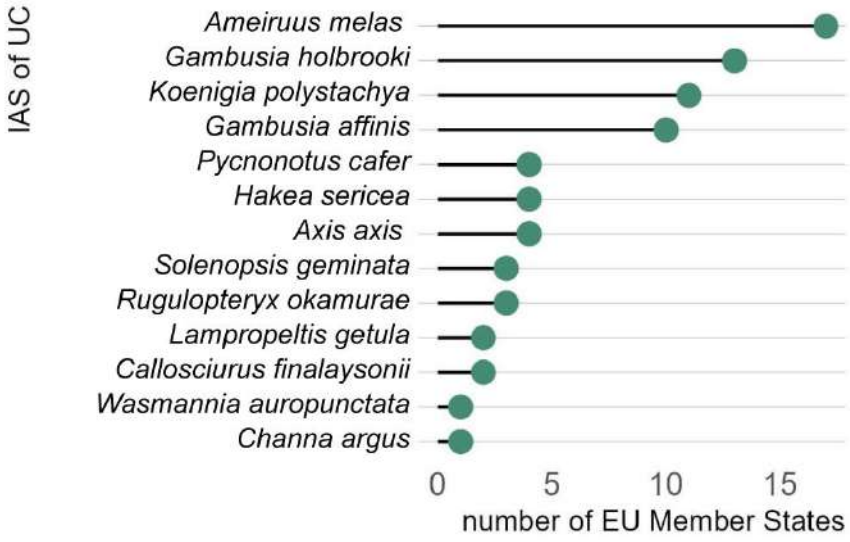

Figure 3: Number of EU MS where the 13 IAS of UC were reported.

The MS with the highest number of newly listed species is also characterised by the highest number of species per cell (e.g., France, Figure 4).

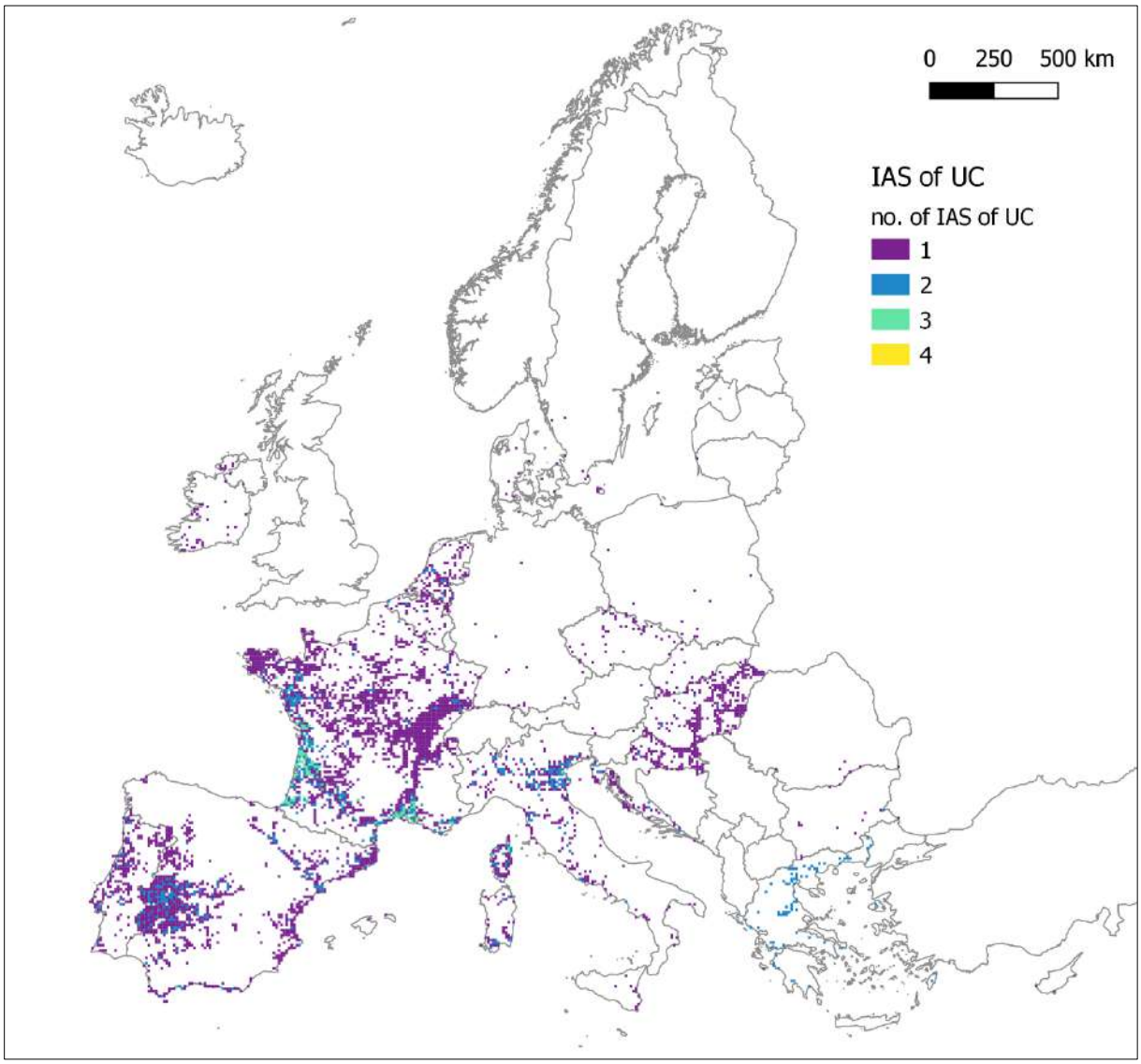

Figure 4: Aggregated number of IAS of UC at cell scale across EU MS based on the collected georeferenced information.

Table 1. Presence of 13 IAS of Union concern across EU MS and their status (established, casual and not reviewed by MS). Color-coded classes: green (established), yellow (casual) and purple (not reviewed by MS). '*' indicates records only at country scale.

Species name	AT	BE	BG	CY	CZ	DE	DK	EE	EL	ES	FR	HR	HU	IE	IT	LT	LU	LV	NL	PL	PT	RO	SE	SI	SK
Ameiurus melas																									
Axis axis																									
Callosciurus finlaysonii																									
*Channa argus**																									
Gambusia affinis																									
Gambusia holbrooki																									
Hakea sericea																									
Koenigia polystachya																									
Lampropeltis getula																									
Pycnonotus cafer																									
Rugulopteryx okamurae																									
Solenopsis geminata																									
Wasmannia auropunctata																									

For the 13 IAS of UC analysed in this report, 50% of freshwater and terrestrial IAS of UC were introduced in Europe through the primary pathway "Escape from confinement" (CBD, 2014 - Figure 5). This unintentional pathway is mostly related (10-15%) to the four sub-categories "Pet/aquarium/terrarium species (including live food for such species)", "Ornamental purpose other than horticulture", "Aquaculture/Mariculture", and "Botanical garden/zoo/aquaria" (Figure 5). Other unintentional pathways of introduction for IAS of UC were 'Transport – Contaminant' (15%) and 'Transport – Stowaway' (15%). While 20% of the IAS of UC related to intentional introductions: "Biological control" (10 %) or "Other intentional release" (10%) (Figure 5).

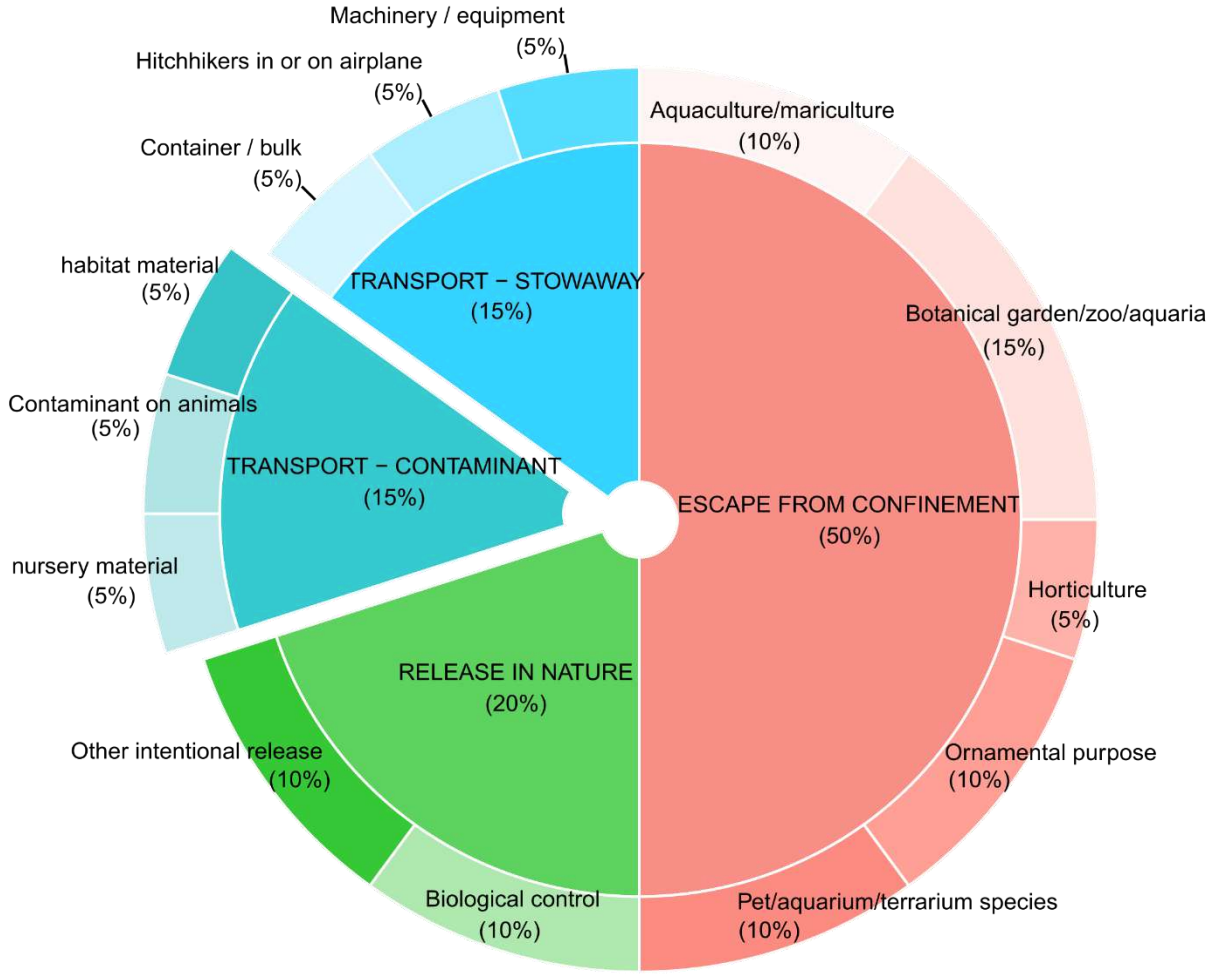

Figure 5: Primary pathways of introduction for the 13 IAS of UC analysed in this report.

3.1 IAS of Union concern cumulative pressure case study

Among terrestrial ecosystems, cropland ecosystems show the highest percentage of invaded area (about 40%, Figure 6) and the highest average of cumulative pressure (0.26, Table 2), while the lowest pressure is recorded in grassland (0.048, Table 2). However, larger standard deviations suggest that the average pattern of invasion is highly variable in space. Overall, IAS of UC invaded 15.5% of the European freshwater ecosystems.

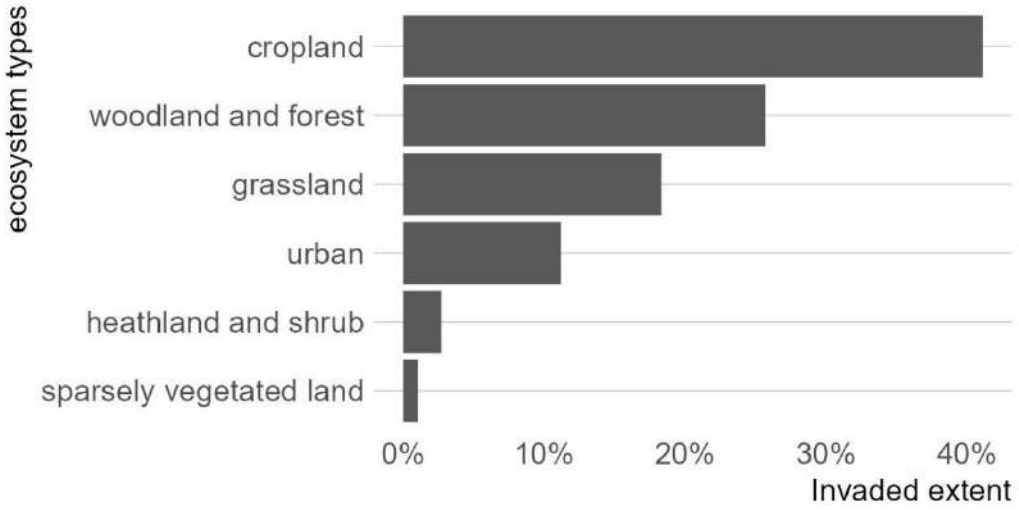

Figure 6: Relative percentage of invaded ecosystem types, to the total of invaded area.

On terrestrial ecosystems, the highest pressure is recorded in the north of Portugal, the Netherlands, Belgium the north-east of France, and north-west of Croatia (Figure 7a). While IAS pressure on freshwater ecosystems shows higher values in the north-east of Italy, the south and south-west of France, and central-west of Spain (Figure 7b). The frequency distribution where most of the cumulative pressure is recorded, is 0.46 in terrestrial, and 1.20 in freshwater ecosystems (Figure 8a,b).

Table 2. Summary statistics of the cumulative pressure by IAS of UC on ecosystem types.

ecosystem types	mean	sd	min (>0)	max	median
cropland	0.296	0.189	0.010	0.873	0.273
woodland and forest	0.266	0.244	0.001	1.000	0.173
urban	0.118	0.152	0.000	0.990	0.056
heathland and shrub	0.072	0.113	0.000	0.583	0.025
sparsely vegetated land	0.062	0.128	0.000	0.693	0.013
grassland	0.048	0.102	0.000	1.000	0.011
freshwater	1.201	0.465	1	3	1

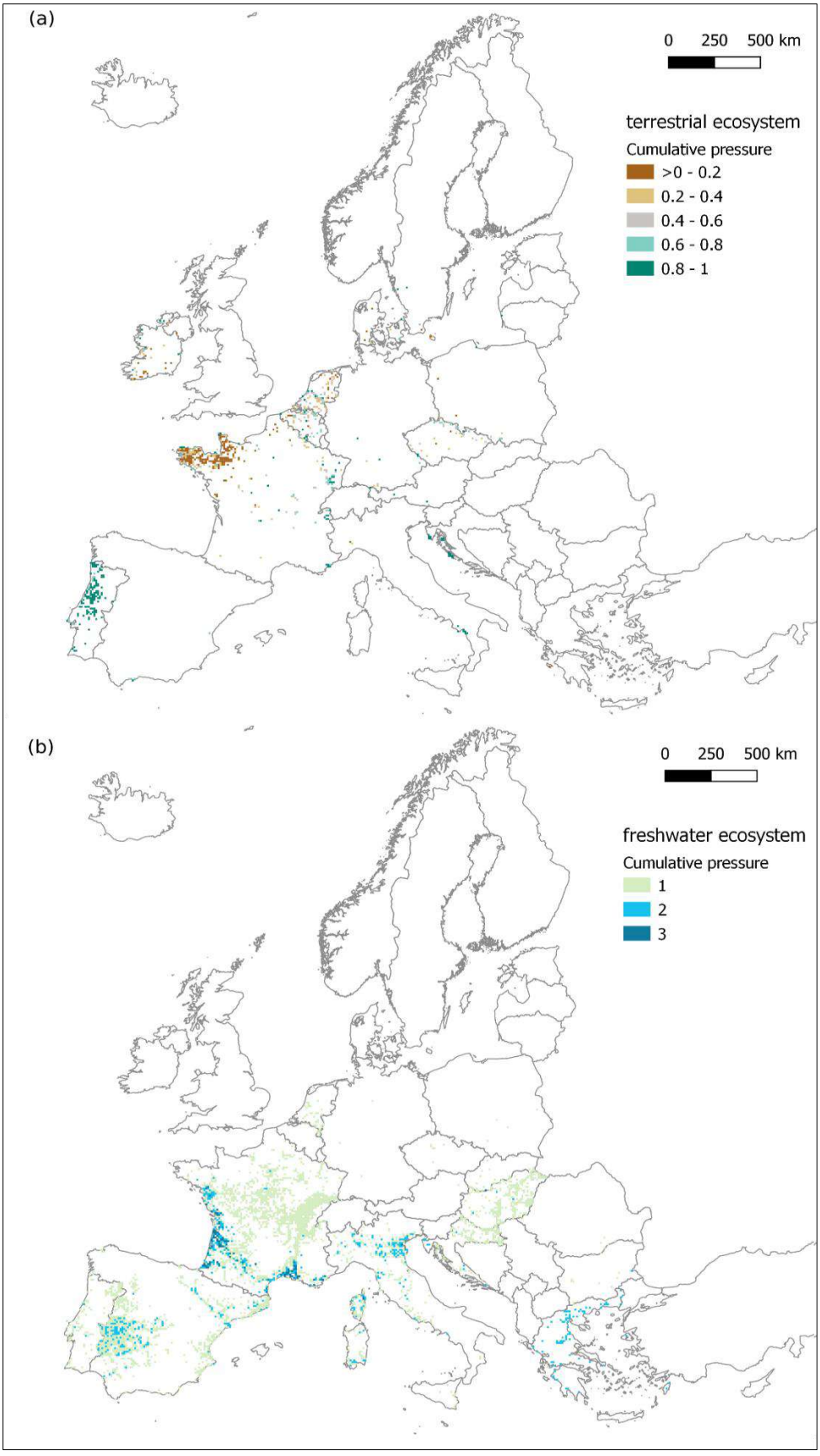

Figure 7: Cumulative pressure of IAS of UC on terrestrial (a) and freshwater (b) ecosystems

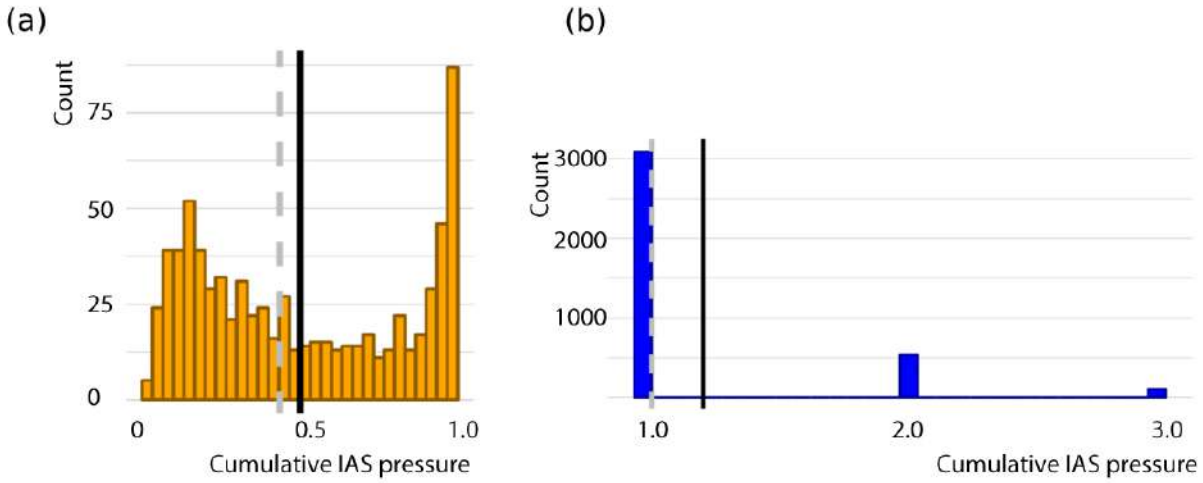

Figure 8: The histograms show the frequency distribution of cumulative pressure in terrestrial (a) and freshwater (b) ecosystems, the arithmetic mean (solid line) and the median (dashed line).

3.2 Data accessibility and usage

The data on the 13 IAS of UC of this baseline and the four IAS of UC for which restrictions have not yet entered into force (Table A.1, Section 2) was integrated and made accessible through EASIN databases and services[16], which ensure long-term persistence and preservation of data to assist the EC, MS and EU citizens in the accomplishment of alien species relevant policies. The contribution by EASIN and the MS Competent Authorities to the data on all the 17 new IAS of UC present in EU territory and integrated in EASIN Catalogue and Geodatabase was 55% and 45% respectively.

As for other IAS on the Union list, **species data can be accessed** through the 'EASIN Species Search[17]' function which allows users to filter single species or groups of species by taxonomy, pathway, alien status, and impact. Specific dynamic Factsheets[18] on IAS of UC include for each regulated species its traits (i.e., taxonomy, environment, origin) and invasion-related factors, and its distribution map. As an evolving data product, updates and corrections to IAS of UC data will occur with the upcoming versions of the EASIN Catalogue. As a result, the semantic versioning is used to label the Catalogue versions.

IAS of UC occurrences can be mapped from EASIN Geodatabase using the 'EASIN Species Mapper[19], which enables mapping species occurrences as polygons at e.g. country or cell scale (10 km x 10 km). This tool also allows users to select occurrences by time ranges, and to **export** the map in .PDF format or download it in WKT (EPSG:3035, ETRS89) or GeoJSON (EPSG:4326, WGS84) formats.

IAS of UC data on traits and invasion-related factors, and spatial occurrences can be **retrieved and queried** using the EASIN RESTful Web Services[20].

[16] https://easin.jrc.ec.europa.eu/spexplorer/
[17] https://easin.jrc.ec.europa.eu/spexplorer/search/
[18] https://easin.jrc.ec.europa.eu/spexplorer/species/factsheet/R00053
[19] https://easin.jrc.ec.europa.eu/spexplorer/map/
[20] https://easin.jrc.ec.europa.eu/apixg

4 Conclusions

This baseline provides **high quality and updated data** on 13 IAS of UC on which early detection, early detection notifications, rapid eradication, and management measures (for widely spread species) are required (Art. 14, 16, 17, 19 of the IAS Regulation). Information on IAS of UC traits, invasion-related factors and distribution is integrated in EASIN, which **ensures its systematic updates, accessibility, and visibility** to researchers, policy makers, managers, and the public.

This baseline at EU scale is a key source of knowledge to benchmark the progress on the implementation of the IAS Regulation, and its development highlights challenges and areas for improvements.

Eighteen MS contributed with the revision of EASIN data, supplementing it with further national data, while nine MS were not in a position to provide timely feedback. As a result, in MS that could not revise EASIN data, exclusively EASIN data was used to map the distribution of IAS of UC. To this end, considering that 45% of new data was provided by contributing MS, **EASIN is a unique source of spatial data on IAS of UC at the EU level and provides spatial consistency to this EU-wide baseline**. To this end, **MS and EASIN could improve collaboration to better align and integrate data** collected under the IAS regulation through the official notification platform NOTSYS, hosted in EASIN. The data could help streamlining the notification process by offering reliable reference for a quick response to IAS posing a threat to biodiversity, health, and the economy. To this regard, this and previous baselines of IAS of UC (Tsiamis et al., 2017, 2019a, 2019b, 2021) should foster **cooperation and coordination** between the competent authorities of EU MS and non-EU countries (Art. 22 of IAS Regulation), enabling them to react rapidly to IAS pressure by tracing species observations and facilitating their management.

Distribution data has revealed that most of the species were introduced and have spread in southern –and western EU countries (e.g., ES, PT, IT, FR, BE, NL), **mostly by unintentional pathways**, i.e., escape from confinement and release in nature, suggesting the urgent need to implement action plans to address these priority pathways (Art. 13 IAS Regulation). Complementarily, the prioritization of management actions, based on species gateway of introduction, distribution and pathways of introduction can further account for the pressure on ecosystems. In this report, the **pressure of IAS of UC is larger in cropland and woodland ecosystems,** indicating the presence of several IAS in the same areas and/or larger invasion of an ecosystem type by one or more species. This result could help targeting areas requiring an increase of official controls and monitoring of specific impacts on ecosystem services.

This baseline at EU scale will support MS in the implementation of the IAS Regulation. The **continuity of coordinated work** between EASIN and MS Competent Authorities for the **systematic integration of data on IAS of UC** in EASIN platform will help complying with the obligations of Art. 14, 16, 17 and 19 of the IAS Regulation, help monitoring, and adoption of management measures. In addition, a common agreed and shared set of data will leverage the definition of indicators requested by the EU policies on biodiversity and ecosystems and support invasion biology research.

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List of abbreviations and definitions

CBD	Convention on Biological Diversity
EASIN	European Alien System Information Network
EC	European Commission
EU	European Union
IAS	Invasive Alien Species defined in Art. 3 of EU Regulation 1143/2014/EC
IAS of UC	Species identified according to Art. 4 of the EU Regulation 1143/2014/EC, requiring EU concerted action, published in the EU Commission Implementing Regulation 1141/2016/EC of 13 July 2016.
IAS Regulation	Regulation No 1143/2014/EC 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.
MS	Member States
NOTSYS	Official notification system for detection of IAS of Union concern

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Annexes

Annex 1. IAS of UC species listed in the Union list on 12 July 2022 (Comm. Impl. Reg. 2022/1203/EC).

Table A.1: IAS of UC species listed in the Union list on 12 July 2022 (Comm. Impl. Reg. 2022/1203/EC) and those included in the baseline, i.e., '✓. IAS regulation entered into force on August 2022 for all these species except where indicated.

Species name	***Included in the baseline***
Ameiurus melas	✓
Axis axis	✓
Callosciurus finlaysonii	✓
Celastrus orbiculatus	*X (IAS regulation applies from 2 August 2027)*
Channa argus	✓
Faxonius rusticus	*X (not yet in EU)*
Fundulus heteroclitus	*X (IAS regulation applies from 2 August 2024)*
Gambusia affinis	✓
Gambusia holbrooki	✓
Hakea sericea	✓
Koenigia polystachya	✓
Lampropeltis getula	✓
Limnoperna fortunei	*X (not yet in EU)*
Morone americana	*X (not yet in EU)*
Pistia stratiotes	*X (IAS regulation applies from 2 August 2024)*
Pycnonotus cafer	✓
Rugulopteryx okamurae	✓
Solenopsis invicta	*X (not yet in EU)*
Solenopsis geminata	✓
Solenopsis richteri	*X (not yet in EU)*
Wasmannia auropunctata	✓
Xenopus laevis	*X (IAS regulation applies from 2 August 2024)*

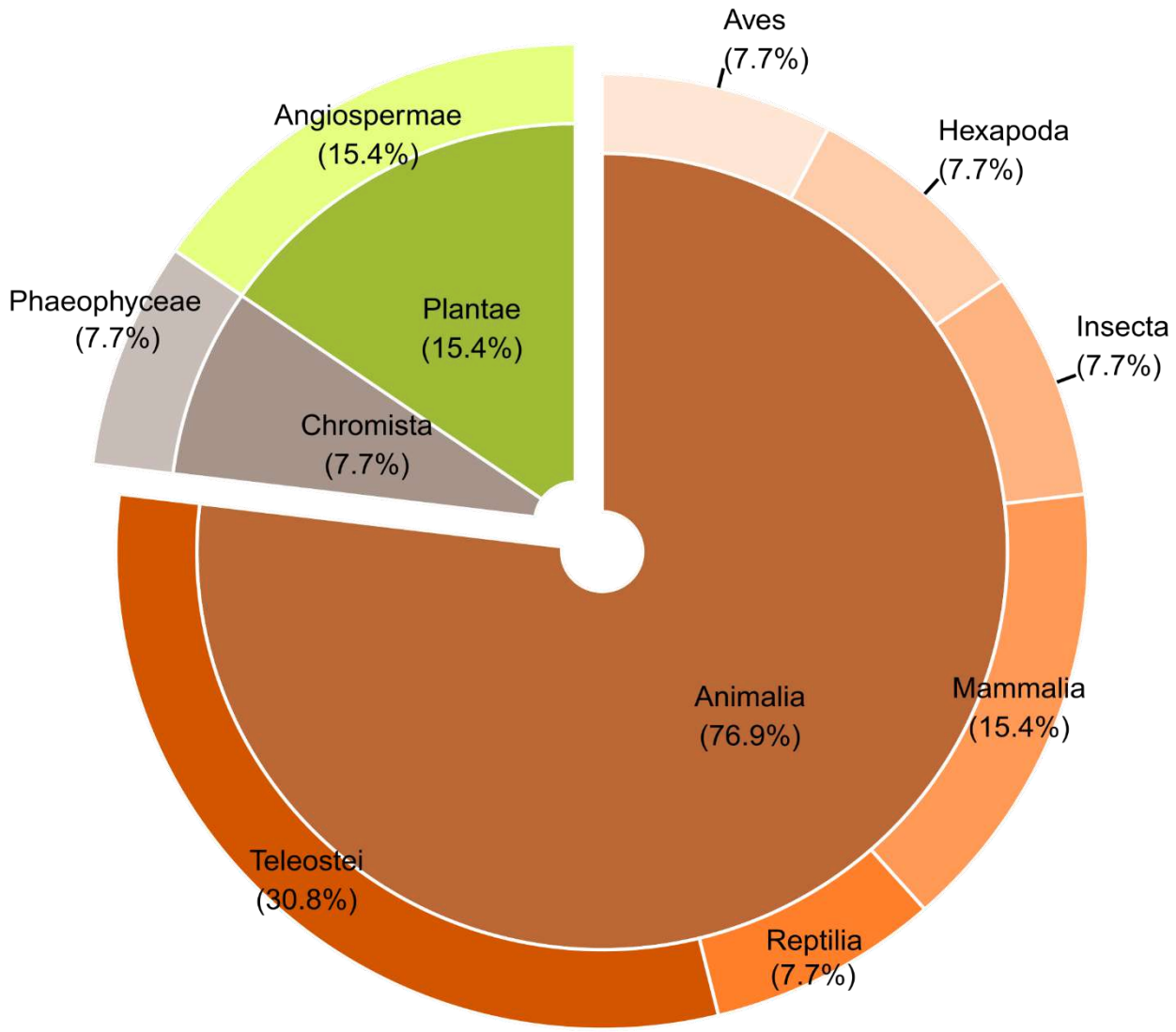

Figure A.1: proportion of Kingdom and Class of the 13 IAS of UC analysed in this report.

Table A.2: Traits and invasion-related factors for the 13 IAS of UC covered by this report. Information was extracted from EASIN and the Risk Assessment of the IAS Regulation.

Species name	Common name	Taxonomic group	Habitat	Origin	Primary pathway of introduction	Year of first introduction in EU	Country of first introduction in EU
Ameiurus melas	Black bullhead	Teleostei	freshwater	North- America	ESCAPE FROM CONFINEMENT: Aquaculture/mariculture	1900	IT
Axis axis	Axis deer	Mammalia	terrestrial	Indian subcontinent	ESCAPE FROM CONFINEMENT: Botanical garden/zoo/aquaria (excluding domestic aquaria)	1911	HR
Callosciurus finlaysonii	Finlayson's squirrel	Mammalia	terrestrial	Indochina	RELEASE IN NATURE: Other intentional release	1981	IT
Channa argus	Northern snakehead	Teleostei	freshwater	Asia	ESCAPE FROM CONFINEMENT: Aquaculture / mariculture	1956	CZ
Gambusia affinis	Wester mosquitofish	Teleostei	freshwater	North- America	RELEASE IN NATURE: Biological control	1919	IT
Gambusia holbrooki	Eastern gambusia	Teleostei	freshwater	North- America	RELEASE IN NATURE: Biological control	1920	TR
Hakea sericea	Bushy needlewood	Angiospermae	terrestrial	South-eastern Australia	ESCAPE FROM CONFINEMENT: Ornamental purpose other than horticulture	1917	FR
Koenigia polystachya	Himalayan knotweed	Angiospermae	terrestrial	Central and Eastern Asia	ESCAPE FROM CONFINEMENT: Horticulture; ESCAPE FROM CONFINEMENT: Ornamental purpose other than horticulture	1885	AT
Lampropeltis getula	Eastern kingsnake	Reptilia	terrestrial	USA, north-western Mexico	RELEASE IN NATURE: Other intentional release; ESCAPE FROM CONFINEMENT: Botanical garden/zoo/aquaria (excluding domestic aquaria); ESCAPE FROM CONFINEMENT: Pet/aquarium/terrarium species (including live food for such species)	2006	IT
Pycnonotus cafer	Red-vented bulbul	Aves	terrestrial	South and south-east Asia	ESCAPE FROM CONFINEMENT: Botanical garden/zoo/aquaria (excluding domestic aquaria); ESCAPE FROM CONFINEMENT: Pet/aquarium/terrarium species (including live food for such species)	2001	ES
Rugulopteryx okamurae	\	Phaeophyceae	marine	North- western Pacific Ocean	TRANSPORT - CONTAMINANT: Contaminant on animals (except parasites, species transported by host/vector)	2002	FR
Solenopsis geminata	Fire ant	Insecta	terrestrial	Central and South America	TRANSPORT - CONTAMINANT: Transportation of habitat material (soil, vegetation, …)	1997	ES
Wasmannia auropunctata	Little fire ant	Hexapoda	terrestrial	Central and South America	TRANSPORT - CONTAMINANT: Contaminant nursery material; TRANSPORT - STOWAWAY: Container / bulk; TRANSPORT - STOWAWAY: Hitchhikers in or on airplane; TRANSPORT - STOWAWAY: Machinery / equipment	1988	NL

Table A.3: Impacts of the 13 IAS of UC covered by this report. Information was extracted from the Risk Assessment of the IAS Regulation.

Species name	Biodiversity and ecosystem impacts	Ecosystem Services impacts	Economic impacts	Social and human impacts	threat to Red List species
Ameiurus melas	(-) competition (for food and/or space) with native species, and predation of native species including fish and fish eggs (-) water quality	(-) fishing as a cultural service (-) changes in the physical habitat	(-) fisheries	(-) painful sting (-) bioaccumulation of heavy metals (-) parasites and viruses	*Pelobates cultripes*
Axis axis	(-) on native vegetation seedling and sapling survival through browsing and bark stripping (-) on habitat by deer trampling which cause increased runoff and erosion (-) competition with the native deer (-) host of pathogens and parasites	(-) provisioning biomass (e.g. cultivated/reared and wild plants and animals) (-) regulation & maintenance (e.g. baseline flows and extreme events, pest and disease control) (-) cultural (e.g. physical and experiential interactions)	(-) overgrazing: sheep, cattle, cereal grain and fruit commodities (-) road collisions (-) disease transmission to reared animals and humans	(-) disease transmission (-) road collisions	
Callosciurus finlaysonii	(-) predator of bird nests (-) bark stripping which increases fungal infections and invertebrate damages on trees (-) transmission of pathogens (-) intraspecific competition with native species, i.e. red squirrel and Calabrian black squirrel	(-) provisioning biomass (e.g. cultivated and wild plants) (-) regulation & maintenance (e.g. lifecycle maintenance-seed dispersal, and pest and disease control) (-) cultural (e.g. experiential interactions)	(-) bark tripping: massive cutting of ornamental deciduous trees	(-) disease transmission	
Channa argus	(-) food competition with native species	(-) on fisheries and aquaculture (-) recreational usage of waterbodies	(-) anglings	(-) disease transmission	
Gambusia affinis	(-) food and space competition and predation with native species (-) physical habitat disturbance (e.g. increased turbidity, dissolved organic phosphorous)		(-) management and eradication	(-) disease transmission (-) eutrophication	

Gambusia holbrooki	(-) competition with native species			(-) disease transmission (-) eutrophication	*Aphanius baeticus, Aphanicus iberus, Hyla meridionalisPelobates cultripes, Triturus dobrogicus, Valencia hispanica*
Hakea sericea	(-) competition with native species and fauna	(-) increase the intensity of fire in areas where the species invades. (-) hydrological regimes (-) tourism: cannot access to natural sites			
Koenigia polystachya	(-) competition with native species	(-) availability of nutrients in the soil (-) availability of water for recreational activities	(-)management and eradication	(-) infrastructures in urban areas	
Lampropeltis getula	(-) predation and competition with native species (-) disease and parasites	(-) disturbance of outdoor activities and cultural heritage		(-) disease transmission	
Pycnonotus cafer	(-) competition and community changes due to dispersal of invasive alien plant seeds (frugivory) (-) hybridisation (-) predation	(-) provisioning: cultivated terrestrial plants grown for nutritional purposes and as ornamentals (e.g. active dispenser of invasive alien plants) (-) cultural: disturbance of the heritage of island ecosystems	(-)agricultural pest (i.e. great costs of management and control)		
Rugulopteryx okamurae	(-) community structure and composition (e.g. space competition)		(-) fisheries (-) costs of management (e.g. removal of its biomass from beaches)		
Solenopsis geminata	(-) predation on fauna (-) seed dispersal of myrmecochorous plants (-) interactions between plants and insects by reducing number of plant	(-) provisioning - nutrition (e.g. foragers tend honeydew-producing homoptera and root feeding species) (- / +) regulating seed dispersal (-) cultural-physical use of landscapes	(-) agricultural crops (+) predator of arthropod pests	(-) allergic reactions (-) infrastructure (dense population)	

	mutualists that protect the plant or disperse plant seeds			
Wasmannia auropunctata	(-) competition and predation fauna (i.e. ants, invertebrates) (-) seed dispersal of myrmecochorous plants (+) ant-visited plants grew higher than ant-excluded plants	(-) provisioning - nutrition (-) regulating seed dispersal (-) regulating pest and disease control (interferes with beneficial insects that exert biocontrol activities in modified habitats) *(-)* cultural-physical use of landscapes	(-) horticulture	(-) painful sting which might cause blindness

Table A.4: The pressure caused to artificial areas and macro-categories of ecosystems by the 13 IAS of UC. 1 = evidence of pressure; 0 = absence of evidence. '*'IAS of UC excluded from the analysis: Channa argus which records are not available at cell scale, and Rugulopteryx okamurae, a marine species which cumulative pressure cannot be calculated on the marine ecosystem for lack of data.

Species name	**man-made structures**	**agriculture**	**forest & seminatural**	**freshwater**
Ameiurus melas	0	0	0	1
Axis axis	1	1	1	0
Callosciurus finlaysonii	1	0	1	0
*Channa argus**	0	0	0	1
Gambusia affinis	0	0	0	1
Gambusia holbrooki	0	0	0	1
Hakea sericea	0	1	1	0
Koenigia polystachya	1	0	1	0
Lampropeltis getula	1	0	0	0
Pycnonotus cafer	0	1	1	0
*Rugulopteryx okamurae**	1	0	0	0
Solenopsis geminata	1	0	0	0
Wasmannia auropunctata	0	1	1	0

Annex 2. List of MS Competent authorities.

List of MS Competent authorities revising and supplementing IAS of UC data. Nine MS did not contribute to the baseline: Bulgaria, Cyprus, Germany, Ireland, Italy, Lithuania, Malta, Portugal, Romania. Finland declared not having records for this baseline. (*) reporting "*Celastrus orbiculatus*" which was not included in the analysis of this report.

Member State	***Competent Authority***
AT- Austria	*Amt der Burgenländischen Landesregierung*
BE- Belgium	*National Scientific Secretariat on Invasive Alien Species- Royal Belgian Institute of Natural Sciences*
CZ- Czechia	*Department of the Species Protection and Implementation of International Commitments, Ministry of the Environment*
DK- Denmark	*The Danish Environmental Protection Agency*
*EE- Estonia**	*Ministry of the Environment of Estonia*
EL- Greece	*General Directorate of Environmental Policy. Directorate of Natural Environment Management and Biodiversity*
ES- Spain	*Dirección General de Biodiversidad, Bosques y Desertificación. Ministerio para la Transición Ecológica y el Reto Demográfico*
FI- Finland	*Natural Resources Institute Finland (Luke)*
FR- France	*French Biodiversity Agency (OFB)*
HR- Croatia	*Ministry of Economy and Sustainable Development*
HU- Hungary	*Ministry of Agriculture, Department for Nature Conservation*
LU- Lussembourg	*Ministry of the Environment, Climate and Sustainable Development (MECDD), Nature and Forest Agency (ANF)*
*LV- Latvia**	*Department of Nature Protection. Ministry of Environmental Protection and Regional Development*
NL- The Netherlands	*Nederlandse Voedsel-en Warenautoriteit (NVWA)*
PL- Poland	*General Directorate for Environmental Protection*
SE- Sweden	*Swedish Species Information Centre, Swedish Agency for Marine and Water Management (SwaM) and the Swedish Environmental Protection Agency (EPA)*
SI- Slovenia	*Institute of the Republic of Slovenia for Nature Conservation (Sonja Rozman) with the cooperation of the Fisheries Research Institute of Slovenia*
SK- Slovakia	*Department for Biodiversity and Landscape Protection. Directorate for Nature Protection and Biodiversity*

Annex 3. Distribution maps.

Maps showing the spatial distribution at cell scale of 12 IAS of UC analysed in this report. *C. argus* is missing since data at cell scale was not available.

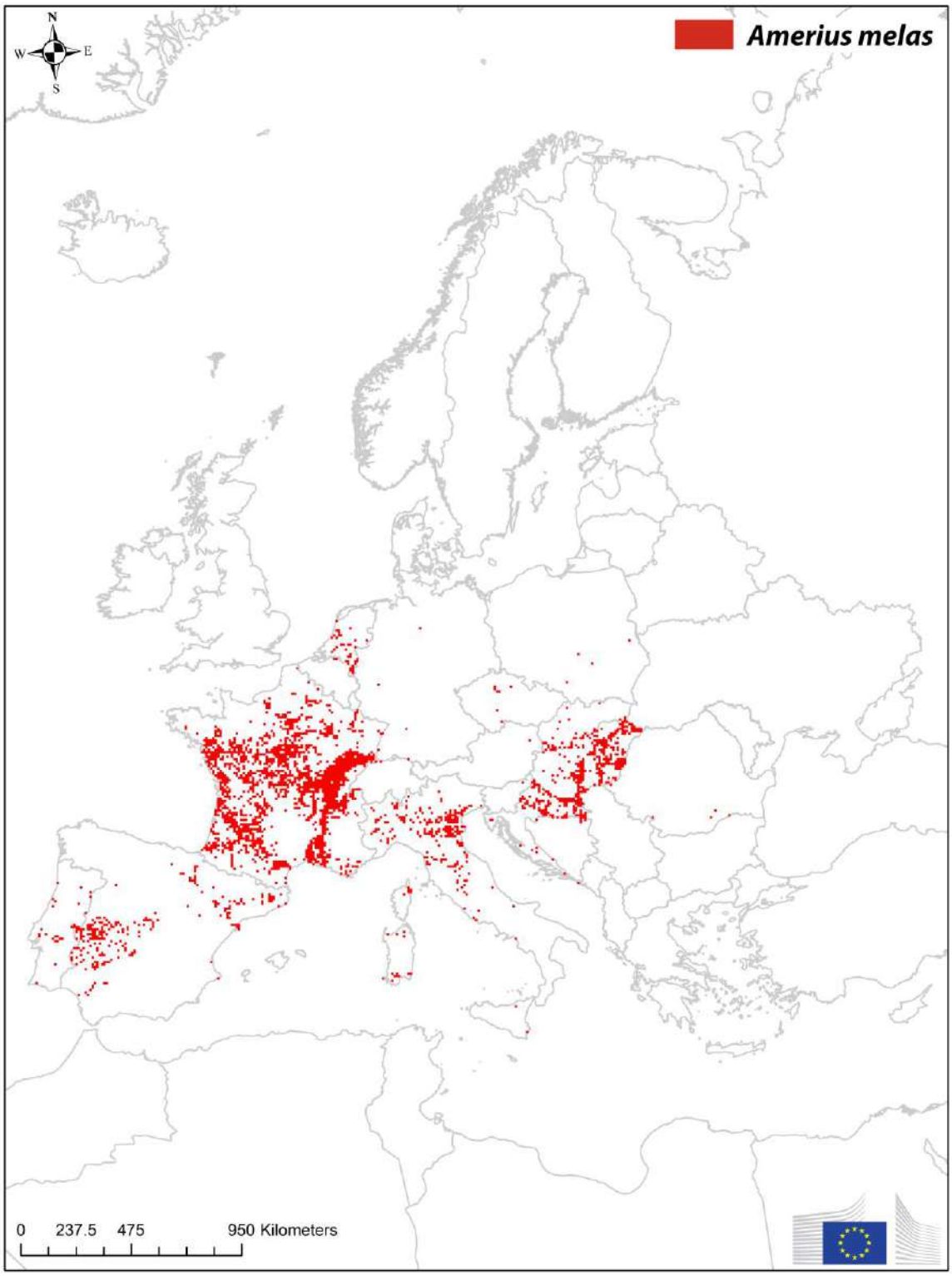

Figure A.3.1: distribution map of *Amerius melas* (cell size 10 km x 10 km) in EU.

Figure A.3.2: distribution map of *Axis axis* (cell size 10 km x 10 km) in EU.

Figure A.3.3: distribution map of *Callosciurus finlaysonii* (cell size 10 km x 10 km) in EU.

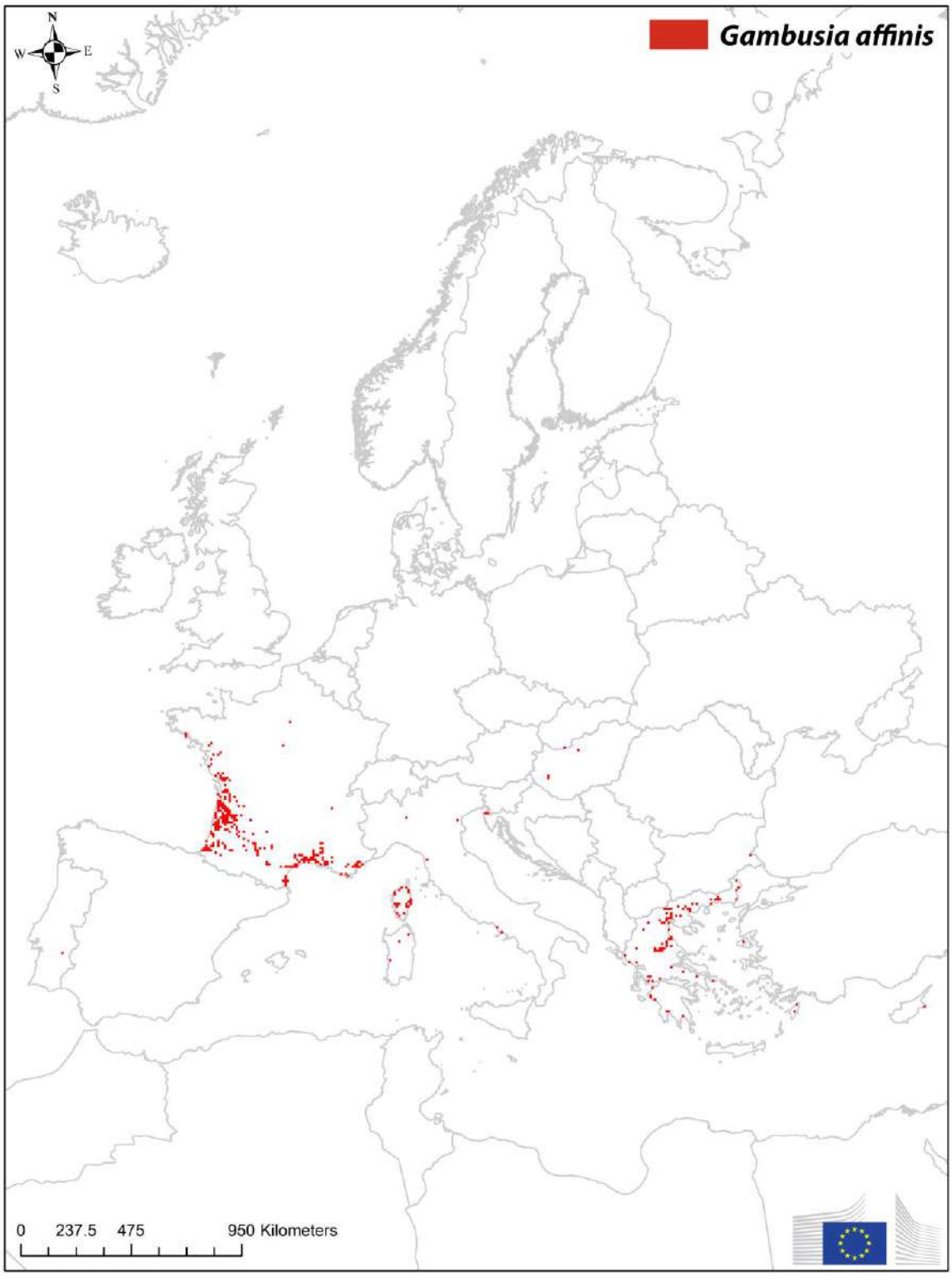

Figure A.3.4: distribution map of *Gambusia affinis* (cell size 10 km x 10 km) in EU.

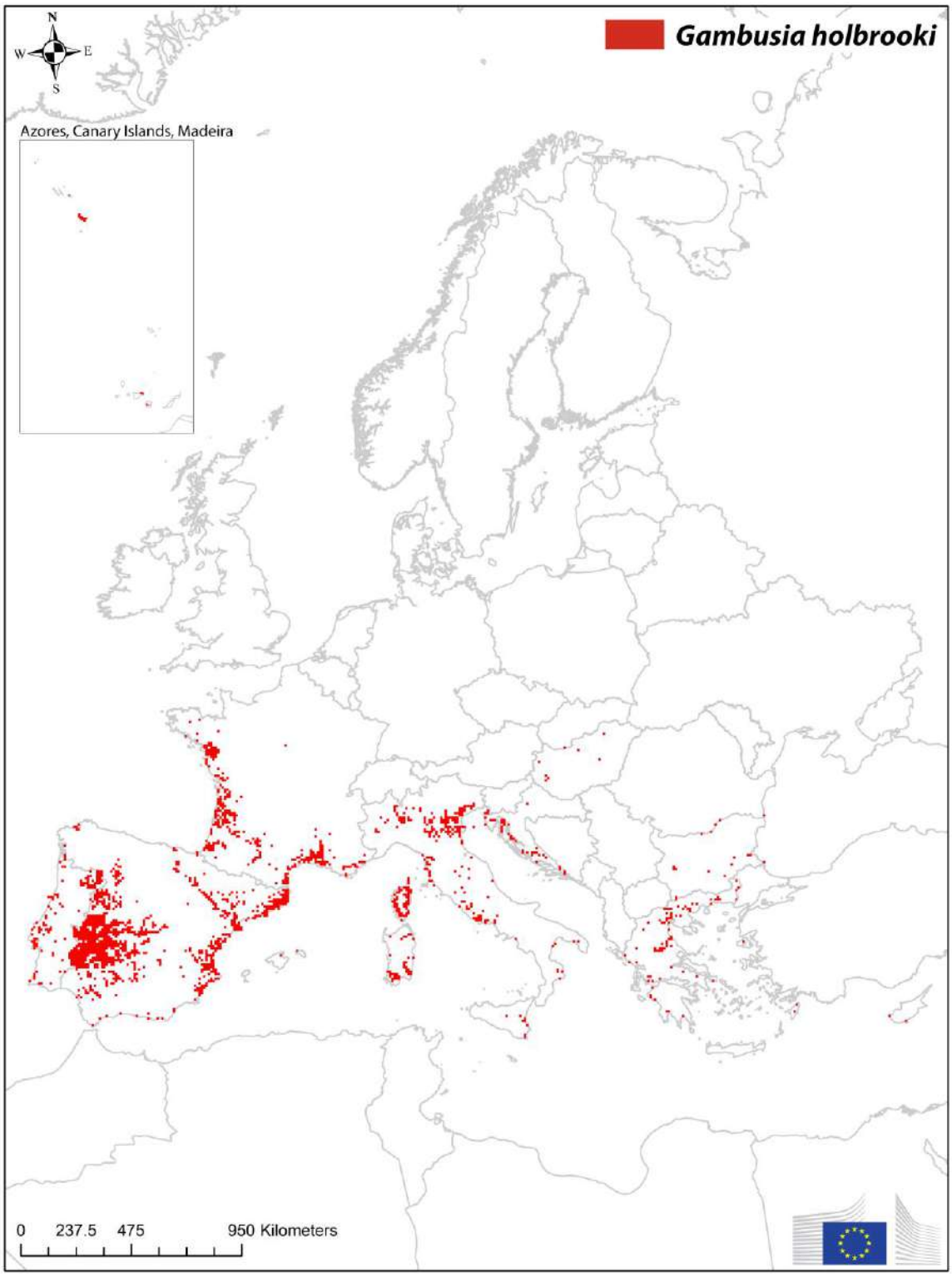

Figure A.3.5: distribution map of *Gambusia holbrooki* (cell size 10 km x 10 km) in EU.

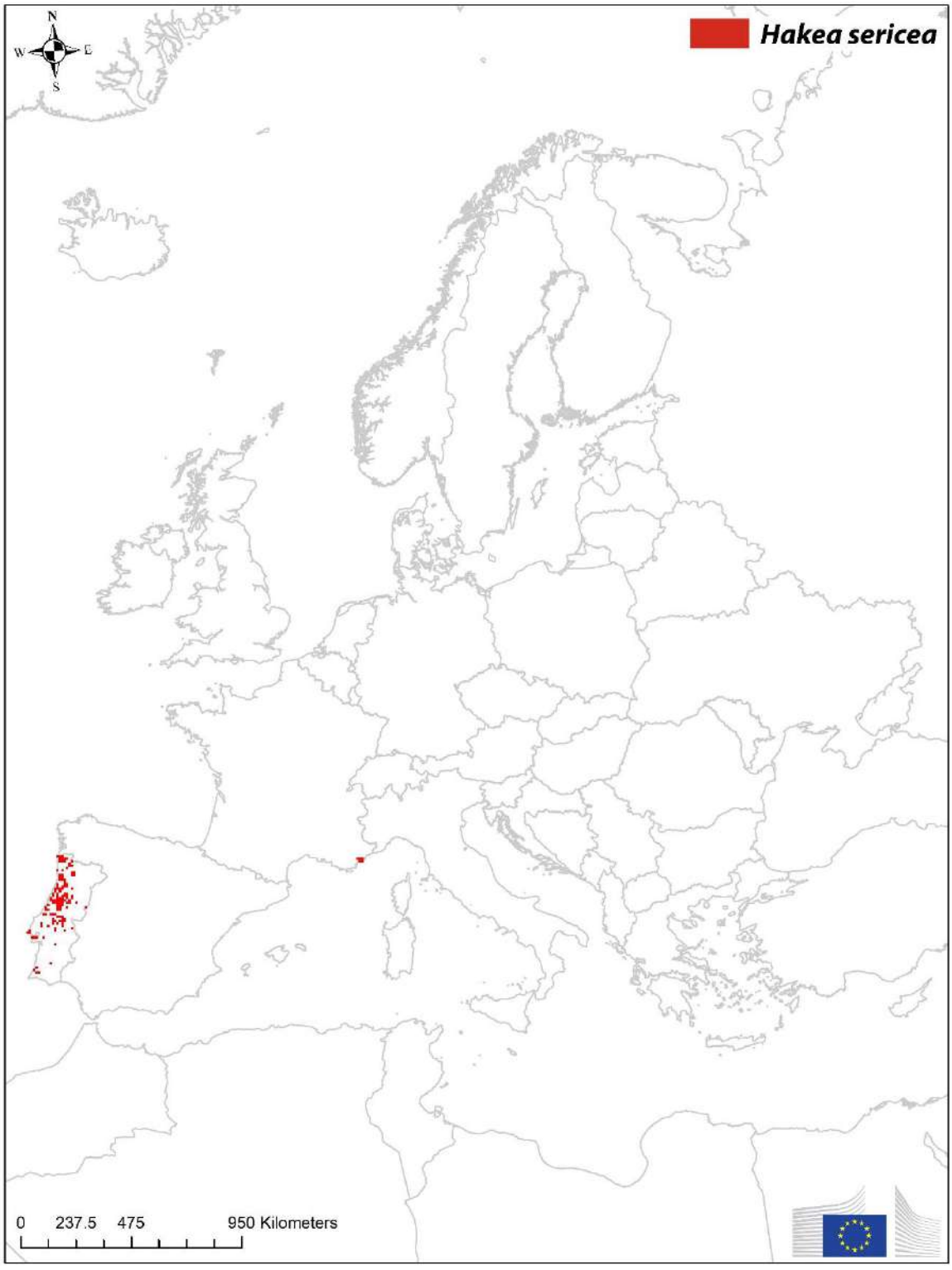

Figure A.3.6: distribution map of *Hakea sericea* (cell size 10 km x 10 km) in EU.

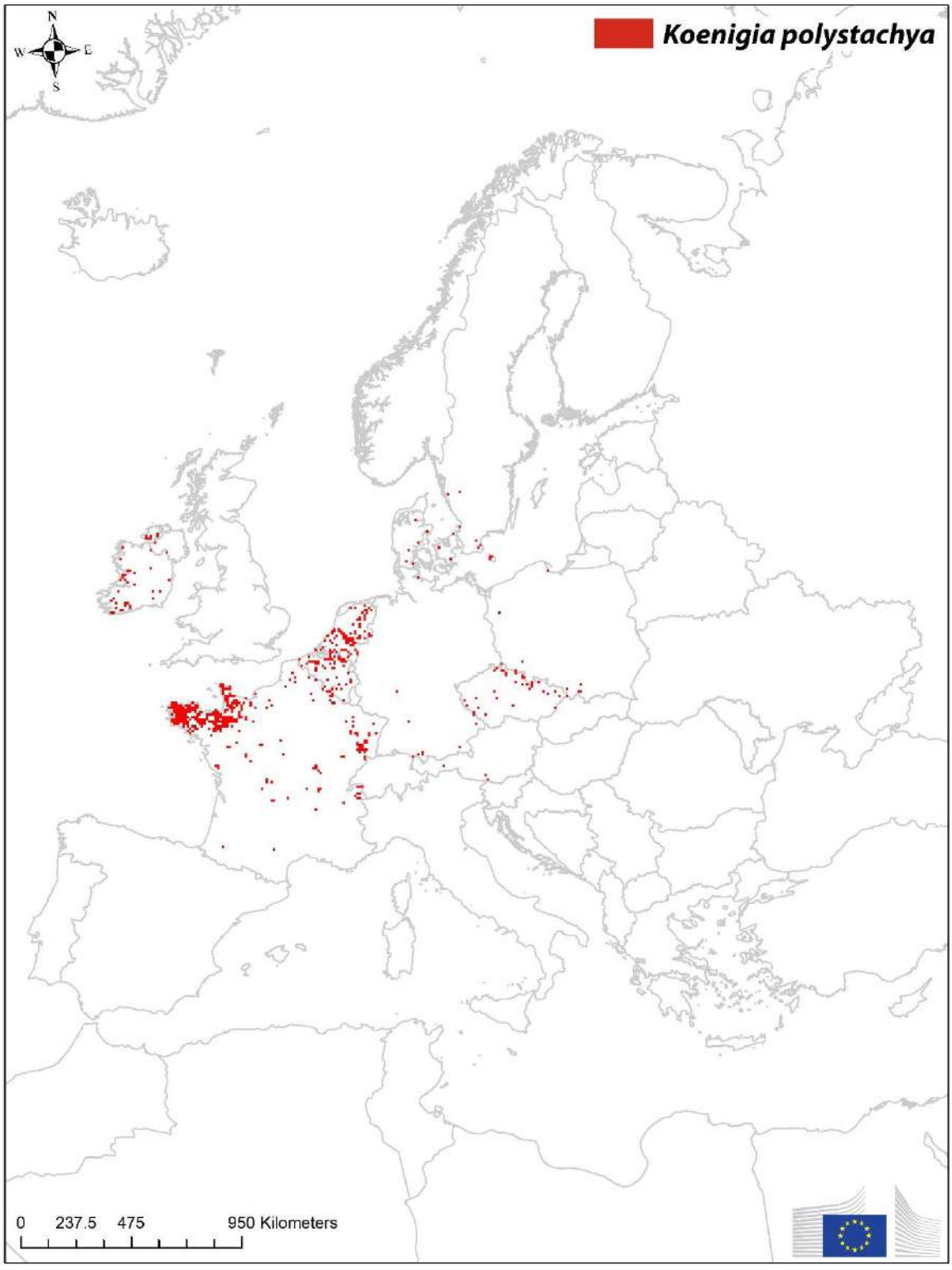

Figure A.3.7: distribution map of *Koenigia polystachya* (cell size 10 km x 10 km) in EU.

Figure A.3.8: distribution map of *Lampropeltis getula* (cell size 10 km x 10 km) in EU.

Figure A.3.9: distribution map of *Pycnonotus cafer* (cell size 10 km x 10 km) in EU.

Figure A.3.10: distribution map of *Rugulopteryx okamurae* (cell size 10 km x 10 km) in EU.

Figure A.3.11: distribution map of *Solenopsis germinata* (cell size 10 km x 10 km) in EU.

Figure A.3.12: distribution map of *Wasmannia auropunctata* (cell size 10 km x 10 km) in EU.

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