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Impact caused by Invasive Alien Species of Union concern on habitats and species of the Nature Directives and Natura 2000 sites

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The withdrawal of the United Kingdom from the European Union did not affect the production of the report. Data reported by the United Kingdom are included in all analyses and assessments contained herein, unless otherwise indicated.

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1 Introduction

The core of Regulation (EU) 1143/2014 on the prevention and management of the introduction and spread of invasive alien species (IAS[1]), which entered into force on 1 January 2015, is a list of "IAS of Union concern" (the Union list). Within the obligations of the reporting according to Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora (the Habitats Directive – HD) and Council Directive 2009/147/EC on the conservation of wild birds (the Birds Directive – BD), Member States (MS) had to assess and report on the target species and habitats of these Directives which are inter alia impacted by "IAS of Union concern". The latest reporting period for this exercise (2013-2018) partly overlapped with the abovementioned reporting period of the IAS-Regulation (2015-2018).

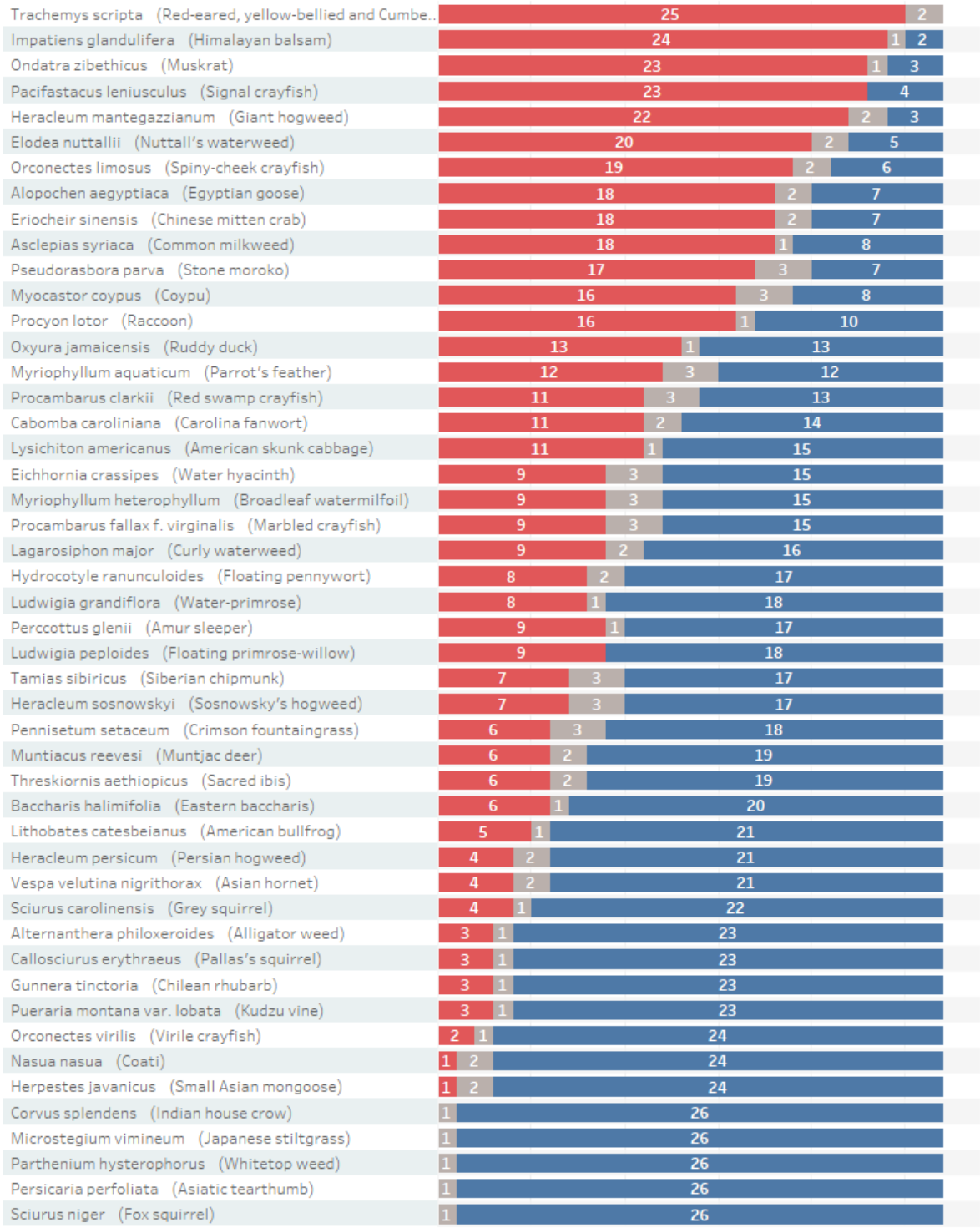
Within the first reporting period of the IAS-Regulation (1.1.2015 - 31.12.2018), Member States provided specific information on 48[2] IAS of Union concern (23 plants, 25 animals) for their particular territory[3]. The red-eared slider *Trachemys scripta* is present in 25 of 27 reporting MS. Two MS reported its presence as unknown. Five species are reported as present in more than 20 countries: *Trachemys scripta*, *Impatiens glandulifera*, *Ondatra zibethicus*, *Pacifastacus leniusculus* and *Heracleum mantegazzianum*. Five species are reported absent from all reporting countries: *Corvus splendens*, *Microstegium vimineum*, *Parthenium hysterophorus*, *Persicaria perfoliata* and *Sciurus niger* (Fig. 1-1).

The reported numbers of IAS of Union concern per Member State range from 3 (Cyprus) to 34 (France) (Map 1-1). In total, 43 (of 48) IAS of Union concern are present in the EU. The presence of these species per biogeographic regions of Member States (Map 1-2) and per grid cells (Map 1-3) confirm general invasion patterns from larger European datasets indicating a west-east gradient that presumably is an effect of economic wealth and human population density (e.g. DAISIE 2009, Pyšek et al. 2010). The maximum number of IAS of Union concern in one single grid cell[4] is 17 species which is a bit more than one third of the Union list.

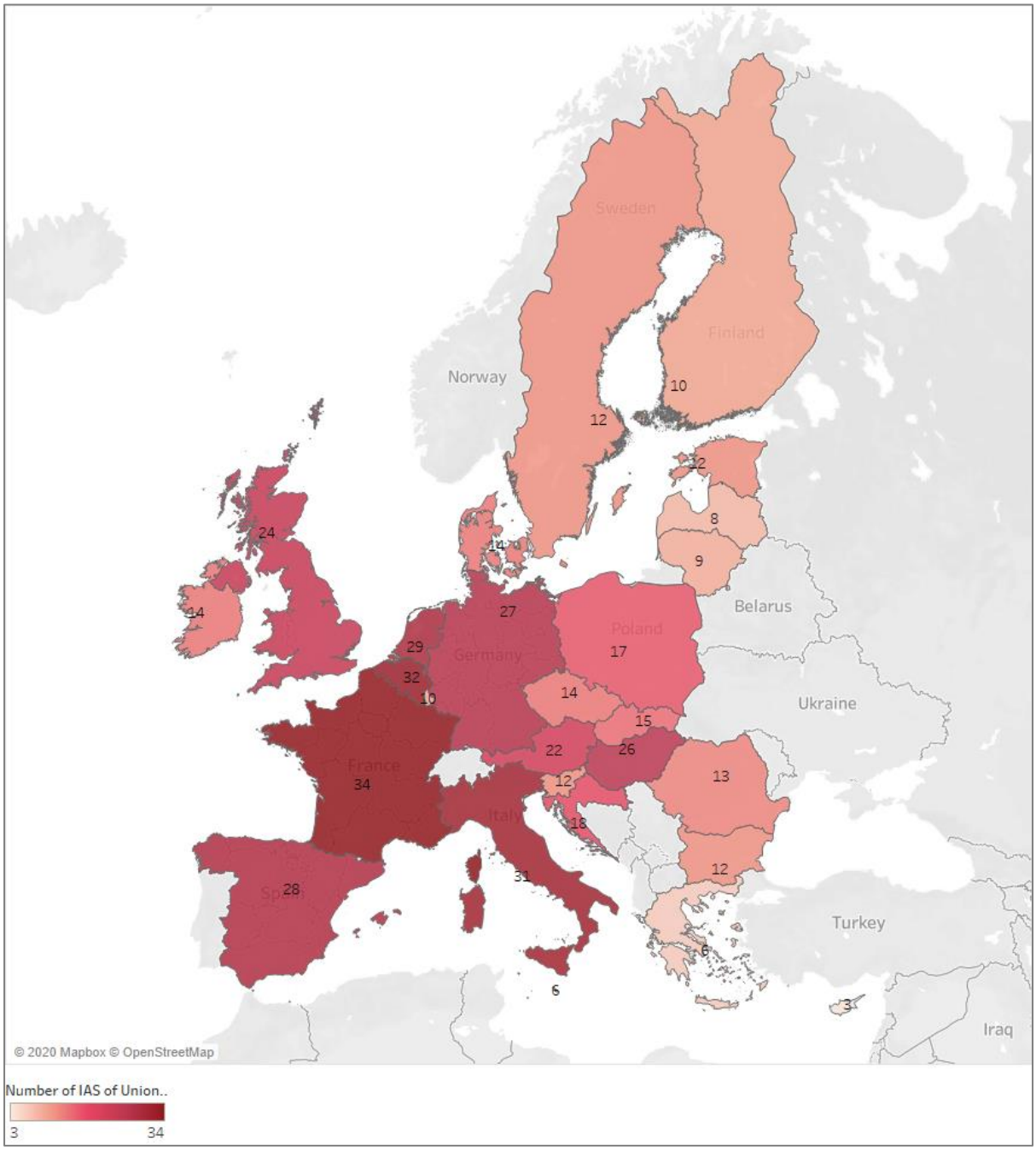
The present report investigates the numbers and frequency of HD habitats and species and BD species affected by IAS of Union concern. Case studies in this report illustrate the differences in information (concerning IAS occurrence, distribution and impact) provided between reports under the Nature Directives (ND) and the IAS regulation. These differences can lead to inconsistencies when aggregating reported data.

[1] 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.
[2] *Nyctereutes procyonoides*, the raccoon dog, has been added to the list in February 2019.
[3] Recently, in August 2019, an extension brought the list to 66 species (36 plants, 30 animals).
[4] Located between Antwerpen and Vlaams-Brabant in Belgium

Figure 1-1 **Number of countries that reported the IAS of Union concern as present (red bar) in their territory during the reporting period; grey bar: unknown, blue bar: absent**

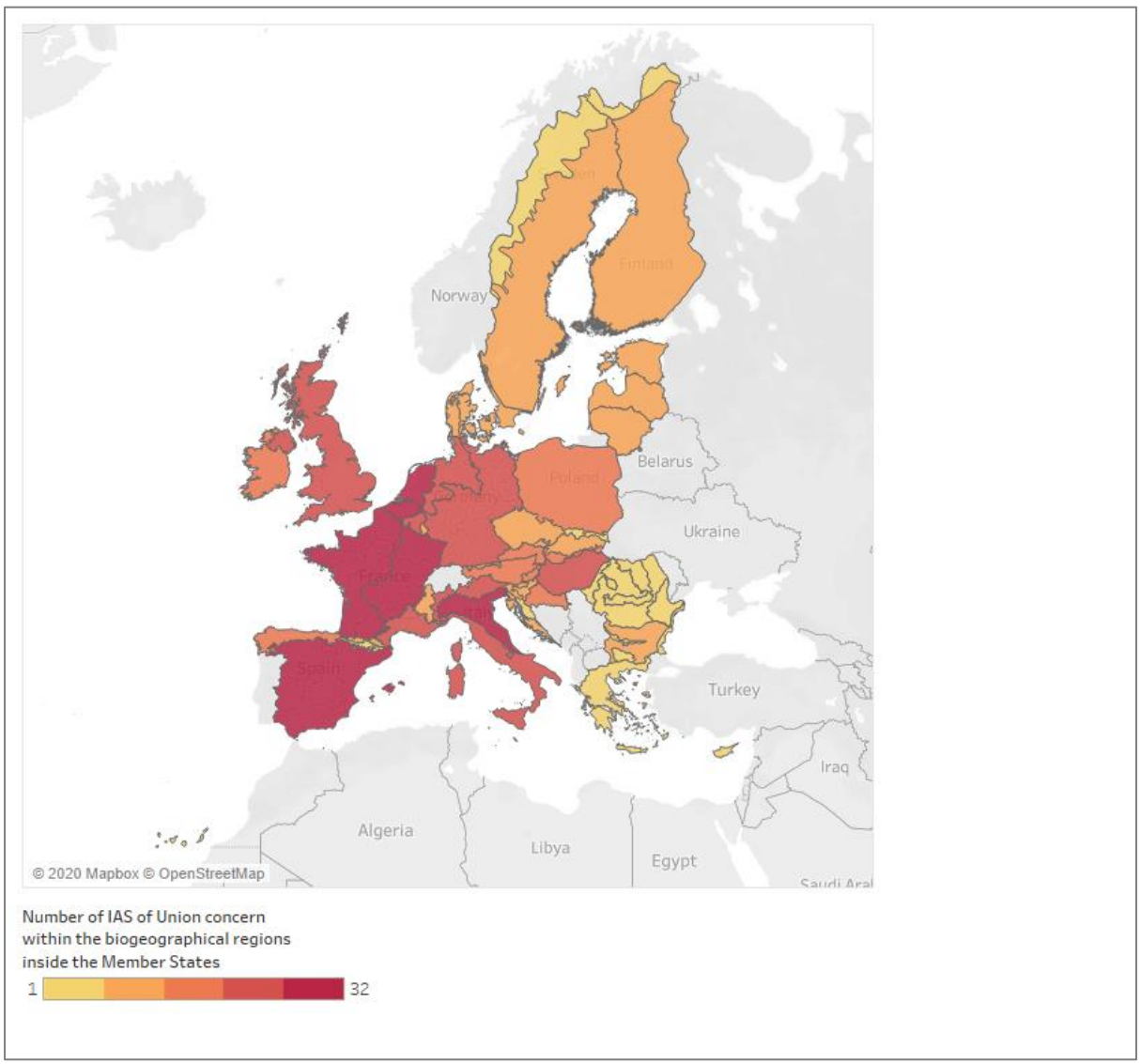


Map 1-1 Reported numbers of IAS of Union concern per Member State (for 27 of 28 Member States)



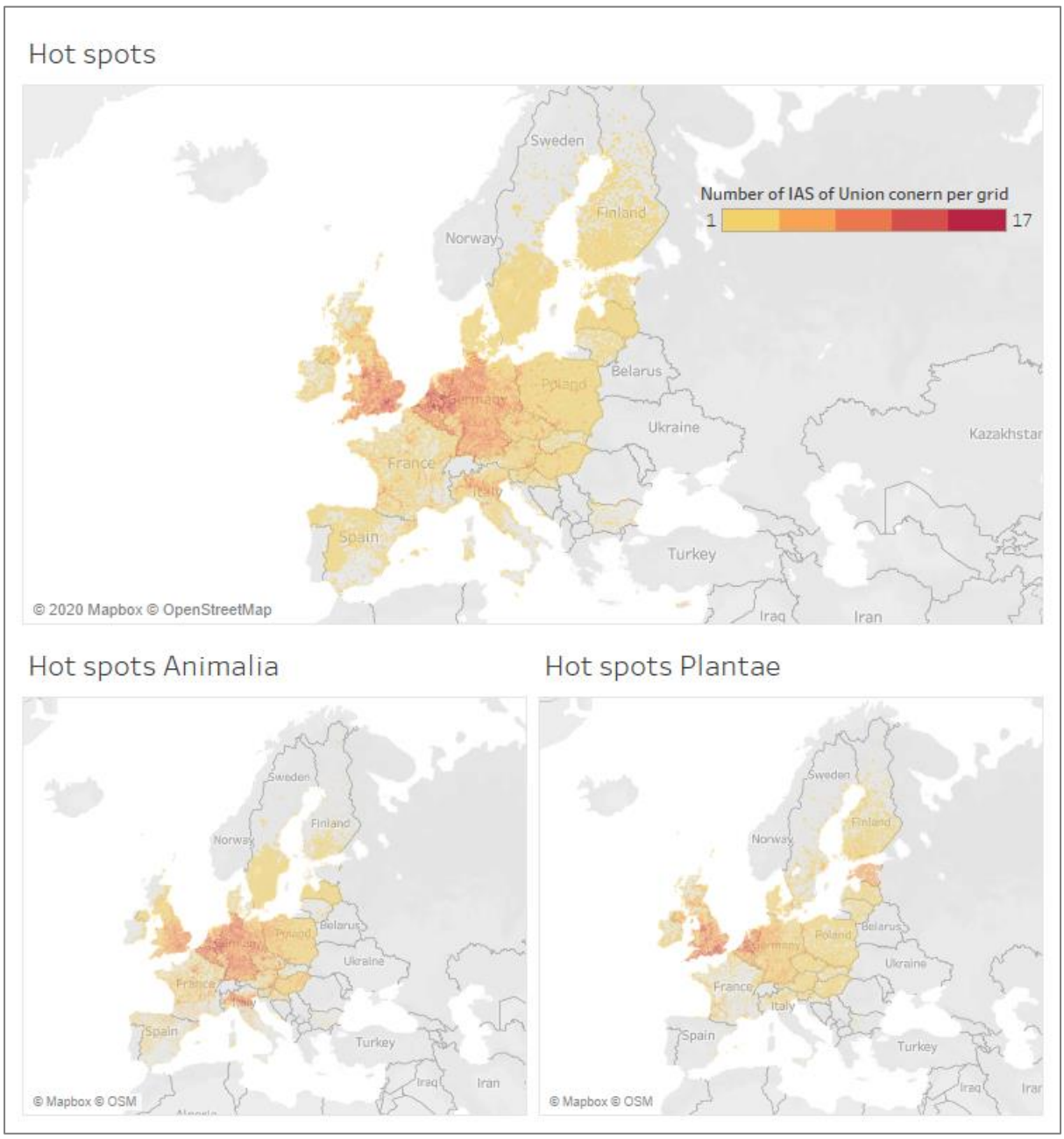
Source: Member States reports under the IAS regulation, 2019

Map 1-2 Reported numbers of IAS of Union concern per biogeographical region per Member State (for 27 of 28 Member States)



Source: Member States reports under the IAS regulation, 2019

Map 1-3 **Number of reported IAS of Union concern per grid cell ("Hot spots") (for 27 of 28 Member States) for all taxa (n=48), animals (n=25) and plants (n=23)**



Source: Member States reports under the IAS regulation, 2019
Note: The maps are available at https://ias.eea.europa.eu/products/european-statistics in the dashboard 'IAS of Union concern'

The Member States report inter alia on pressures and threats on habitats and species targeted by the Nature Directives. The list of pressures and threats used for this purpose has a dedicated category for Invasive alien species of Union concern ("I01"). Furthermore, the Member States can explicitly mention, which IAS of Union concern causes a pressure or threat on an Annex species or habitat in a specific biogeographical region. This optional field in the report format was introduced only shortly before the reporting started and information was provided in approx. 48 % (240 of 502 records for species) and 30 % (99 of 345 records for habitats and 48 of 160 records for birds) of the cases. The information provided in this free text field, however, was not standardized and therefore is difficult to analyse. The table in Annex 1 provides an overview of explicitly mentioned IAS of Union concern as

a “Pressure” for species and habitats of the HD per biogeographic region. The data mostly reflect the general distribution of IAS of Union concern (e.g. Map 1-3), and should be interpreted with great caution, because of substantial gaps (see below). A further complication is the restriction to maximally assign ten pressures or threats during reporting. Member States repeatedly commented that there have been more than ten pressures and threats identified, but not all could be included in the assessment. Similarly, under the IAS reporting the Member States could mention in an optional field, for which habitats and species of the Nature Directives the IAS of Union concern being present in their territory had an impact, but again, not all Member States were able to provide this information.

In addition, Member States can mention “Other invasive alien species (other than species of Union concern) (“I02”) from the list of pressures and threats in the ND reporting. Member States assigned this in 893 cases for species and in 955 cases for habitats. Thereof, however, in 59 cases for species and 45 cases for habitats the comment explicitly refers to IAS of Union concern and these data should be transferred to “I01”. The comments within this free text field provide diverse information which could not be systematically analysed in the context of this report. Examples of “Other IAS” include species that are native in parts of the EU, e.g. the zebra mussel *Dreissena polymorpha* and the wels catfish *Silurus glanis*, but also species alien to Europe, e.g. the Asian clam *Corbicula fluminea* and the American mink *Neovison vison*.

The data resulting from both reportings (Nature Directives and IAS regulation) should match each other. However, the data show discrepancies and gaps regarding the impact of IAS on the target habitats and species of the Nature Directives. There are several possible reasons for the differences, e.g. lack of time for assessors, uncertainties surrounding the first IAS-Reporting, different organisations or assessors were preparing the reports in Member States with insufficient coordination among them. Closing some of the gaps can be achieved by making the respective fields of the report formats obligatory instead of optional in future reportings. Changes to the IAS-reporting format require a change in the IAS-Regulation, which might not be feasible. However, a modification in the corresponding reporting guidelines might help to improve data quality for the next reporting. A dedicated workshop to discuss improvements of the guidelines within the advisory boards for reporting might help to overcome the inherent, non-genuine variance in impact data across the EU in the future. Improved coordination and communication between assessors within Member States appears to be key to a harmonized data set within each Member State.

A direct link of negative impacts between some IAS of Union concern and species protected by the Nature Directives is comprehensible, e.g. pathogen transmission of invasive crayfish and its consequences for native crayfish or hybridization between ruddy duck and white-headed duck. However, general or indirect impacts on species (e.g. via predation or competition) and habitats (e.g. changes in nutrient cycles or food-web structure) often are more subtle and require detailed scientific investigations to disentangle the responsible factors. It is rarely a single factor responsible for a change in the conservation status of a species or habitat. Furthermore, assignments of pressures and threats caused by IAS (both “IAS of Union concern” and “Other IAS”) on species and habitats in the Art. 17 reporting will always remain subjective to some degree.

2 Impact of IAS of Union concern on the target habitats and species of the Nature Directives

2.1 Number of Habitats Directive Annex I habitat types impacted by IAS of Union concern

According to the reports provided by the Member States under article 17 of the Habitats Directive (HD), 22 IAS of Union concern (that is 45 % of the 49[5] species; 13 plants and 9 animals) have a negative impact on 47 different habitats of the Habitats Directive (in eight habitat groups, only rocky habitats have no reports of negative impacts) in the reporting period (Table 2-1). These 47 habitats constitute 20,1 % of the 233 habitats listed in Annex I of the Habitats Directive. Most affected habitats belong to the categories of Coastal habitats, Forests, and Freshwater habitats (Fig. 2-2), while Freshwater habitats are affected by the highest reported numbers of IAS, followed by coastal habitats (Fig. 2-3, 2-4).

The most frequently mentioned species is Eastern Baccharis (*Baccharis halimifolia*), followed by Red Swamp Crayfish (*Procambarus clarkii*), Pond Slider (*Trachemys scripta*) and Himalayan Balsam (*Impatiens glandulifera*) (Fig. 2-1). The 14 habitats affected by *Baccharis halimifolia* and all other habitats affected by IAS of Union concern are listed in Annex 1. The complete list of IAS of Union concern that were assigned having an impact on the target habitats of the HD is given in Annex 2. Unfortunately, these assignments appear to be highly inconsistent, incomprehensible and include serious gaps.

Inconsistencies: Species with identical or similar invasion ecology should have identical or similar impacts on habitats in adjoining countries or within biogeographic regions. However, this is not the case for e.g. *Myriophyllum aquaticum* and *M. heterophyllum*, *Ludwigia grandiflora* and *L. peploides*, *Heracleum sosnowskyi* and *H. mantegazzianum* or *Procyon lotor* and *Nyctereutes procyonoides*. In addition, impacts of the crayfish species on habitats differ widely between species or are missing (see below). This might be a consequence of different species distributions and therefore different impacts between Member States, or could be related to species misidentification (e.g. for *Heracleum*), but might also reflect different expert opinions or knowledge on the impacts within a Member State.

Incomprehensibilities: Negative impacts of the Asian hornet (*Vespa velutina nigrithorax*) on Forests and Grasslands are at least doubtful, but impacts of this species on Freshwater habitats (and species, see below) are odd. Similarly, there is no evidence that Ruddy duck (*Oxyura jamaicensis*) causes any pressure to coastal or freshwater habitats.

[5] The IAS-reporting was due for 48 species of Union concern, as the raccoon dog entered the list only shortly after the reporting period. However, in the HD-reporting the raccoon dog was included as a possible pressure/threat, which is why the HD-reporting included 49 IAS of Union concern.

Table 2-1 Reported numbers of IAS of Union concern having an impact on HD habitats

Bogs, mires & fens	Calcareous fens with Cladium mariscus and species of the Caricion davallianae	3
	Transition mires and quaking bogs	3
Coastal habitats	Annual vegetation of drift lines	1
	Atlantic salt meadows (Glauco-Puccinellietalia maritimae)	1
	Boreal Baltic coastal meadows	1
	Boreal Baltic islets and small islands	1
	Coastal lagoons	7
	Estuaries	2
	Mediterranean and thermo-Atlantic halophilous scrubs (Sarcocornetea fruticosi)	4
	Mediterranean salt meadows (Juncetalia maritimi)	2
	Mudflats and sandflats not covered by seawater at low tide	1
	Salicornia and other annuals colonizing mud and sand	4
	Spartina swards (Spartinion maritimae)	1
	Vegetated sea cliffs of the Atlantic and Baltic Coasts	1
Dunes habitats	Embryonic shifting dunes	1
	Fixed coastal dunes with herbaceous vegetation ("grey dunes")	1
	Humid dune slacks	1
	Pannonic inland dunes	1
	Shifting dunes along the shoreline with Ammophila arenaria ("white dunes")	1
Forests	Alluvial forests with Alnus glutinosa and Fraxinus excelsior (Alno-Padion, Alnion incanae, Salicion ..	3
	Euro-Siberian steppic woods with Quercus spp.	1
	Fennoscandian hemiboreal natural old broad-leaved deciduous forests (Quercus, Tilia, Acer, Fraxi..	1
	Fennoscandian herb-rich forests with Picea abies	1
	Mediterranean pine forests with endemic Mesogean pines	1
	Olea and Ceratonia forests	1
	Pannonic inland sand dune thicket (Junipero-Populetum albae)	1
	Riparian mixed forests of Quercus robur, Ulmus laevis and Ulmus minor, Fraxinus excelsior or Frax..	2
	Salix alba and Populus alba galleries	1
	Southern riparian galleries and thickets (Nerio-Tamaricetea and Securinegion tinctoriae)	1
	Thermophilous Fraxinus angustifolia woods	3
Freshwater habitats	Alpine rivers and their ligneous vegetation with Myricaria germanica	4
	Constantly flowing Mediterranean rivers with Paspalo-Agrostidion species and hanging curtains ..	1
	Hard oligo-mesotrophic waters with benthic vegetation of Chara spp.	7
	Natural eutrophic lakes with Magnopotamion or Hydrocharition - type vegetation	12
	Oligotrophic to mesotrophic standing waters with vegetation of the Littorelletea uniflorae and/or..	2
	Oligotrophic waters containing very few minerals of sandy plains (Littorelletalia uniflorae)	5
	Rivers with muddy banks with Chenopodion rubri p.p. and Bidention p.p. vegetation	5
	Water courses of plain to montane levels with the Ranunculion fluitantis and Callitricho-Batrachio..	7
Grasslands	Fennoscandian lowland species-rich dry to mesic grasslands	2
	Hydrophilous tall herb fringe communities of plains and of the montane to alpine levels	6
	Lowland hay meadows (Alopecurus pratensis, Sanguisorba officinalis)	1
	Pannonic loess steppic grasslands	1
	Pannonic sand steppes	1
	Semi-natural dry grasslands and scrubland facies on calcareous substrates (Festuco-Brometalia) (..	1
	Species-rich Nardus grasslands, on siliceous substrates in mountain areas (and submountain area..	1
Heath & scrub	Dry Atlantic coastal heaths with Erica vagans	1
Sclerophyllous scrubs	Arborescent matorral with Juniperus spp.	1
	Arborescent matorral with Laurus nobilis	1
	Thermo-Mediterranean and pre-desert scrub	1

Figure 2-1 **Reported numbers of affected habitats of the Habitat Directive by IAS of Union concern. No negative effects on habitats were reported for 27 IAS of Union concern**

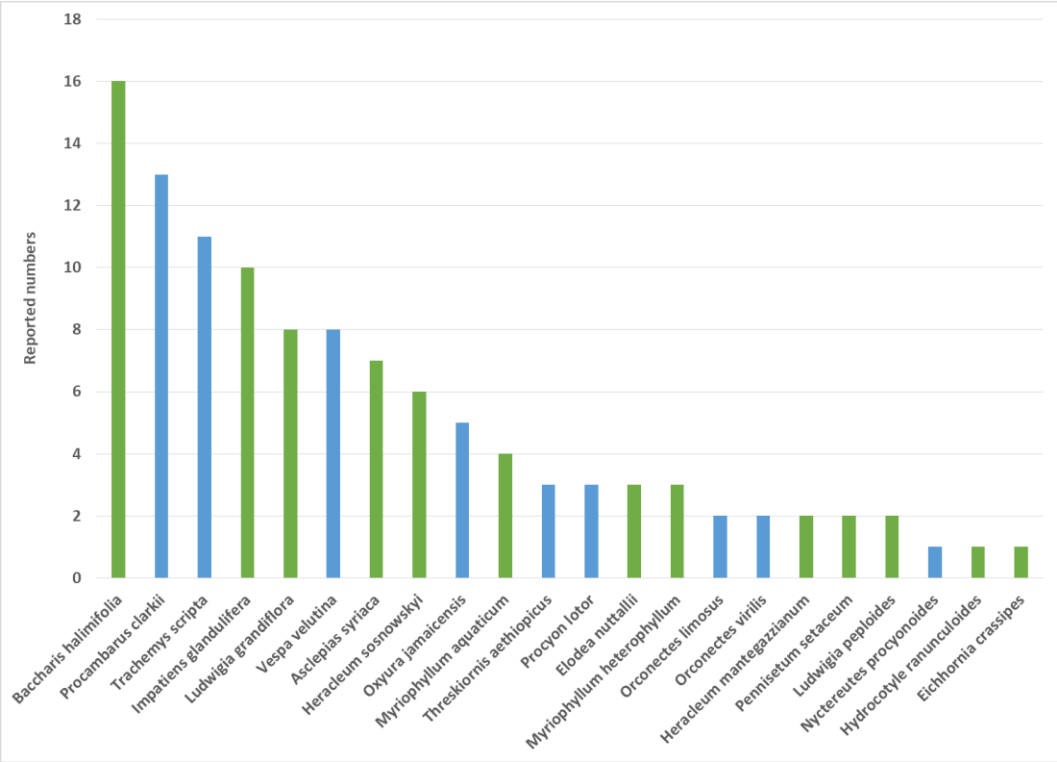


Figure 2-2 **Number of HD habitats impacted by IAS of Union concern**

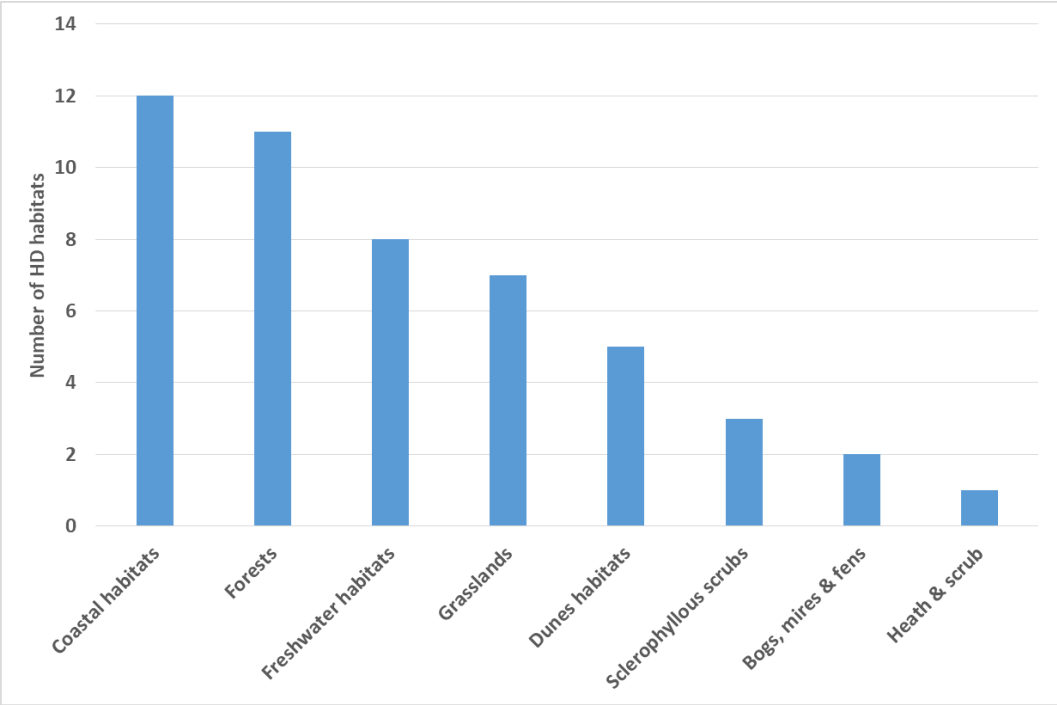
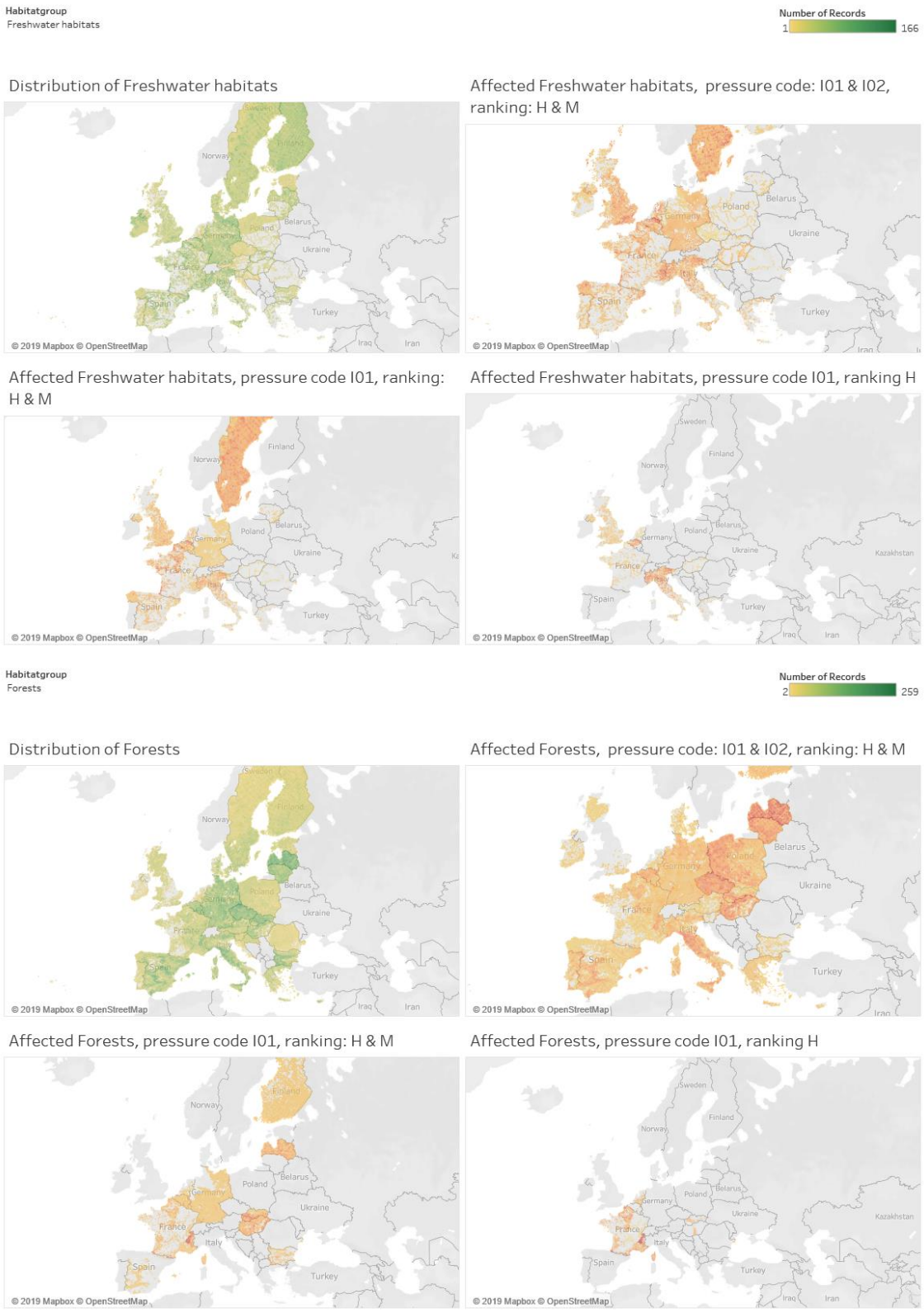
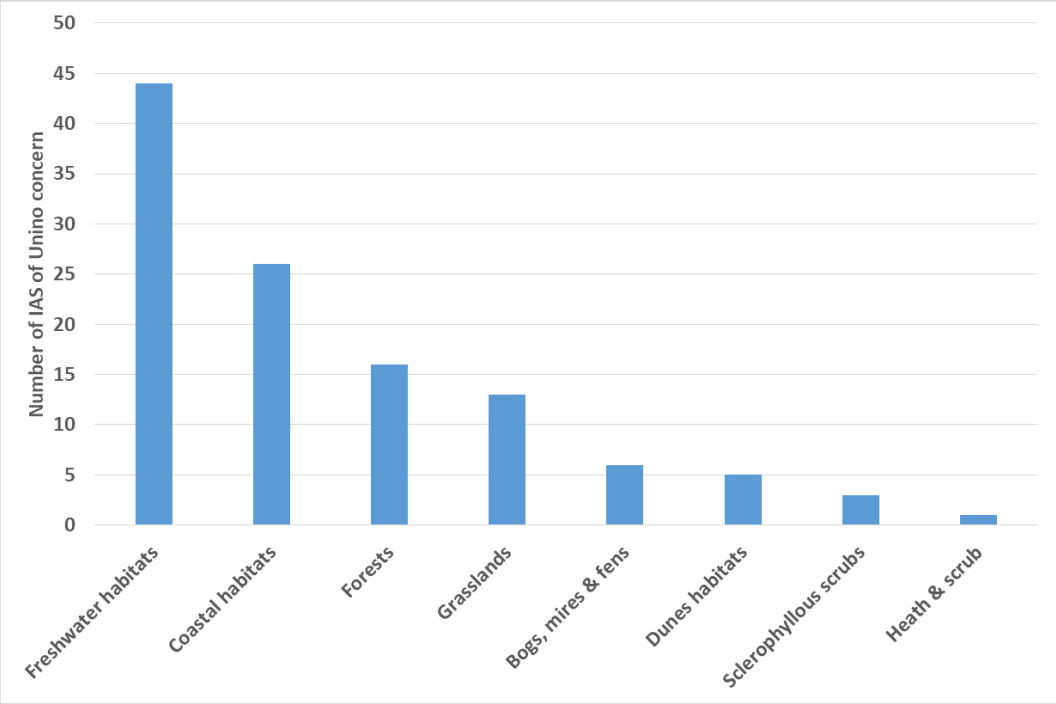


Figure 2-3 Distribution of freshwater and forest habitats in the European Union and affected habitats (pressure code I01 and I01 & I02, High and Medium confidence; I01 with High confidence) based on Member State reports



Source: Member States reports under the IAS regulation, 2019

Figure 2-4 Reported numbers of IAS of Union concern having an impact on HD habitats



Gaps: Several IAS of Union concern with documented negative impacts on habitats are not mentioned. For example, Grey Squirrel (*Sciurus carolinensis*) and Muntjac deer (*Muntiacus reevesi*) have negative effects on forest ecosystems, Nutria (*Myocastor coypus*) and Muskrat (*Ondatra zibethicus*) on river wetlands (Scalera et al. 2012), but these are not mentioned. All aquatic water plants have similar effects on ecosystems, but not all are mentioned (for example, no impacts were mentioned for *Cabomba caroliniana*). *Gunnera tinctoria* is known to have major effects on *Salix*-woodlands and coastal cliffs and is not mentioned. As mentioned earlier, this probably is a consequence of under-reporting, due to the optionality of answering the question, lack of communication of assessors and experts within Member States or due to the relatively short introduction of the question before the reporting started. In any case, these inconsistencies and gaps should be addressed in future reportings.

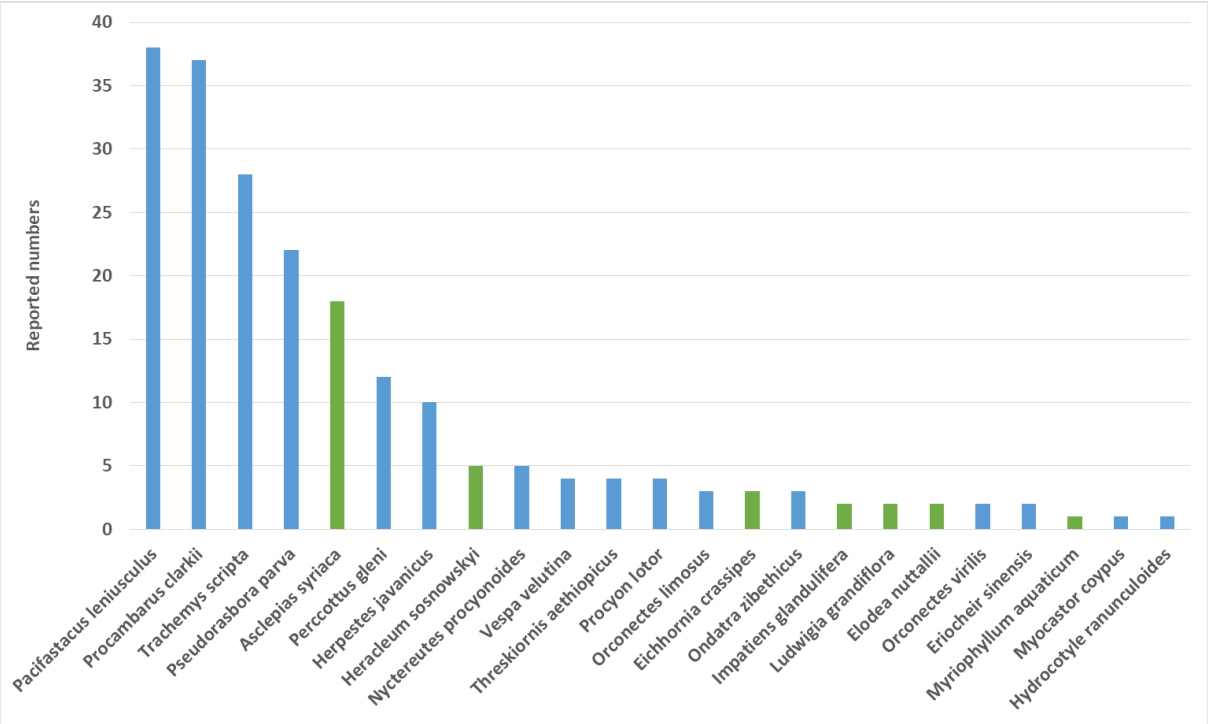
2.2 Number of target species of the Habitat and Bird Directive impacted by IAS of Union concern

According to Member State reports 22 IAS of Union concern (that is 45 % of the 49[6] species; 7 plants and 15 animals) have a negative impact on species of the Habitats Directive in the reporting period. The most frequently mentioned species is Signal Crayfish (*Pacifastacus leniusculus*), followed by Red

[6] The IAS-reporting was due for 48 species of Union concern, as the raccoon dog entered the list only shortly after the reporting period. However, in the HD-reporting the raccoon dog was included as a possible pressure/threat, which is why the HD-reporting included 49 IAS of Union concern.

Swamp Crayfish (*Procambarus clarkii*), Pond Slider (*Trachemys scripta*) and Stone moroko (*Pseudorasbora parva*) (Fig. 2-5). The 38 species of the Habitats Directive affected by *Pacifastacus leniusculus* and all other species affected by IAS of Union concern are listed in Annex 3.

Figure 2-5 Reported numbers of affected species of the Habitat Directive by IAS of Union concern. No negative effects on species were reported for 27 IAS of Union concern



Similar to the assignments of IAS of Union concern to habitats, the assignments to impacted Habitats Directive species entail some problems. Again, differences between similar species appear to be an effect of the regional native/non-native distribution (e.g. for crayfish) or the local abundance (e.g. the *Heracleum* species) rather than an inconsistency. In the case of the very similar *Heracleum* species, wrong identification or different understanding of the taxonomy of the species should also be considered. The Habitats Directive species impacted by the Asian hornet (e.g. *Unio elongatulus*, *Astacus astacus*, *Rana arvalis*, *Emys orbicularis*), however, might possibly result from mistakes during data input.

As for habitats, there are also gaps in the data. For example, *Eichhornia crassipes* can have an impact on amphibians & reptiles, and additional fish species; *Lysichiton americanus* can have an impact on *Sphagnum* species in Germany and river habitats in Sweden; *Perccottus glenii* is a significant pressure to newts (*Lissotriton* spp., *Triturus* spp) (see Scalera et al. 2020).

2.2.1 Birds

According to Member State reports within the Bird Directive, nine IAS of Union concern (that is 18 % of the 49 species; 3 plants and 6 animals) have a negative impact on bird species in the reporting period. Most often mentioned is the Raccoon dog (*Nyctereutes procyonoides*), followed by – but considerably less often mentioned – the Coypu (*Myocastor coypus*) and the Egyptian goose (*Alopochen aegyptiacus*). Three plants are also mentioned, the Common Milkweed (*Asclepias syriaca*), the Alligator Weed (*Alternanthera philoxeroides*), and the Chilean rhubarb (*Gunnera tinctoria*) (Fig. 2-6).

In total, 31 bird species were identified being under pressure from IAS of Union concern (Tab. 2-2), constituting 6 % of the 512 bird taxa reported under Article 12 of the Bird Directive. The Marbled duck (*Marmaronetta angustirostris*) and the Western swamphen (*Porphyrio porphyrio porphyrio*) appear to be the species affected by most IAS (four IAS each), followed by the White-headed duck (*Oxyura leucocephala*), which is not only affected by the Ruddy duck (*Oxyura jamaicensis*), but also by the Egyptian goose and by the Raccoon (*Procyon lotor*).

Figure 2-6 **Reported numbers of affected bird species of the Bird Directive by IAS of Union concern. No negative effects on bird species were reported for 40 IAS of Union concern**

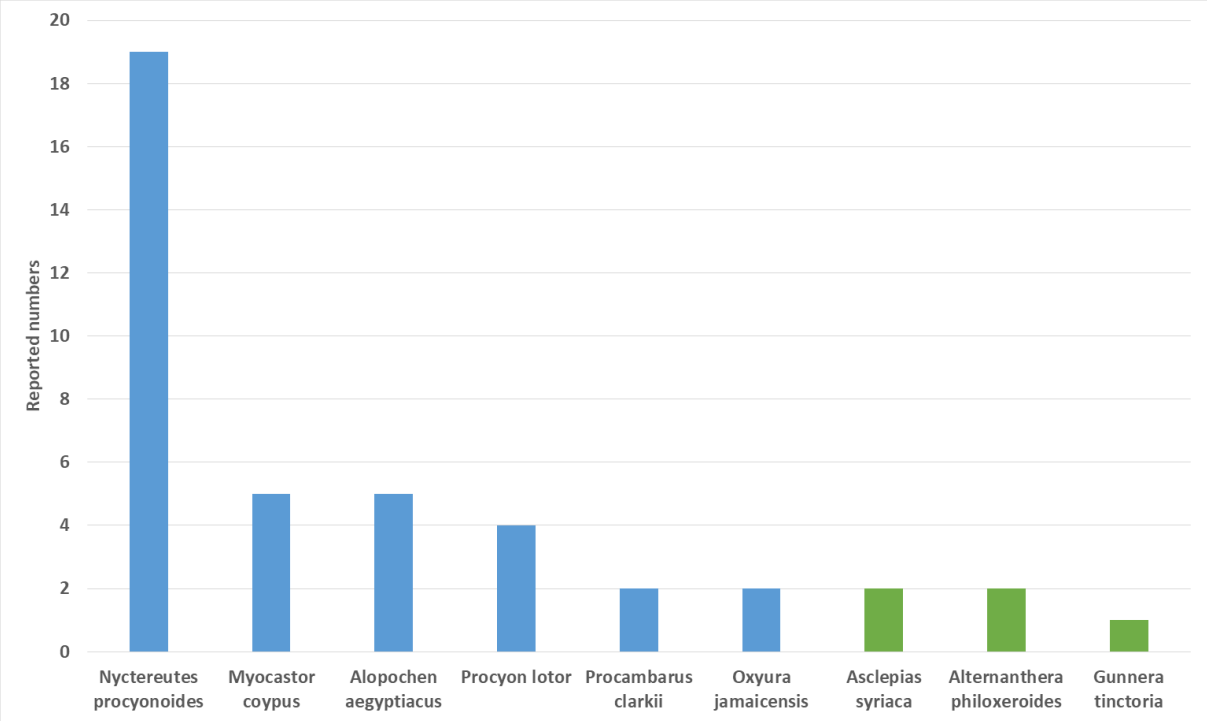


Table 2-2 Reported numbers of IAS of Union concern having an impact on Bird Directive species

Birds	Acrocephalus melanopogon	2
	Anas acuta	1
	Arenaria interpres	1
	Asio flammeus	1
	Aythya ferina	1
	Bonasa bonasia	1
	Botaurus stellaris	1
	Calidris alpina schinzii	1
	Chlidonias hybrida	1
	Chlidonias leucopterus	1
	Chlidonias niger	1
	Ciconia ciconia	1
	Ciconia nigra	1
	Emberiza hortulana	1
	Fulica atra	1
	Gallinula chloropus	1
	Gavia arctica	1
	Ixobrychus minutus	1
	Marmaronetta angustirostris	4
	Melanitta fusca	1
	Microcarbo pygmaeus	2
	Netta rufina	1
	Oxyura leucocephala	3
	Phylloscopus sibilatrix	1
	Podiceps cristatus	2
	Porphyrio porphyrio porphyrio	4
	Pyrrhula murina	1
	Somateria mollissima	1
	Spatula querquedula	1
	Sternula albifrons	1
	Xenus cinereus	1

2.2.2 Amphibians

In total, 24 amphibian species were identified being under pressure from IAS of Union concern (Tab. 2-3), with the crayfish *Pacifastacus leniusculus* and *Procambarus clarkii* most often mentioned (for 19 of the 24 species). *Trachemys scripta* was mentioned as a pressure for 13 species, *Heracleum sosnowskyi* and *Nyctereutes procyonoides* were mentioned for four species, *Elodea nuttallii* for two species and *Threskiornis aethiopicus*, *Perccottus glenii* and *Pseudorasbora parva* for one species. Within amphibians, *Rana arvalis*, was mentioned as being the species affected by most IAS (Tab. 2-3). Not all these assigments, however, make a biological sense (e.g. *Vespa velutina* mentioned as IAS of Union concern affecting *R. arvalis*) (Annex 3). These 24 amphibian species make up 32,9 % of the 73 amphibian taxa reported under Article 17 of the Habitats Directive.

Table 2-3 Reported numbers of IAS of Union concern having an impact on HD amphibian species

Group	Name	
Amphibians	Alytes cisternasii	3
	Alytes dickhilleni	3
	Alytes obstetricans	3
	Bufotes viridis	2
	Calotriton arnoldi	2
	Calotriton asper	2
	Chioglossa lusitanica	2
	Discoglossus galganoi	3
	Discoglossus pictus	3
	Epidalea calamita	3
	Hyla meridionalis	3
	Hyla molleri	3
	Pelobates cultripes	3
	Pelophylax esculentus	1
	Pelophylax lessonae	3
	Pelophylax perezi	4
	Pelophylax ridibundus	2
	Rana arvalis	6
	Rana dalmatina	2
	Rana iberica	2
	Rana pyrenaica	2
	Rana temporaria	2
	Triturus marmoratus	3
	Triturus pygmaeus	3

2.2.3 Reptiles

In total, 16 reptile species were identified being under pressure from IAS of Union concern (Tab. 2-4), with *Herpestes javanicus* being most often mentioned as a pressure (for 10 of the 16 species), followed by *Asclepias syriaca* (for five species) and *Trachemys scripta* (for the 3 turtle species of the HD). Within reptiles, *Emys orbicularis* was mentioned being most affected, by eight IAS (Annex 4). However, again, not all these assigments are biologically comprehensible (e.g. *Vespa velutina* mentioned as IAS of Union concern affecting *E. orbicularis* while *Procyon lotor* is not mentioned). These 16 reptile species make up 15,1 % of the 106 reptile taxa reported under Article 17 of the Habitats Directive.

Table 2-4 Reported numbers of IAS of Union concern having an impact on HD reptile species

Group	Name	
Reptiles	Elaphe quatuorlineata	1
	Emys orbicularis	8
	Hierophis gemonensis	1
	Lacerta agilis	1
	Lacerta viridis	1
	Mauremys leprosa	3
	Mauremys rivulata	1
	Ophisaurus apodus	1
	Platyceps najadum	1
	Podarcis melisellensis	1
	Podarcis siculus	1
	Podarcis taurica	1
	Telescopus fallax	1
	Vipera ammodytes	1
	Vipera ursinii rakosiensis	1
	Zamenis situla	1

2.2.4 Fish

In total, 22 fish species were identified being under pressure from IAS of Union concern (Tab. 2-5), with the other fish species being most often mentioned (*Pseudorasbora parva* for 17 species, *Perccottus glenii* for 10 species), followed by the crayfish *Pacifastacus leniusculus* (9 spp.), *Procambarus clarkii* (9 spp.) and the pond slider *Trachemys scripta* (8 spp.). Within fish, five species were mentioned (*Cobitis calderoni*, *C. paludica*, *C. vettonica*, *Pseudochondrostoma duriense*, *Cottus hispaniolensis*) being most affected by four IAS each with *Pacifastacus leniusculus, Procambarus clarkii* and *Trachemys scripta* mentioned as a threat for all five species (Annex 4). These 22 fish species make up 9,1 % of the 241 fish taxa reported under Article 17 of the Habitats Directive.

Table 2-5 Reported numbers of IAS of Union concern having an impact on HD fish species

Group	Name	
Fish	Achondrostoma arcasii	3
	Anaecypris hispanica	3
	Aphanius iberus	3
	Aspius aspius	2
	Cobitis calderoni	4
	Cobitis paludica	4
	Cobitis taenia Complex	2
	Cobitis vettonica	4
	Cottus hispaniolensis	4
	Eudontomyzon mariae	2
	Gymnocephalus baloni	2
	Gymnocephalus schraetzer	2
	Iberochondrostoma lemmingii	2
	Misgurnus fossilis	2
	Pelasgus prespensis	1
	Pelecus cultratus	2
	Phoxinellus alepidotus	1
	Pseudochondrostoma duriense	4
	Rhodeus amarus	1
	Romanogobio kesslerii	2
	Romanogobio vladykovi	2
	Umbra krameri	2

2.2.5 Mammals

In total, only two mammal species were identified being under pressure from IAS of Union concern (Tab. 2-6) (*Myocastor coypus* for *Lutra lutra* and *Nyctereutes procyonoides* and *Procyon lotor* for *Mustela putorius*). These two mammal species make up 1,4 % of the 142 mammal taxa reported under Article 17 of the Habitats Directive.

Table 2-6 Reported numbers of IAS of Union concern having an impact on HD mammal species

Group	Name	
Mammals	Lutra lutra	1
	Mustela putorius	2

2.2.6 Molluscs

In total, six mollusc species were identified being under pressure from IAS of Union concern (Tab. 2-7), with *Ondatra zibethicus* and *Procyon lotor* being most often mentioned, followed by *Pacifastacus leniusculus* and *Procambarus clarkii*. Within molluscs, *Unio elongatulus* and *Margaritifera margaritifera* were mentioned being most affected by five and four IAS, respectively (Annex 4), although some assignments probably are erroneous (e.g. *Vespa velutina* negatively affecting *U. elongatulus*). These six mollusc species make up 12,5 % of the 48 mollusc taxa reported under Article 17 of the Habitats Directive.

Table 2-7 Reported numbers of IAS of Union concern having an impact on HD molluscs species

Molluscs	Anisus vorticulus	1
	Margaritifera auricularia	2
	Margaritifera margaritifera	4
	Unio crassus	3
	Unio elongatulus	5
	Unio tumidiformis	1

2.2.7 Arthropods

In total, 10 arthropod species were identified being under pressure from IAS of Union concern (Tab. 2-8), thereof four butterflies & moths, three crayfish and three dragonflies. The crayfish *Pacifastacus leniusculus* and *Procambarus clarkii* being most often mentioned as a pressure (for five and four species, respectively; including native crayfish and dragonflies), followed by the other non-native crayfish and *Trachemys scripta*; Within plants, *Asclepias syriaca* is mentioned as a pressure for four butterfly & moth species with some of the water plants being a pressure to dragonflies. All crayfish are affected by several (up to eight) IAS (Annex 4). Within dragonflies, *Macromia splendens*, is reported being under pressure by six IAS of Union concern (Annex 4). These 10 arthropod species make up 7,7 % of the 129 arthropod taxa reported under Article 17 of the Habitats Directive.

Table 2-8 Reported numbers of IAS of Union concern having an impact on HD arthropod species

Group	Name	
Arthropods	Astacus astacus	8
	Austropotamobius pallipes	7
	Austropotamobius torrentium	5
	Coenagrion mercuriale	1
	Coenonympha oedippus	1
	Eriogaster catax	1
	Gortyna borelii lunata	1
	Macromia splendens	6
	Oxygastra curtisii	1
	Proserpinus proserpina	2

2.2.8 Vascular plants

In total, eleven vascular plant species were identified being under pressure from one IAS of Union concern (Tab. 2-9). *Asclepias syriaca* was most often mentioned as a pressure (for nine species, all of which in Hungary), with *Heracleum sosnowskyi* (only recorded from Latvia) and *Impatiens glandulifera* being the other two species. These eleven vascular plant species make up 1,7 % of the 662 plant taxa reported under Article 17 of the Habitats Directive.

Table 2-9 **Reported numbers of IAS of Union concern having an impact on HD vascular plant species**

Group	Name	
Vascular plants	Angelica palustris	1
	Colchicum arenarium	1
	Crambe tataria	1
	Dianthus diutinus	1
	Iris aphylla subsp. hungarica	1
	Iris humilis subsp. arenaria	1
	Lycopodium spp.	1
	Pulsatilla grandis	1
	Pulsatilla patens	1
	Pulsatilla pratensis subsp. hungarica	1
	Thlaspi jankae	1

2.2.9 Non-vascular plants and other invertebrates

No IAS of Union concern were mentioned as a pressure for these groups of HD species.

2.2.10 Overview

In absolute and relative numbers, amphibians and reptiles are most affected from IAS of Union concern (Figs. 2-7 & 2-8). Almost a third (32,9 %) of all amphibian species of the HD are negatively impacted from IAS of Union concern, followed by 15,1 % of all reptiles.

Figure 2-7 **Reported numbers of affected species of the Habitat and Bird Directive by IAS of Union concern. No negative effects were reported for non-vascular plant species and other invertebrates**

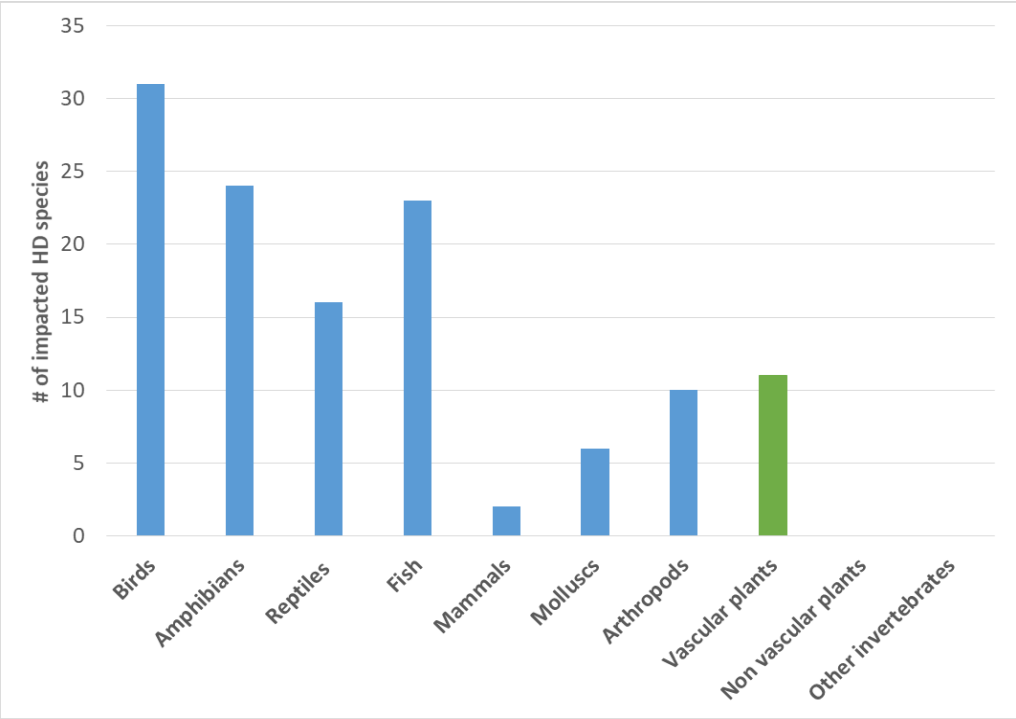
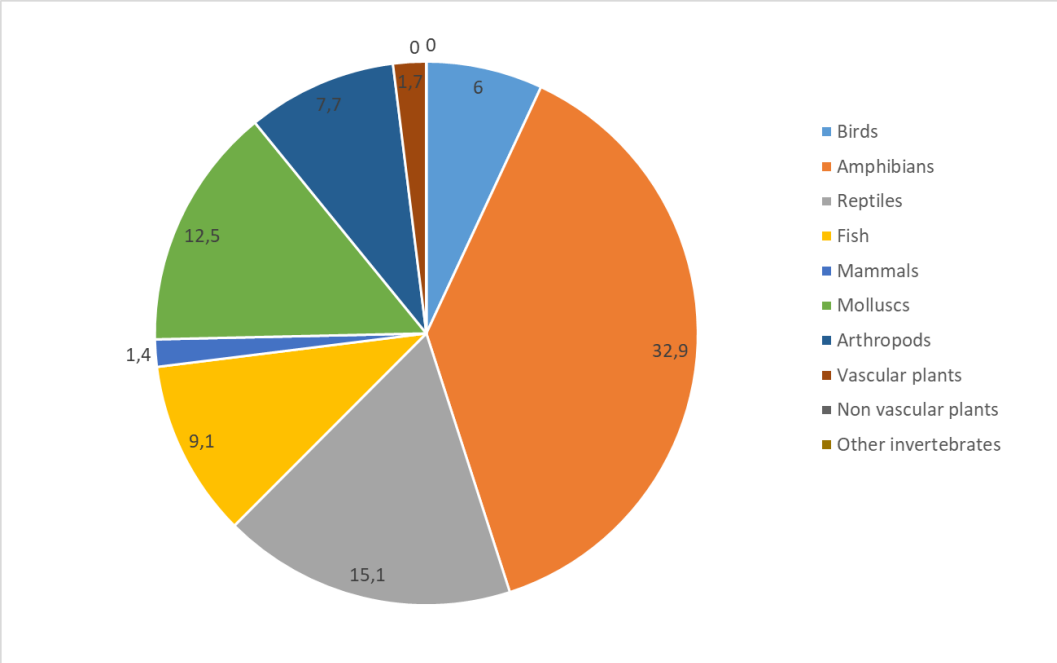


Figure 2-8 **Percentages of affected species of the Habitat Directive by IAS of Union concern as a share of the total numbers of listed species within the taxon group. No negative effects were reported for non-vascular plant species and other invertebrates**



2.3 Number of reported pressures caused by IAS of Union concern: Overview

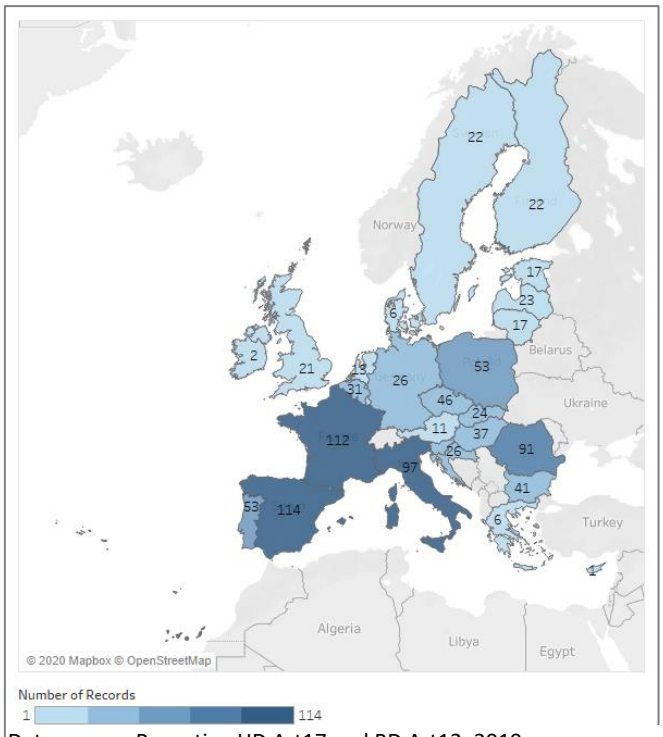
Member states explicitly listed IAS of Union concern (pressure code I01 AND explicitly mentioning the relevant species in the optional comment field) in 71 cases being a pressure for habitats, 203 cases for species and 35 cases for birds. Additionally, Member States listed IAS of Union concern as a pressure (without being explicit which species is causing the pressure) in 271 cases for habitats, 298 cases for species, and 77 cases for birds (Table 2-10).

While there is evidence that impacts from IAS of Union concern differ between Member States, the data also show some outliers, maybe indicating some assessor bias. Pressure on birds, for example, ranges between 0 and 10 species in all Member States, while in Poland 36 bird species are under pressure from IAS of Union concern. Pressure on species of the HD ranges between 1 (there is no Zero, i.e. there is no Member State without pressure from IAS of Union concern on species of the HD) and approx. 40 for most Member States, in France (62) and Spain (71) there are many more species under pressure. Pressure on habitats of the HD ranges between 0 and approx. 30 for most Member States, while in France (47), Romania (50) and Italy (56) there are many more habitats under pressure. As mentioned above, there is a geographical pattern in impacts from IAS of Union concern, but in the current data set this pattern is mixed with artefacts from wrong data entries, and it would be necessary to analyse these data in greater detail after a thorough examination and quality check to separate a true pattern from any data (reporting) artefacts.

Comparing all pressures across the EU sees Spain, France, Italy and Romania in the lead. The lowest numbers have been reported from Ireland and Cyprus (Map 2-1).

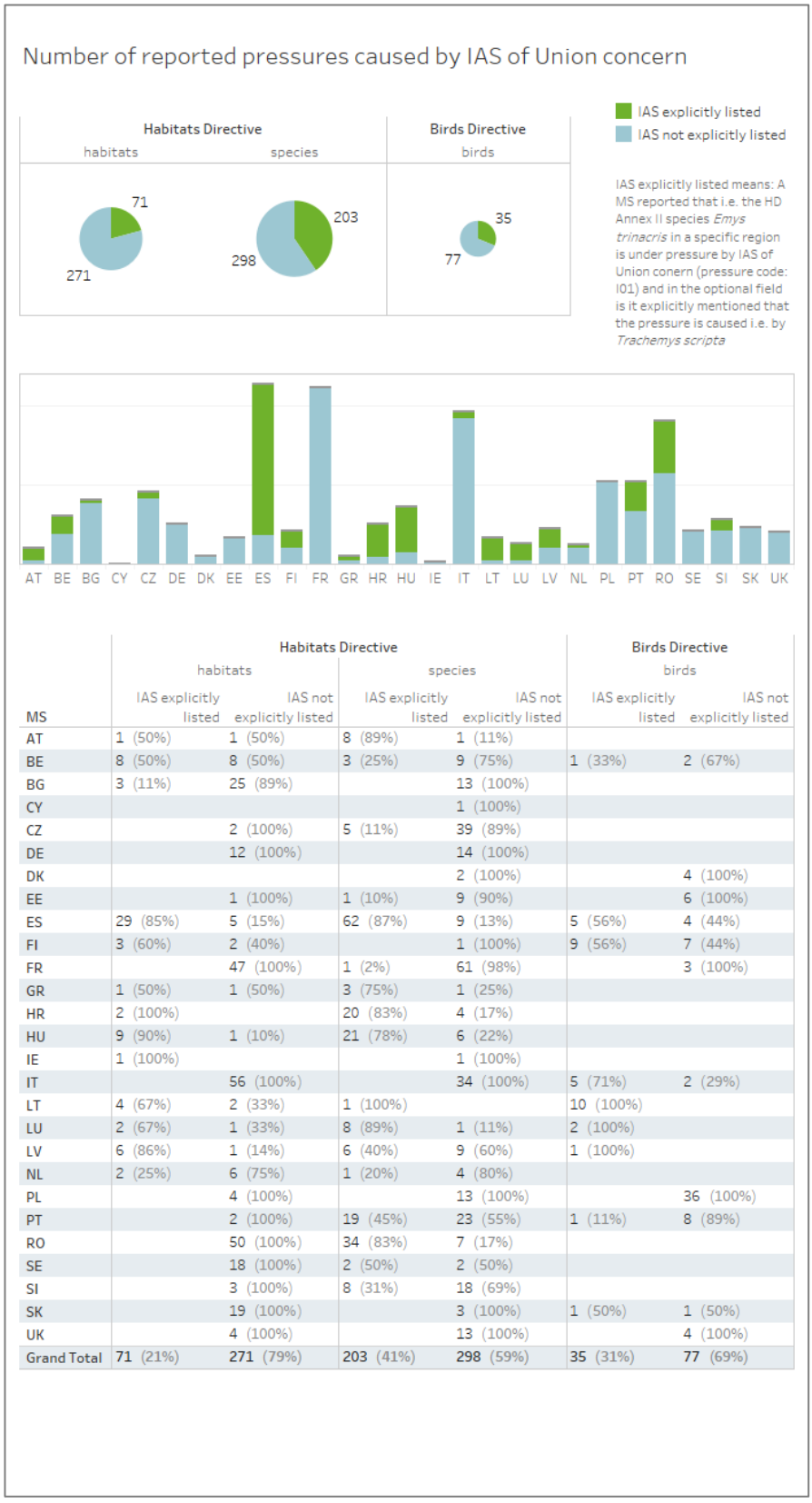
It is interesting to note that pressure from IAS of Union concern on species is much more often reported than on habitats (501 vs 342), probably because impacts on species are often direct and easier to observe and document, while impacts on habitats often are indirect and difficult to detect. It is also of interest that pressure on bird species is reported being lower (112) than for habitats or species of the HD. This might be a true pattern, an assessor bias, or both. Again, a more detailed analysis, and a comparison between the HD and the BD seems worthwhile.

Map 2-1 Number of reported pressures caused by IAS of Union concern



Data source: Reporting HD Art17 and BD Art12, 2019

Table 2-10 **Reported numbers of pressures caused by IAS of Union concern for habitats and species of the Habitats Directive and for birds of the Bird Directive by 27 Member States**



	Habitats Directive				Birds Directive	
	habitats		species		birds	
MS	IAS explicitly listed	IAS not explicitly listed	IAS explicitly listed	IAS not explicitly listed	IAS explicitly listed	IAS not explicitly listed
AT	1 (50%)	1 (50%)	8 (89%)	1 (11%)		
BE	8 (50%)	8 (50%)	3 (25%)	9 (75%)	1 (33%)	2 (67%)
BG	3 (11%)	25 (89%)		13 (100%)		
CY				1 (100%)		
CZ		2 (100%)	5 (11%)	39 (89%)		
DE		12 (100%)		14 (100%)		
DK				2 (100%)		4 (100%)
EE		1 (100%)	1 (10%)	9 (90%)		6 (100%)
ES	29 (85%)	5 (15%)	62 (87%)	9 (13%)	5 (56%)	4 (44%)
FI	3 (60%)	2 (40%)		1 (100%)	9 (56%)	7 (44%)
FR		47 (100%)	1 (2%)	61 (98%)		3 (100%)
GR	1 (50%)	1 (50%)	3 (75%)	1 (25%)		
HR	2 (100%)		20 (83%)	4 (17%)		
HU	9 (90%)	1 (10%)	21 (78%)	6 (22%)		
IE	1 (100%)			1 (100%)		
IT		56 (100%)		34 (100%)	5 (71%)	2 (29%)
LT	4 (67%)	2 (33%)	1 (100%)		10 (100%)	
LU	2 (67%)	1 (33%)	8 (89%)	1 (11%)	2 (100%)	
LV	6 (86%)	1 (14%)	6 (40%)	9 (60%)	1 (100%)	
NL	2 (25%)	6 (75%)	1 (20%)	4 (80%)		
PL		4 (100%)		13 (100%)		36 (100%)
PT		2 (100%)	19 (45%)	23 (55%)	1 (11%)	8 (89%)
RO		50 (100%)	34 (83%)	7 (17%)		
SE		18 (100%)	2 (50%)	2 (50%)		
SI		3 (100%)	8 (31%)	18 (69%)		
SK		19 (100%)		3 (100%)	1 (50%)	1 (50%)
UK		4 (100%)		13 (100%)		4 (100%)
Grand Total	71 (21%)	271 (79%)	203 (41%)	298 (59%)	35 (31%)	77 (69%)

3 Impacts of IAS of Union concern

IAS of Union concern have been mentioned by the Member States as pressure for habitats and species as part of the Art.17 (HD) and Art. 12 (BD) reporting. However, IAS of Union concern have often not been mentioned explicitly in the reports, although evidence suggest such impacts (see e.g. Scalera et al. 2020). One explanation presumably is that it was only optional for the Member States to provide this information; another reason might have been that the option to mention IAS of Union concern was introduced only shortly before the reporting started.

Under the IAS-Regulation, only eleven habitats of the HD (in five habitat groups) are reported as being negatively impacted – all by one country and by two species: *Heracleum sosnowkyi* and *Impatiens glandulifera*. Five species of the HD (*Bombina bombina*, *Astacus astacus*, *Margaritifera margaritifera*, *Unio crassus*, and *Emys orbicularis*) are reported as impacted by one or two IAS of Union concern. Five IAS of Union concern have been reported as causing negative impacts on ecosystem services, e.g. *Heracleum sosnowskyi* on pollination and seed dispersal, and *Elodea nuttallii* on drinking water (via blocking of waterworks).

We noted a further discrepancy between the Member State reportings under Art.17 of the Habitats Directive and under the IAS-Regulation. Some IAS of Union concern have been reported as pressure (in section 7.3 "Additional information" of the Art.17 report format), although they are not present in the Member State (according to the IAS-reporting). For example, *Vespa velutina*, the Asian hornet, was mentioned several times (by five different Member States) as pressure on habitats (3230, 6430) and species (1033, 1091, 1214, 1220), although it is not present in these Member States. Because *Vespa* should not be considered a pressure on these habitats and species at all (even if present) for ecological reasons, these assignments appear to be errors during the data input. Two Member States reported invasive alien crayfish as pressure on native crayfish, although the alien crayfish were not reported as being present in these two Member States. Also, the Sacred Ibis was reported as pressure from four Member States, although the species was not reported as being present in these Member States according to the IAS-Reporting.

In addition, assignments of IAS of Union concern have not been reported exclusively within the corresponding category "I01", but also sometimes in the category "I02 (Other IAS)". This can be partly explained by the fact that Member States provided their comments in the optional field "7.3. Additional information" and combined or copy-pasted their answers (Tab. 3-1). In this way, the mentioned species appear both within the I01 and the I02 categories. All these inconsistencies result in a time-consuming challenge when analysing the data, although it has to be assumed that all mentioned IAS pose a pressure and threat on the target habitat or species. Some Member States provided comprehensive comments, mentioning the species within the free text field, which makes analysis again time-consuming.

Among the "Other IAS" (see Annex 5), there are species mentioned that have been added to the List of IAS of Union concern after the current reporting period[7]. Most often mentioned was Pumpkinseed (*Lepomis gibbosus*) and Tree-of-Heaven (*Ailanthus altissima*) (Tab. 3-2), being a pressure and threat for one habitat and 29 species and seven habitats and one species, respectively.

[7] https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1565100914543&uri=CELEX:32019R1262

The raccoon dog *Nyctereutes procyonoides* is a special case, because this species entered the List of IAS of Union concern delayed on 2 February 2019, i.e. only after the reporting period. It was assigned to the category I02 by some Member States with the comment "IAS of Union concern", but was also assigned to the category I01 by other Member States (Tab. 3-2). It was mentioned as a pressure for nine bird species, again, both under the categories I01 and I02 in the Bird Directive.

Table 3-2 Invasive alien species from the second update of the Union list, mentioned as pressure and threat within the Habitat and Bird Directive reporting

IAS	Biogeo	Member State	Negative impact on
Acacia saligna	MED	MT	• Tetraclinis articulata forests (9570)
Ailanthus altissima	ALP ATL MED	ES, IT, MT	• Alluvial forests with Alnus glutinosa and Fraxinus excelsior (Alno-Padion, Alnion incanae, Salicion albae) (9,10E+01) • Constantly flowing Mediterranean rivers with Paspalo-Agrostidion species and hanging curtains of Salix and Populus alba (3280) • Southern riparian galleries and thickets (Nerio-Tamaricetea and Securinegion tinctoriae) (92D0) • Thermophilous Fraxinus angustifolia woods (91B0) • Mediterranean pine forests with endemic Mesogean pines (9540) • Olea and Ceratonia forests (9320) • Quercus ilex and Quercus rotundifolia forests (9340) • Astragalus aquilanus (1558)
Baccharis halimifolia	MATL ATL	ES	• Estuaries (1130) • Spartina swards (Spartinion maritimae) (1320)
Lepomis gibbosus	ALP ATL CON MED	AT ES PT	• Rivers with muddy banks with Chenopodion rubri p.p. and Bidention p.p. vegetation (3270) • Achondrostoma arcasii (6155) • Alosa alosa (1102), A. fallax (1103) • Anaecypris hispanica (1133) • Aphanius iberus (1151), A. baeticus (5196) • Cobitis vettonica (5301), C. paludica (5302), C. calderoni (5303) • Cottus hispaniolensis (5317), C. aturi (5318) • Iberochondrostoma lemmingii (5926), I. oretanum (6930) • Iberocypris palaciosi (1118) • Luciobarbus graellsii (5283), L. guiraonis (5284), L. microcephalus (5285), L. sclateri (5286), L. comizo (6168) • Parachondrostoma arrigonis (5294), P. miegii (5292), P. turiense (5293) • Pseudochondrostoma duriense (5296), P. polylepis (6149) P. willkommii (6162) • Umbra krameri (2011)

			• Squalius alburnoides (6975) • Unio tumidiformis (5382) • Valencia hispanica (1153)
Nyctereutes procyonoides	HD: CON PAN BOR BD: B	AT CZ FI LV LT	• Mustela putorius (1358), M.eversmanii (2633) • Boreal Baltic islets and small islands (1620) • Bufotes viridis (6997), Pelophylax lessonae (6981), P. ridibundus (6938), Rana arvalis (1214) • Gavia arctica (A002), Botaurus stellaris (A021), Ixobrychus minutus (A022), Anas acuta (A054), Aythya ferina (A059), Somateria mollissima (A063), Melanitta fusca (A066), Bonasa bonasa (A104), Fulica atra (A125), Xenus cinereus (A167), Arenaria interpres (A169), Chlidonias niger (A197), C. leucopterus (A198), Asio flammeus (A222), Calidris alpina schinzii (A466-B), Chlidonias hybrida (A734), Spatula querquedula (A856), Sternula albifrons (A885)

Member States reported several "Other IAS" within the category I02, including some well-known examples of alien species, such as *Acer negundo*, *Azolla filiculoides*, *Buddleja davidii*, *Campylopus introflexus*, *Carpobrotus* spp., *Corbicula fluminea*, *Crassula helmsii*, *Cydalima perspectalis*, *Elodea canadensis*, *Fallopia japonica/sachalinensis/x bohemica*, *Ipomoea indica*, *Lantana camara*, *Neovison vison, Phytolacca americana*, *Prunus serotina*, *Psittacula krameri*, *Rattus* spp., *Robinia pseudoacacia*, *Senecio inaequidens*, and *Sinanodonta woodiana*. Within this category, Member States also reported species that are partly native and partly alien to the European Union, such as *Acer pseudoplatanus*, *Aesculus hippocastanum*, *Dreissena polymorpha*, *Esox lucius*, *Prunus laurocerasus*, *Rhododendron ponticum*, *Sander lucioperca*, and *Silurus glanis*. Member States also reported species that are used in aquaculture, such as *Acipenser baerii*, *Crassostrea gigas*, *Cyprinus carpio* and *Oncorhynchus mykiss*. Some of the beforementioned IAS have a potential for conflicts of interest as for their use in forestry, as ornamentals or in landscape planning, in aquaculture and fisheries. Negative impacts of introduced pathogens and diseases appear to be underreported. Only Spain mentioned the chytrid fungus *Batrachochytrium dendrobatidis* as a pressure and threat for the Majorcan midwife toad (*Alytes muletensis*). The same seems be true for domestic or feral pets. Only Malta reported the cat (*Felis catus*) as a pressure and threat for small mammals (incl. bats), lizards and snakes.

It is strongly encouraged that responsible reporting organisations in Member States cooperate, share and discuss these information before submission of final reports. The cross-compliance of the different EU Nature Directives (also including Water Framework Directive and Marine Strategic Framework Directive), specifically with regard to Invasive Alien Species, needs to be improved in future reportings.

3.1 Selected examples of gaps in the reporting of impacts (and distributions)

3.1.1 Asclepias syriaca

The Common Milkweeed (*Asclepias syriaca*) is native to temperate northeastern North America and was introduced to Europe in the 17th century. It established in the wild in the early 19th century and is currently present in 17 Member States (Austria, Belgium, Bulgaria, Croatia, Czech Republic, Finland, France, Germany, Hungary, Italy, Lithuania, Netherlands, Poland, Slovakia, Slovenia, Spain and Sweden) (Map 3-1), with an approximate grid cell area of 121 500 km^2. It prefers dry soil and warmer

climates, but can establish and spread in a wide variety of habitats. Dominant stands of the plant threaten native plant and arthropod species diversity, particularly in pannonic sand dune (including HD Annex I habitats 2130 and 2160) and river valley habitats in Hungary and the Netherlands (Gallé et al. 2015, Matthews et al. 2015, Kelemen et al. 2016). The species is poisonous for animals and can be a vector of fungal and plant diseases (Matthews et al. 2015).

Map 3-1 Reported distribution of *Asclepias syriaca* in 26 of 28 Member States of the EU

Source: Member States reports under the IAS regulation, 2019
Note: The distribution for *Asclepias syriaca* in Romania is not shown on this map, because the spatial data were not delivered in the agreed format in 2019.

The reported distribution in MS (Map 3-1) reflects well the distributional information provided in the EU-Risk Assessment (Tokarska-Guzik & Pisarczyk 2015). The only deviation is that it was mentioned as established species in Denmark in the Risk Assessment, but as not being present in the MS-Report. According to the MS-Report, the species has indeed been present (or at least listed) in the past, but recent investigations have shown that the species is no longer present in Denmark. Within the EU, *Asclepias syriaca* is most widely distributed in the Pannonian biogeographic region (Tab. 3-1), covering 64,6 % of its total size. Most grid cells with presence of the species are situated in alluvial forests and lowland hay meadows, followed by semi-natural dry grasslands, alluvial meadows and pannonic loess steppic grasslands with additional sand dune habitats colonized (Tab. 3-2).

Table 3-1 Total grid cell area (km2) of *Asclepias syriaca* per biogeographic region

Region	Area (km^2)	% of total Area
ALP	3 800	1,0
ATL	2 600	0,3
BOR	700	0,1
CON	31 200	2,4
MED	1 700	0,2
PAN	81 500	64,6

Table 3-2 Numbers of overlapping grid cells between *Asclepias syriaca* and habitats of the HD

Art17 habitats		Art 17 grid cell area overlapping with A. syriaca
91E0	Alluvial forests with Alnus glutinosa and Fraxinus excelsior (Alno-Padion, Alnion incanae, Salicion albae)	908
6510	Lowland hay meadows (Alopecurus pratensis, Sanguisorba officinalis)	723
6210	Semi-natural dry grasslands and scrubland facies on calcareous substrates (Festuco-Brometalia) (* important orchid sites)	541
6440	Alluvial meadows of river valleys of the Cnidion dubii	540
6250	Pannonic loess steppic grasslands	488
6430	Hydrophilous tall herb fringe communities of plains and of the montane to alpine levels	485
91F0	Riparian mixed forests of Quercus robur, Ulmus laevis and Ulmus minor, Fraxinus excelsior or Fraxinus angustifolia, along the great rivers (Ulmenion minoris)	477
3150	Natural eutrophic lakes with Magnopotamion or Hydrocharition — type vegetation	445
6410	Molinia meadows on calcareous, peaty or clayey-silt-laden soils (Molinion caeruleae)	431
3130	Oligotrophic to mesotrophic standing waters with vegetation of the Littorelletea uniflorae and/or of the Isoëto-Nanojuncetea	352
1530	Pannonic salt steppes and salt marshes	331
6260	Pannonic sand steppes	329
91M0	Pannonian-Balkanic turkey oak –sessile oak forests	325
6240	Sub-Pannonic steppic grasslands	287
2340	Pannonic inland dunes	230

3.1.2 Baccharis halimifolia

Baccharis halimifolia commonly known as Eastern Baccharis, Saltbush or Groundsel tree is native to southeastern North America, eastern Mexico and the Caribbean (Bahamas and Cuba). The species was introduced to Europe in the 17th century as a windbreaker, for soil stabilization and ornamental purposes (Lambdon et al. 2008). Since the 19th century, it is established in France, Spain, Belgium, UK and Italy. *Baccharis halimifolia* is highly resistant to salt spray and flooding and can be found in several coastal habitats including salt marshes, coastal swamps, coastal forests, tidal rivers and sand dunes (EPPO 2013). The plant grows to monospecific stands with a dense canopy, modifying micro-climatic conditions in dune ecosystems and outcompeting natural ground vegetation. Additionally, leaves of the plant are toxic for livestock and highly inflammable, potentially increasing fire hazards.

According to the EU Risk Assessment (EPPO 2013) several Natura 2000 habitats along the Atlantic coastline and the Mediterranean Basin are affected. A comparison with affected HD habitats reveals an overlap of 30 % (Tab. 3-3), with MS-Reports listing additional eight habitat types, including one from a habitat group not mentioned in the Risk Assessment (Bogs, mires & fens). Distribution data reveal largest overlap (in % of the total area of the habitat) for 4040 (19,2 %), followed by 1420, 1320, 2180* and 2170* (4-5 %) and largest total size (in km^2) for 1140 (14 800 km^2), followed by 1110*, 2120, 4030*, and 2110 (Tab. 3-3). Some of these habitats (here indicated by *) have not been reported as under pressure by Member States although the IAS of Union concern apparently is present.

Table 3-3 Numbers of overlapping grid cells between *Baccharis halimifolia* and habitats of the HD

Art17 habitats		Art 17 grid cell area overlapping with *B. halimifolia*
1140	Mudflats and sandflats not covered by seawater at low tide	148
1110	Sanbanks which are slightly covered by sea water	133
2120	Shifting dunes along the shoreline	124
4030	European dry heath	119
2110	Embryonic shifting dunes	119
1330	Altantic salt meadow	119
1310	Salicornia and other annuals colonizing mud and sand	119
1420	(Mediterranean and thermo-Atlantic halophilous scrubs)	95
1320	Spartina swards (Spartinion maritimae)	63
2180	Wooded dunes	75
2170	Dunes with Salix	43
7210	Calcareous fens with Cladium mariscus and species of the Caricion davallianae	41
4040	dry Atlantic coastal heaths with Erica vagans	24

Risk Assessments of IAS often have to rely on impact studies from areas outside the risk assessment area. Therefore, Member States reports of impacts of IAS on HD habitats and species are of particular interest and relevance. This information can be useful for management and restoration, but also for monitoring (surveillance) and research.

3.1.3 Impatiens glandulifera

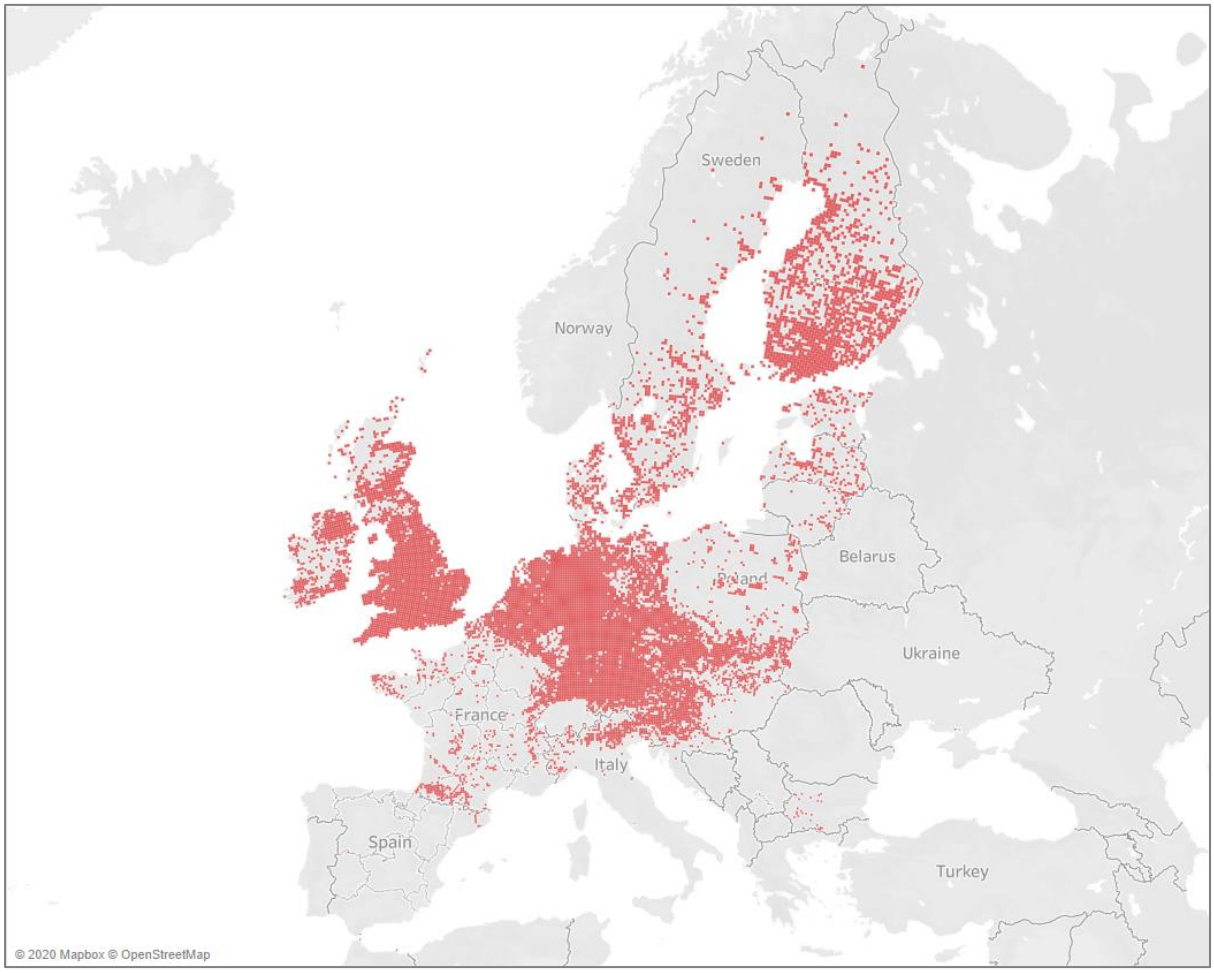
Indian Balsam (*Impatiens glandulifera*) is native in the foothills of the Himalayas from north-west Pakistan to northern India, as well as Nepal and Bhutan. It was introduced to Europe (England) in 1839 for ornamental purposes and subsequently used as pasture for bees (´honey plant´). It established in the wild around 1900 and is currently present in 23 Member States (Austria, Belgium, Bulgaria, Croatia, Czech Republic, Denmark, Estonia, Finland, France, Germany, Hungary, Ireland, Italy, Latvia, Lithuania, Netherlands, Poland, Romania, Slovakia, Slovenia, Spain, Sweden, United Kingdom) (CABI 2015) (Map. 3-2) and six biogeographic regions (Tab. 3-4), where it is particularly abundant in the atlantic and continental regions. The magnitude of the invasion is mainly due to the fast dispersion of seeds along watercourses, contaminated soil, transportation of seeds with river gravel and contamination of building rubbish transported to waste disposal sites (CABI 2015). The species threatens native biodiversity, penetrating into natural and semi-natural habitats and occurring in plant communities along edges of rivers and lakes, light floodplain forests and wet meadows.

Impatiens glandulifera invades several HD Annex I habitats: hydrophilous tall herb fringe communities (6430), alpine rivers and the ligneous vegetation along their banks (3240), alluvial forests (91E0, 91F0), rivers with miuddy banks (3270), grasslands (6430, 6510) and habitats related to wet meadows (Pisarczyk & Tokarska-Guzik 2015). The species poses a high risk of establishment in a wide variety of high conservation value habitats. Table 3-5 provides a comparison of these habitats and the habitats with the greatest overlapping distribution. It has to be mentioned, however, that these data need careful interpretation, as they could be misleading. The high presence of the species in 9060 Coniferous forests does not mean the species is present inside the forests, but – in this case – along the water courses.

Table 3-4 Total area (km^2) of *Impatiens glandulifera* per biogeographic region

Region	Area (km^2)	% of total Area
ALP	97 200	25,7
ATL	410 400	52,5
BOR	202 800	24,1
CON	492 300	38,3
MED	2 600	0,3
PAN	20 500	16,2

Map 3-2 Reported distribution of *Impatiens glandulifera* in 26 of 28 Member States of the EU



Source: Member States reports under the IAS regulation, 2019

Note: The distribution for *Impatiens glandulifera* in Romania is not shown on this map, because the spatial data were not delivered in the agreed format in 2019.

Table 3-5 Numbers and percentages of the top five habitats of the HD with presence of *Impatiens glandulifera* according to (a) percentage of total size and (b) total size in km² and (c) selected habitats

	Art17 habitats	Habitat total size (km²)	Habitat overlapping	Percentage overlapping (%)
a)				
91R0	Dinaric dolomite Scots pine forests	5 500	2 200	40,0
4070	Bushes with Pinus mugo and Rhododendron hirsutum	128 900	39 200	30,4
9420	Alpine Larix decidua and/or P. cembra forests	112 100	32 300	28,8
9030	Natural forests of primary succession stages	39 900	10 600	26,6
9060	Coniferous forests	422 300	111 800	26,5
b)				

91E0	Alluvial forests with Alnus glutinosa and Fraxinus excelsior	6 542 700	762 300	11,6
3260	Water courses of plain to montane levels	5 180 100	711 400	13,7
6510	Lowland hay meadows	4 653 500	598 100	12,8
6430	Hydrophilous tall herb fringe communities	4 613 300	588 100	12,7
3150	Natural eutrophic lakes	4 761 000	564 700	11,9
c)				
3240	Alpine rivers and the ligneous vegetation along their banks	314 100	49 500	15,8
91F0	Riparian mixed forests along the great rivers	1 553 500	116 600	7,5
3270	Rivers with muddy banks	1 193 200	90 000	7,5

3.1.4 Lithobates catesbeianus

The North American bullfrog (*Lithobates catesbeianus*) is native to eastern North America (Nova Scotia to Florida) and was introduced to Europe in the 19th century. The species has currently established populations in four Member States (Belgium, France, Germany & Italy) (Fig. 3-3). *Lithobates catesbeiana* has the capacity to disperse over long distances and increase numbers rapidly when habitat conditions are favorable (Ficetola et al. 2006). The species is known to thrive in a wide range of habitats (natural, semi-natural and highly artificial) and climatic conditions. Most important environmental impacts are the reduction in abundance and diversity of the native amphibian fauna, through predation, competition and disease transmission.

Map 3-3 Reported distribution of *Lithobates catesbeianus* in 26 of 28 Member States of the EU

Source: Member States reports under the IAS regulation, 2019

A comparison of the distributional information provided in Scalera et al. (2012, based on Ficetola et al. 2006) and the MS-reports reveals no change in the situation for Germany, a rather stable situation for Italy and France, a new detection in Spain (Parque Natural del Delta del Ebro in June 2018), and an increase of records in Belgium. The bullfrog has a particular stronghold in the Po valley in Italy and in the Antwerp Province in Belgium (Map 3-3, Tab. 3-6). It was reported as a pressure (and threat) on several amphibian species by Spain under Art. 17 reporting.

Table 3-6 Total grid size area (km^2) of *Lithobates catesbeianus* per biogeographic region and per Member State.

Region	Area (km^2)		Member State	Area (km^2)
ALP	100		Belgium	2 100
ATL	2 600		Germany	200
BOR	0		Spain	100
CON	5 600		France	600
MED	900		Italy	6 200

PAN	0			
TOTAL	9 200		TOTAL	9 200

Based on the MS-reports, management measures have been applied against the population(s) in Spain (rapid eradication in 2018 with yet unclear effect), Belgium, France and Germany (eradication, control, containment). The species was successfully eradicated in 2015 after observations in Slovenia and in the Netherlands. No management measures have been reported from Italy.

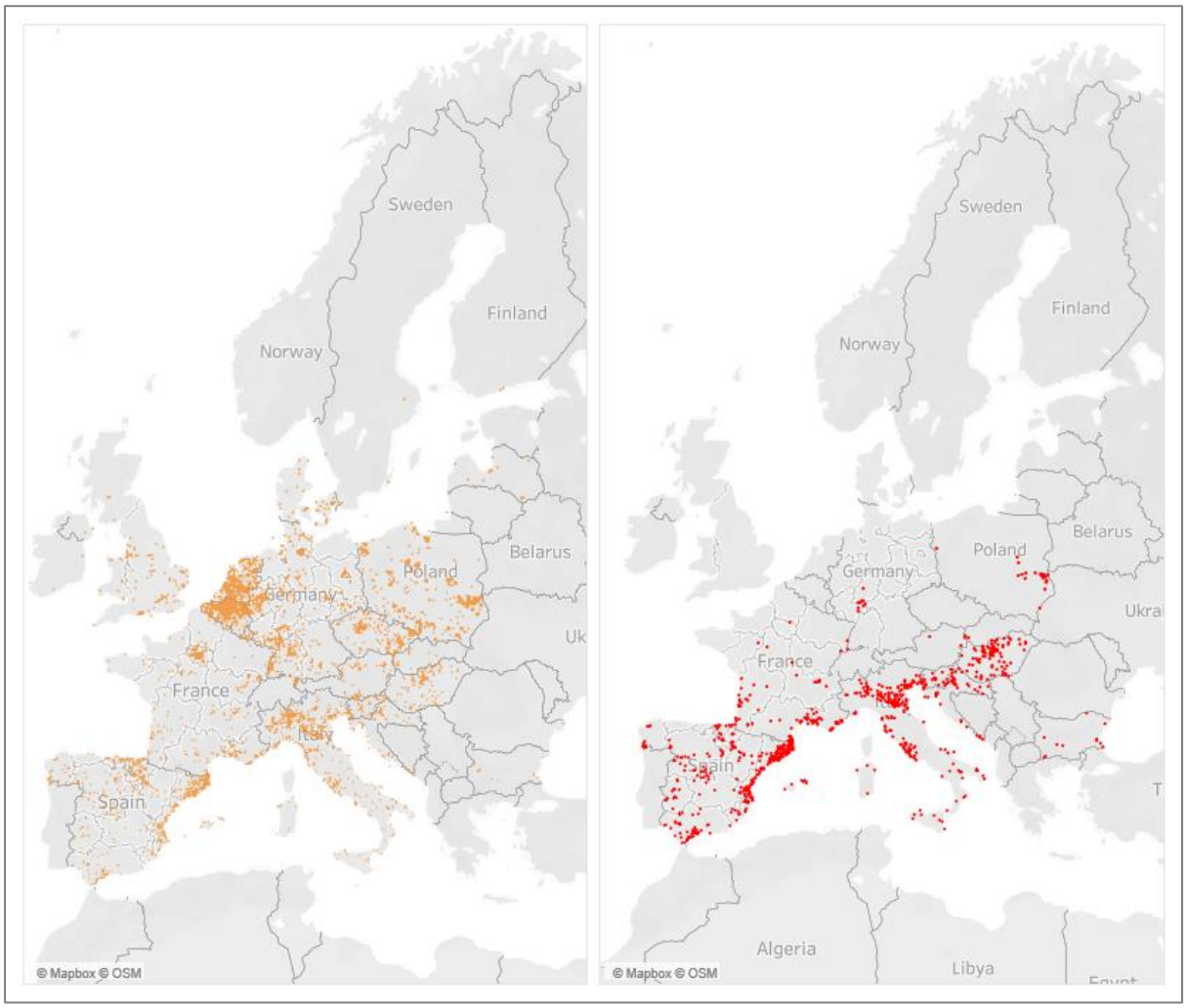
3.2 Selected comparisons of the distribution of IAS of Union concern and affected target habitats and species of the Habitats Directive

3.2.1 Trachemys scripta

Trachemys scripta, the Common slider, may have some impact on local biodiversity through competition for food, basking sites and nesting sites with indigenous turtles. In Europe, there is a growing concern for the few remnant indigenous populations of European pond turtle, which are being replaced by the common slider (Scalera et al. 2012).

Map 3-4 illustrates the areas of co-occurrence of *Trachemys* with the four native HD turtle species in the EU. The climatic limitations of *Trachemys* currently restrict occurrences to the southern regions, but due to climate change, reports of reproducing individuals farther north increase and might pose an additional future risk to native turtle species in the continental regions of Europe.

Map 3-4 **Comparsion of the reported distribution of *Trachemys scripta* (left) and of *Emys orbicularis*, *E. trinacris*, *Mauremys leprosa* and *M. rivulata* (right) in 26 of 28 Member States of the EU**



3.2.2 Baccharis halimifolia

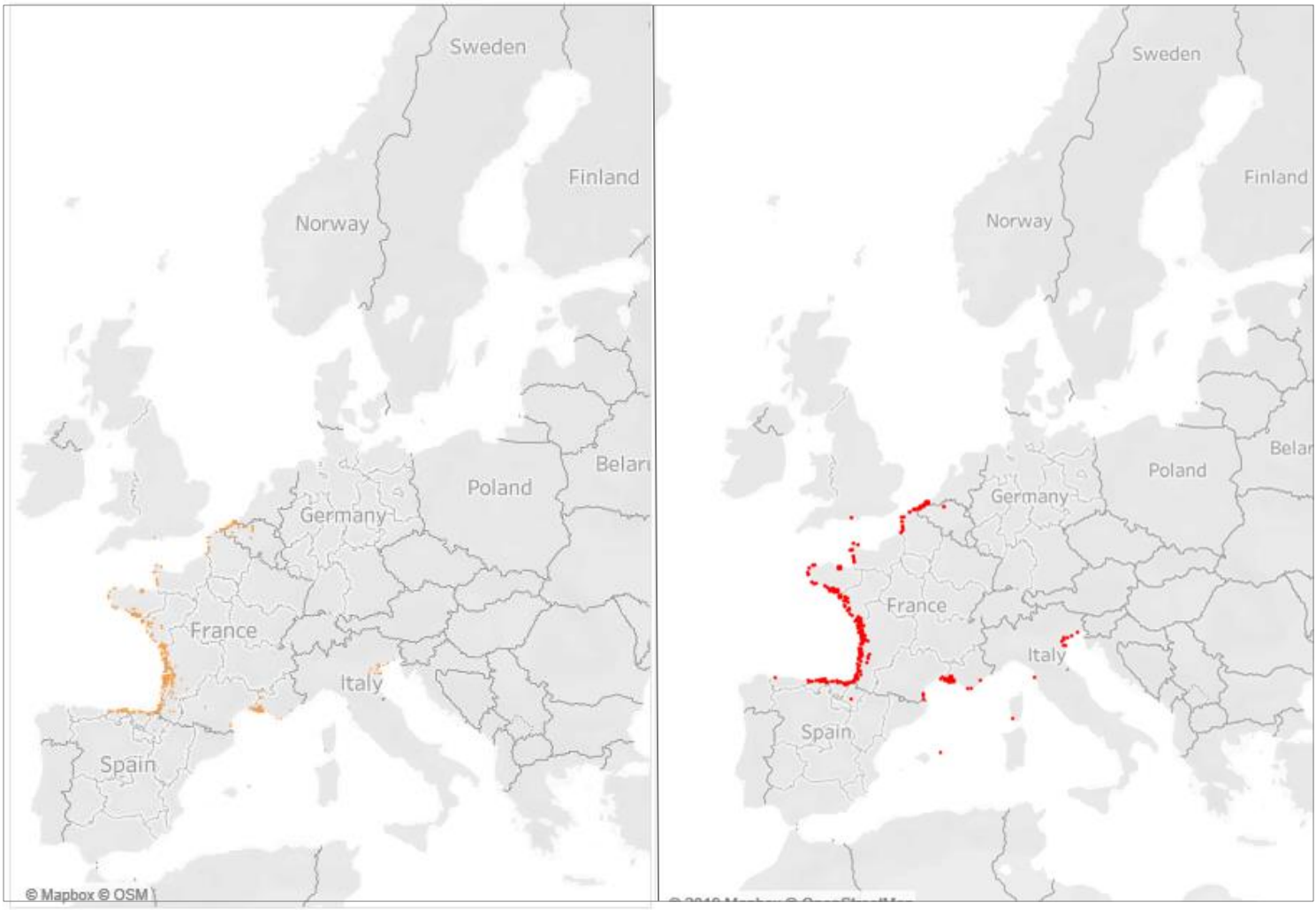
Map 3-5 illustrates the areas of co-occurrence of *Baccharis halimifolia* in the EU with habitats of the HD directive. Almost all occurrences of the invasive alien plant species are situated within habitats of the HD directive. In 19,2 % (2 400 km^2) of the Dry Atlantic coastal heaths (4040) (total size 12 500 km^2) *Baccharis halimifolia* is present. A ranking of occupied grid size area reveals habitats 1140 and 1110 in front (Tab. 3-7). Interestingly, not all of these are mentioned as being under threat either in the Risk Assessment or in the MS Reports. This might provide some guidance for future impact studies or indicative for general research needs.

Table 3-7 **Total grid size area (km^2) of *Baccharis halimifolia* in the EU**

Habitat type	km^2
1140	14800
1110	13300
Habitat type	km^2

2120	12400
4030	11900
2110	11900
1330	11900
1310	11900
2130	11400

Map 3-5 **Reported distribution of *Baccharis halimifolia* in the EU (left) and overlay of 14 habitat types from MS Reports with the occurrence of *Baccharis halimifolia***



3.2.3 *Lithobates catesbeianus*

A comparison of the reported distribution of the bullfrog *Lithobates catesbeianus* with amphibians of the HD revealed highest overlap with the common water frog *Pelophylax esculentus*. In 90,2 % of grid cells where *Lithobates* is occurring, also *Pelophylax* is present. In 3,9 % of all grid cells of *Pelophylax* across the EU, *Lithobates* is present. A relatively high percentage of overlap is also reported for other amphibians and semi-aquatic reptiles (Tab. 3-8).

Table 3-8 Number of occupied grid cells of *Lithobates catesbeianus* vs selected native amphibian species

Native species	Number of grid cells with *L. catesbeianus* co-occurrence	% of total grid cells	% of presence in *Lithobates* grid cells (n=92)
Pelophylax esculentus	83	0,20	90,2
Hierophis viridiflavus	65	0,64	70,6
Bufotes viridis complex	57	1,36	61,9
Hyla intermedia	54	1,40	58,7
Triturus carnifex	50	1,15	54,3
Rana dalmatina	49	0,24	53,3

The conservation status of some of these species has been assessed as U1 or U2 with decreasing trends (e.g. *T. carnifex*, *H. intermedia*). Because the assessment of the conservation status usually is a composite measure of several pressures, no direct link or dependency can be established from these data. However, negative effects of *Lithobates* on native amphibian populations at the local or regional level cannot be ruled out. Furthermore, the analysis of reported distributional information and overlaps between IAS of Union concern and habitats or species from the Nature Directives might be useful for planning future activities. This information can guide targeted management action at local or regional scale, e.g. setting up of monitoring activities to survey adjacent areas (and observe possible spread), study possible impacts in areas of co-occurrence in greater detail, or aiming for eradication of IAS-populations to protect species or habitats of the Nature Directives.

3.2.4 *Pacifastacus leniusculus*

The Signal Crayfish (*Pacifastacus leniusculus*) is native to North America and was introduced to Europe (Sweden) in 1959, and subsequently to other European countries for aquaculture and gastronomic purposes. While some crayfish introductions have been accidental (e.g. through canals, escapes from holding facilities), most have been deliberate (for legal and illegal stocking, live food trade, as aquarium pets, or live bait). Once in the wild individuals can easily spread and reach new waterbodies and streams, due to its high agility. Signal Crayfish are currently established in 18 Member States (Austria, Bulgaria, Czech Republic, Denmark, United Kingdom, Finland, France, Germany, Italy, Latvia, Lithuania, Netherlands, Poland, Portugal, Slovenia, Spain, Sweden, Greece), and it is the most widespread non-native crayfish species in Europe. In Sweden and Finland, the Signal Crayfish population support a large, commercially and recreationally important fishery. The species cause major environmental impacts in Europe by outcompeting native species, community dominance and disseminating the crayfish plague.

The Signal Crayfish is present in 5,390 grid cells in the EU, with the highest share in the Boreal biogeographic region (39 %) (Tab. 3-9). It is omnipresent in southern Sweden, and widely spread in other parts of Europe (Map 3-6).

Map 3-6 Reported distribution of *Pacifastacus leniusculus* in 26 of 28 Member States of the EU

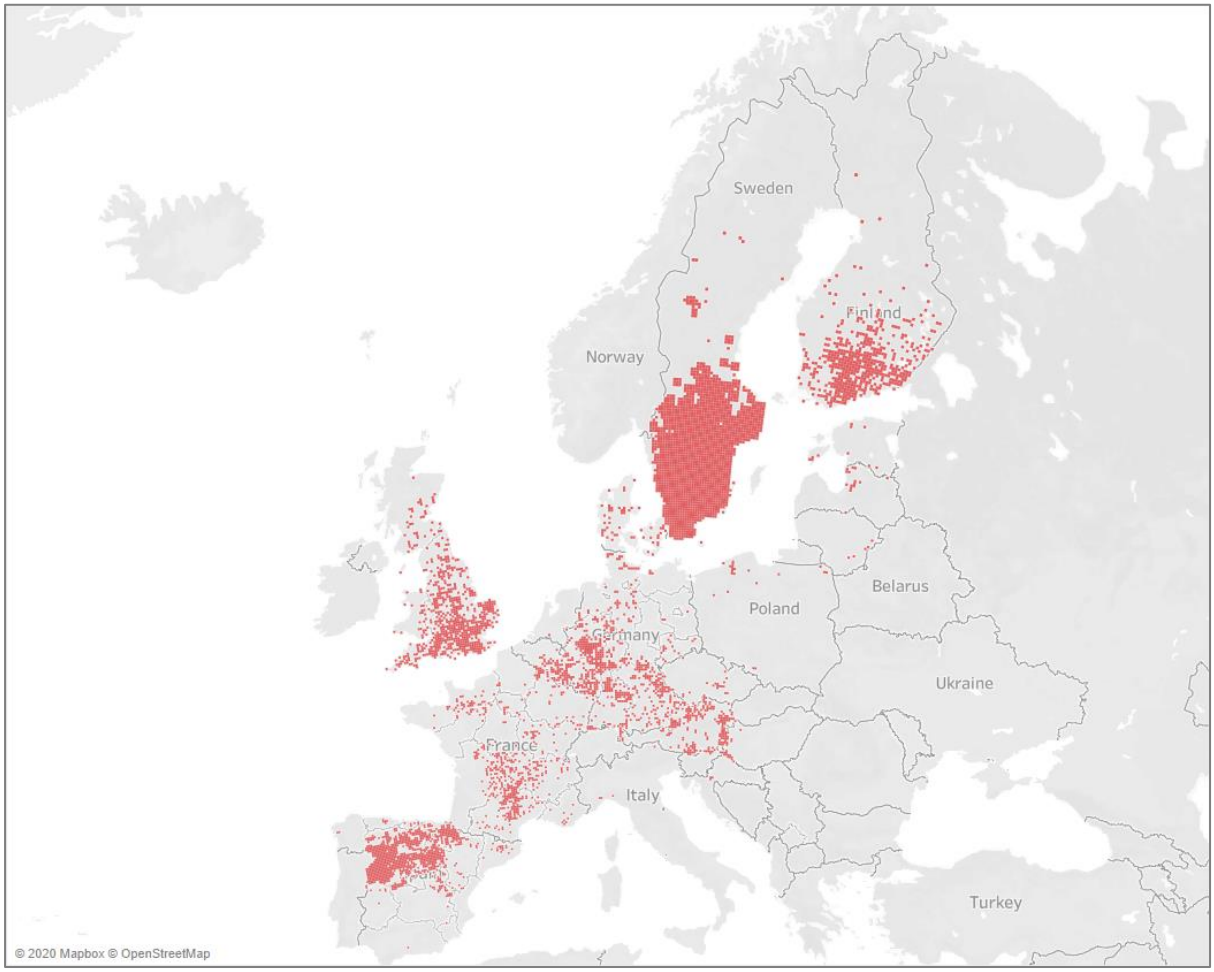
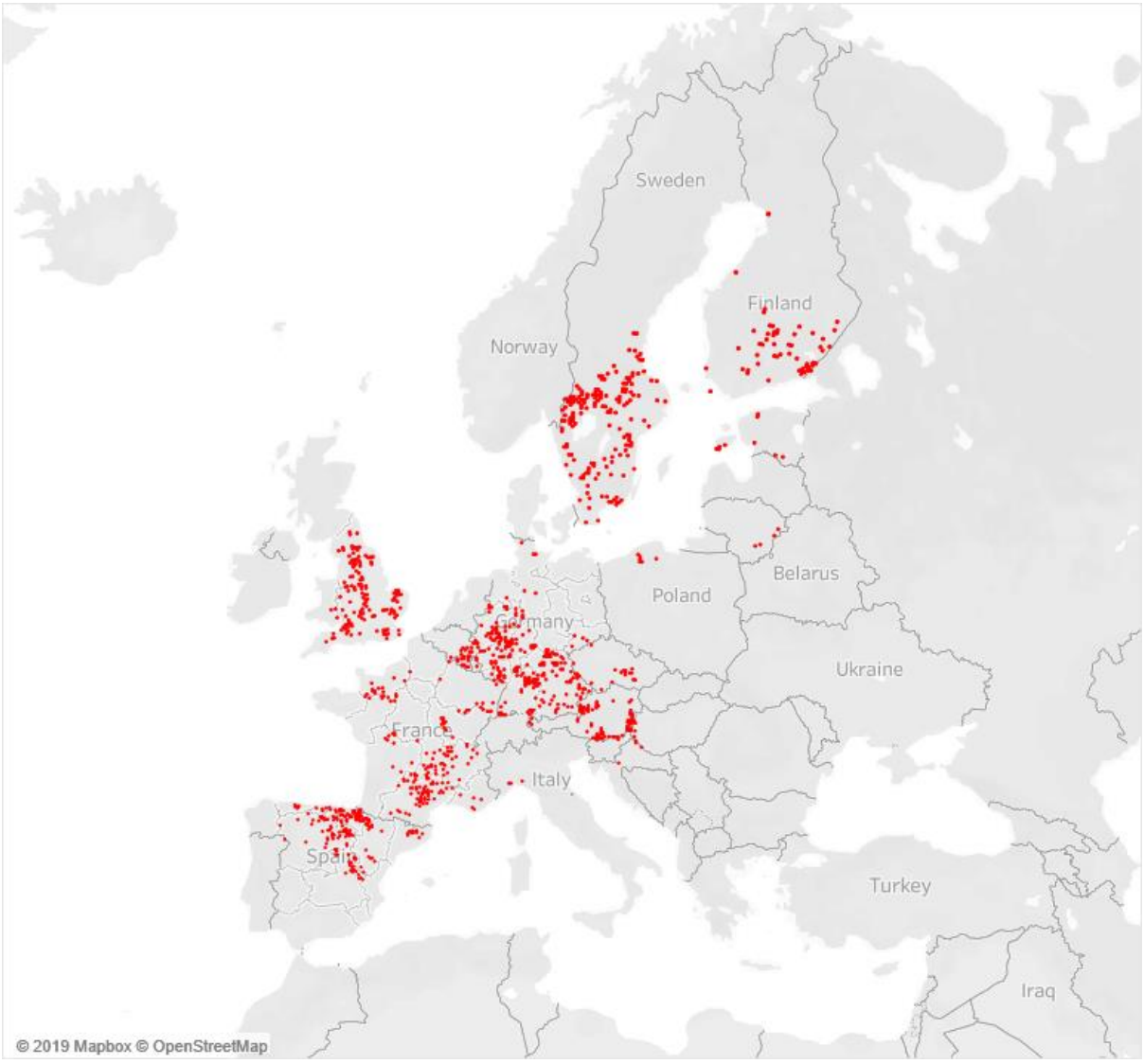


Table 3-9 Total grid size area (km^2) of *Pacifastacus leniusculus* per biogeographic region

Region	Area (km^2)
ALP	9 300
ATL	94 900
BOR	208 600
CON	132 800
MED	90 600
PAN	2 800
TOTAL	**539 000**

In 506 grid cells, Signal Crayfish occurs together with the Noble Crayfish (*Astacus astacus*), followed by 468 overlapping grid cells with the White-clawed Crayfish (*Austropotamobius pallipes*) and 159 overlapping grid cells with the Stone Crayfish (*Austropotamobius torrentium*) (Map 3-7). This overlapping grid cell area makes up 5,48 % of the total reported species distribution area for *A. astacus*, 7,19 % for *A. pallipes* and 4,67 % for *A. torrentium*.

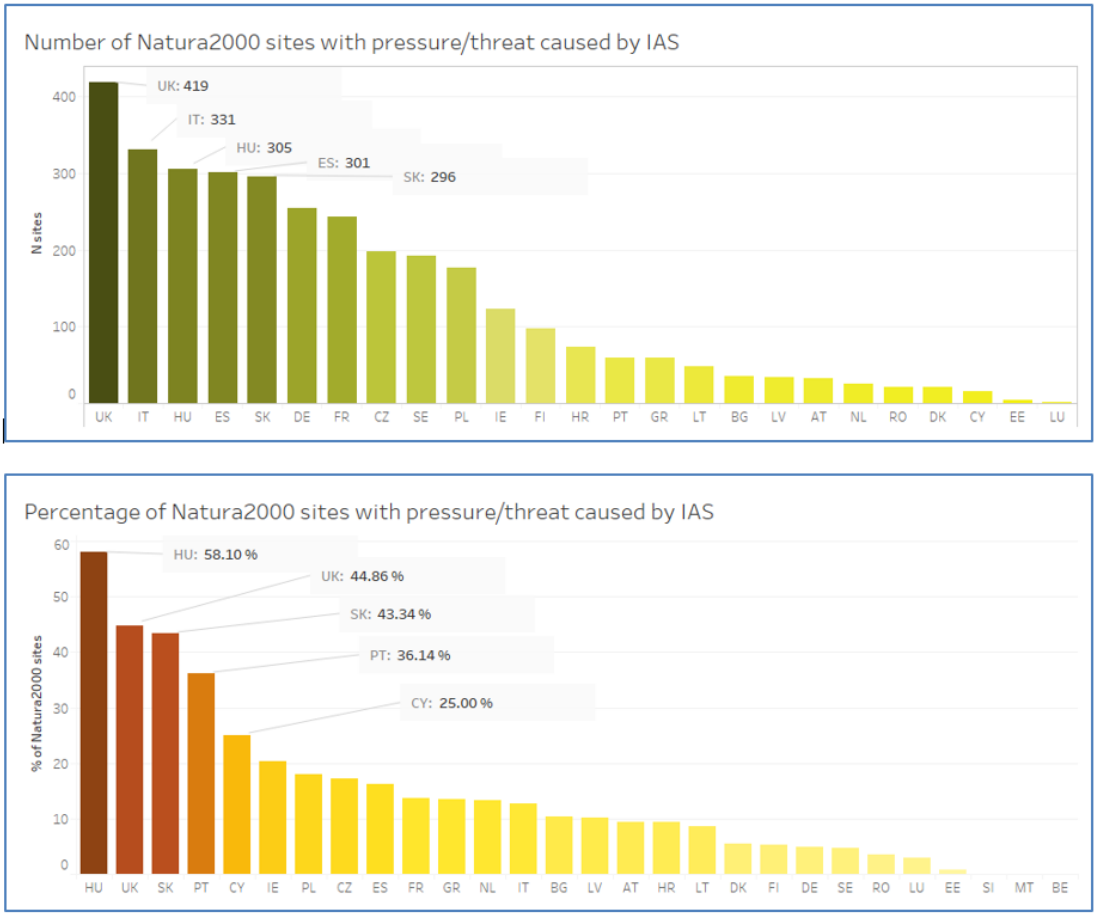
Map 3-7 **Overlapping grid cell distribution of *Pacifastacus leniusculus* and three native crayfish species (*Astacus astacus*, 506 grid cells; *Austropotamobius pallipes*, 468 grid cells, *A. torrentium*, 159 grid cells)**



4 Impact of IAS on Natura2000 sites

Pressures and threats[8] caused by IAS were reported for 3372 Natura2000 sites, this accounts for about 12 % of all Natura 2000 sites. The highest numbers of Natura2000 sites under pressure and/or threat from IAS are reported by the UK (419), followed by Italy with 331 sites and Hungary with 305 sites. Looking at the percentage of all sites, the highest number is reported from HU having 58 % (305/525) of all Natura2000 sites under pressure/threat by IAS (Fig. 4-1).

Figure 4-1 **Natura2000 sites with pressure/threat caused by IAS presented in total numbers and percentage of member states´ total number of Natura2000 sites (from Natura2000 database)**

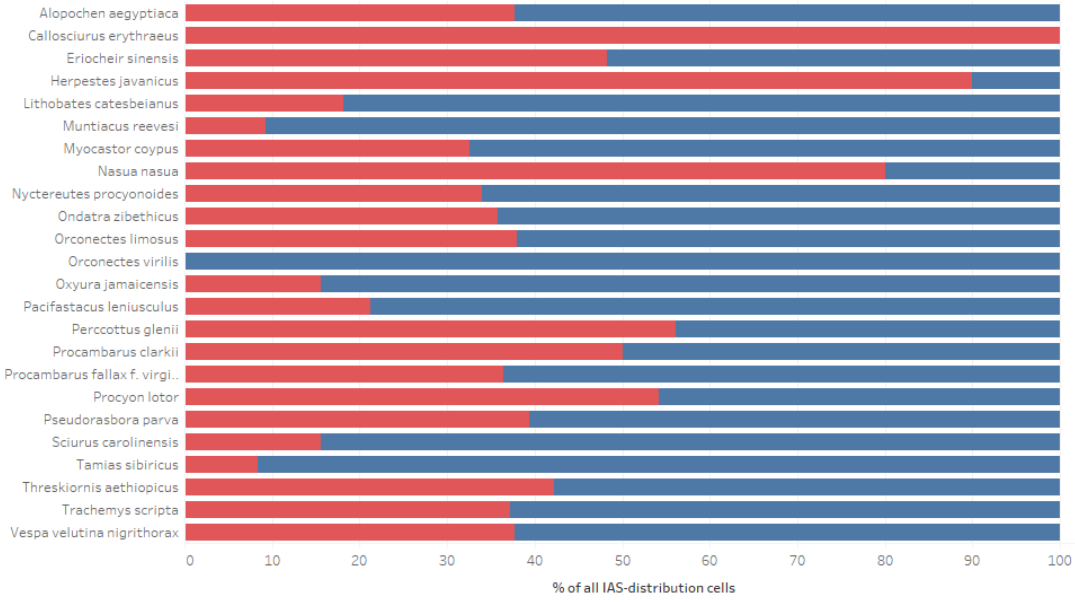


[8] Only high and medium ranking pressures and threats were taken into account

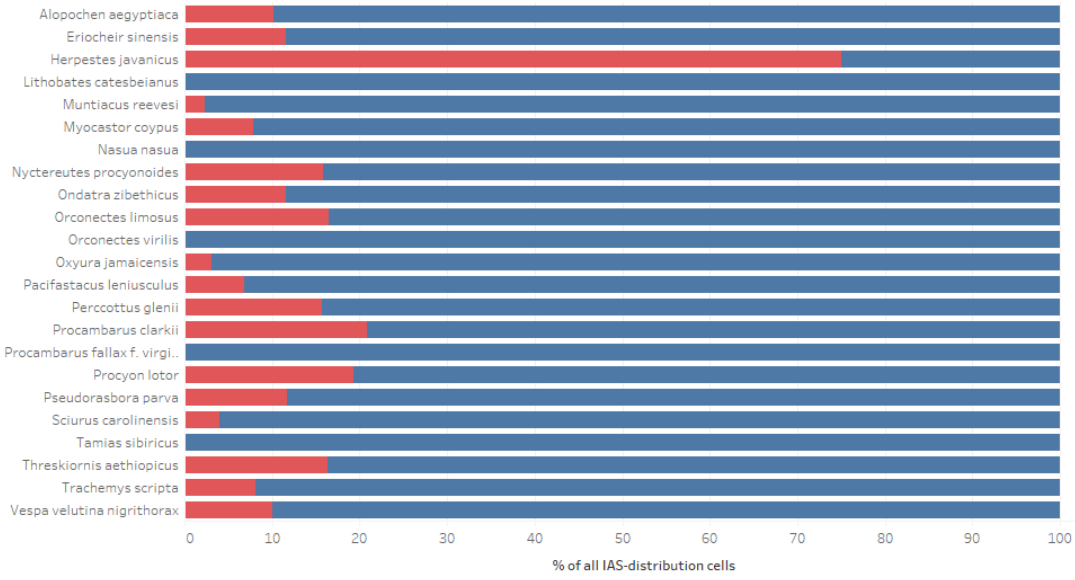
Member States have provided the distribution of IAS of Union concern within their territory based on 10x10 km grid cells. Figures 4-2 (animals) and 4-3 (plants) indicate the presence of IAS of Union concern inside and outside of Natura2000 sites, when a threshold of 50 % or 90 % is applied. The threshold defines the classification of a 10x10 km grid cell as "Natura2000 cell" based on 50% or 90 % coverage, i.e. area percentage of the cell (see Annex 6).

Figure 4-2 **Invasive alien animal species of Union concern distribution inside (red bars) and outside (blue bars) of Natura2000 sites, based on the recorded presence of the species in a 10x10 km² grid cell and a threshold of A) 50 % and B) 90 % of the grid cell being within a Natura2000 site**

A) 50 %



B) 90 %

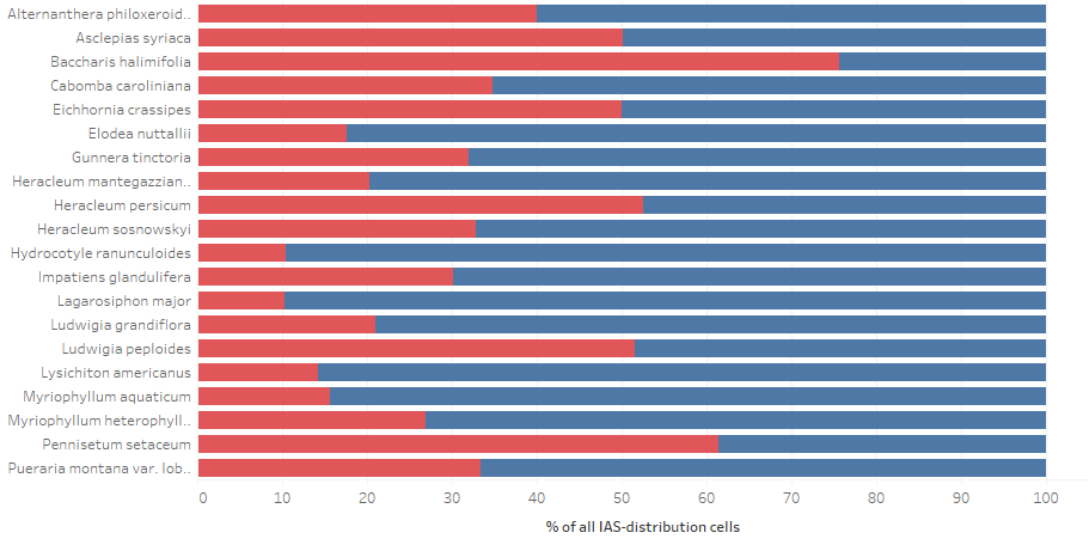


The average percentages of grid cells occupied by IAS of Union concern within Natura2000 cells reach 39 % (animals, n=24) and 34 % (plants, n=20), ranging from 0 % (*Orconectes virilis*) to 100 % (*Callosciurus erythraeus*), at a given threshold of 50 % Natura2000 coverage within the cell. These

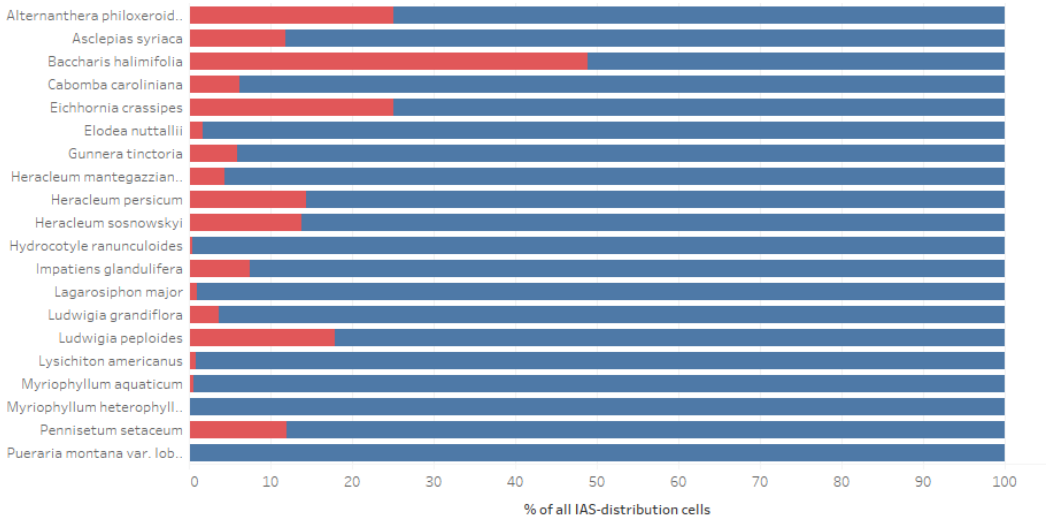
average percentages decrease at the higher threshold of 90 % to 12 % for animals and 10 % for plants, ranging from 0 % (*Lithobates catesbeianus*, *Nasua nasua*, *O. virilis*, *Procambarus virginalis*, *Tamias sibiricus; Hydrocotyle ranunculoides, Lagarosiphon major, Lysichiton americanus, Myriophyllum aquaticum, M. heterophyllum, Pueraria montana var. lobata*) to 75 % (*Herpestes javanicus*) in animals and 49 % (*Baccharis halimifolia*) in plants.

Figure 4-3 **Invasive alien plant species of Union concern distribution inside (red bars) and outside (blue bars) of Natura2000 sites, based on the recorded presence of the species in a 10x10 km2 grid cell and a threshold of A) 50 % and B) 90 % of the grid cell being within a Natura2000 site**

A) 50 %



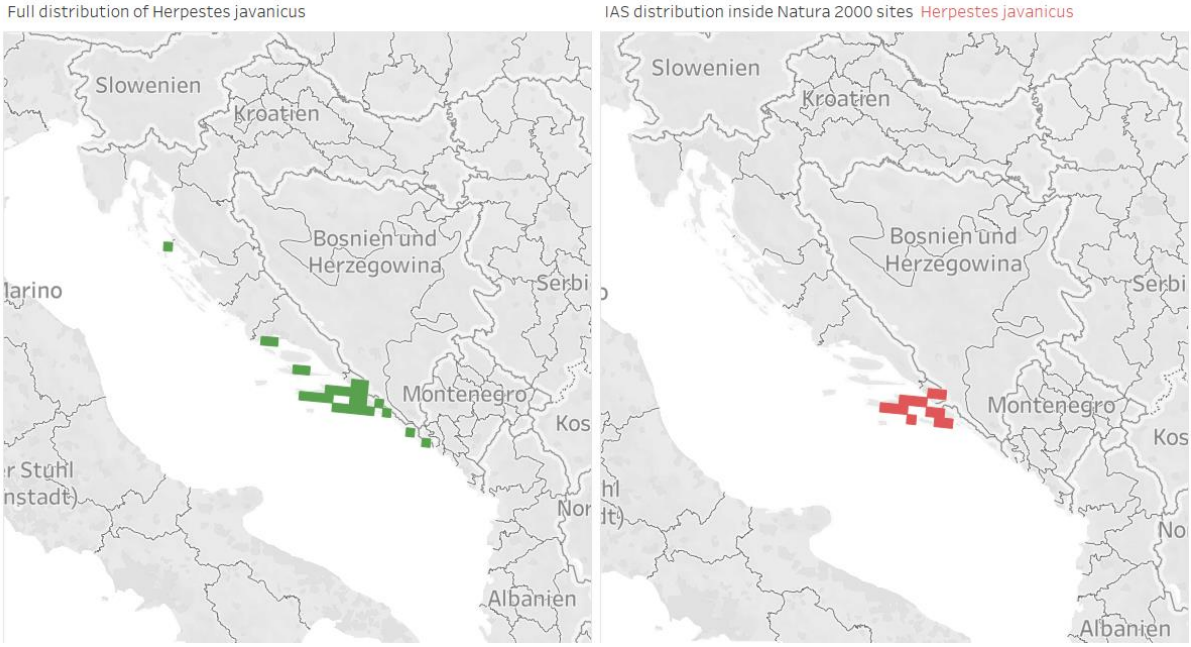
B) 90 %



These data indicate that some IAS of Union concern have a substantial presence in Natura2000 sites (Map 4-1, 4-2), while others seem to mostly occur outside the Natura2000 sites (Map 4-3, 4-4, 4-5). Because of the different spatial scales, these data must be further verified at the local level, but the data could potentially provide insight which species should be prioritized for a more detailed analysis and possibly subsequent targeted management actions, e.g.:

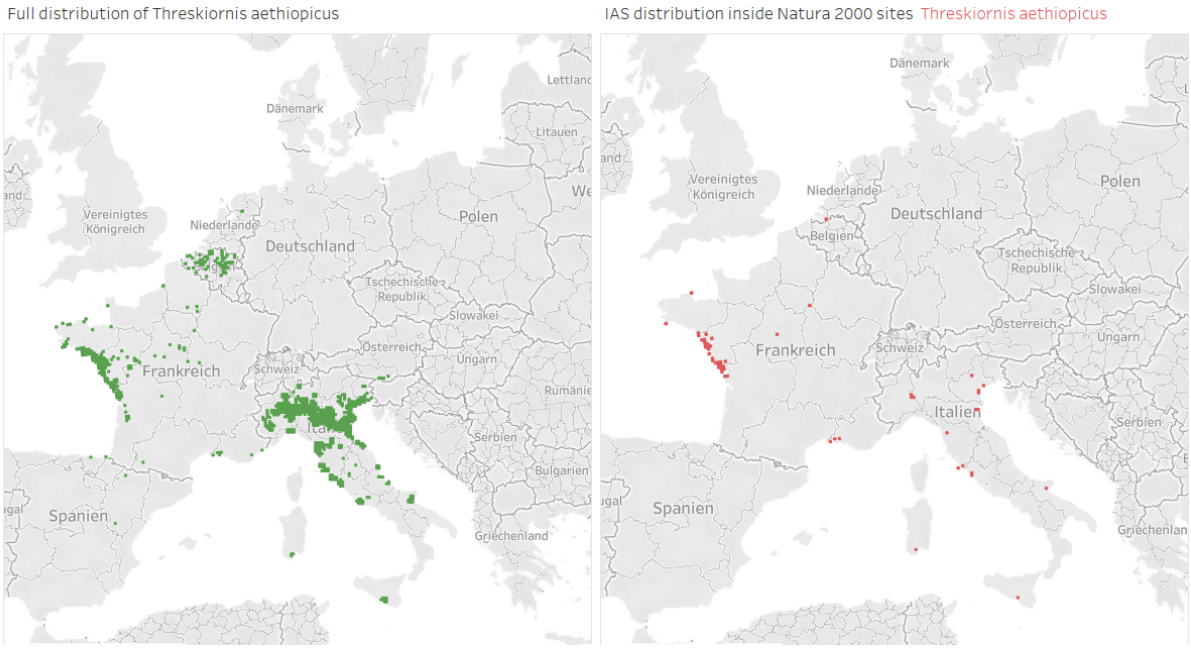
- All or most records are located inside (or close to) Natura2000 sites: *Callosciurus erythraeus*, *Herpestes javanicus* (Map 4-1).
- Relatively high percentages within (or close to) Natura2000 sites: *Orconectes limosus*, *Perccottus glenii*, *Procambarus clarkii*, *Procyon lotor* (Map 4-6), *Threskiornis aethiopicus* (Map 4-2); *Alternanthera philoxeroides*, *Baccharis halimifolia* (Map 4-3), *Eichhornia crassipes*, *Ludwigia peploides.*

Map 4-1 **Full distribution (left) and distribution inside Natura2000 sites (right) of *Herpestes javanicus*, based on a threshold of 50 % coverage of the grid cell being within a Natura2000 site**



Map 4-1 provides an example where targeted management action against an IAS of Union concern (*Herpestes javanicus*) would also be beneficial for Natura2000 sites and HD species. *Herpestes javanicus*, the Small Asian Mongoose has caused the near extirpation of the HD species *Vipera ammodytes* from the island of Mljet, and is suspected of causing declines in the HD reptiles *Lacerta trilineata*, *Pseudopus apodus*, snake species and having a high impact on grounddwelling songbirds (Scalera et al. 2020).

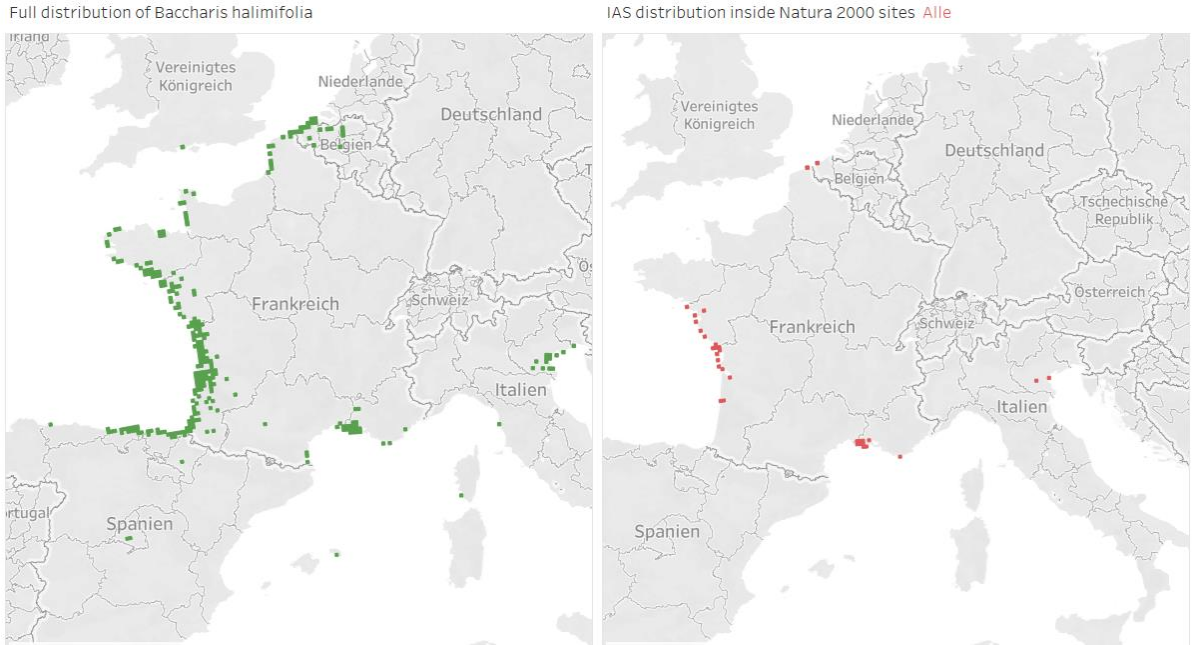
Map 4-2 **Full distribution (left) and distribution inside Natura2000 sites (right) of *Threskiornis aethiopicus*, based on a threshold of 50 % coverage of the grid cell being within a Natura2000 site**



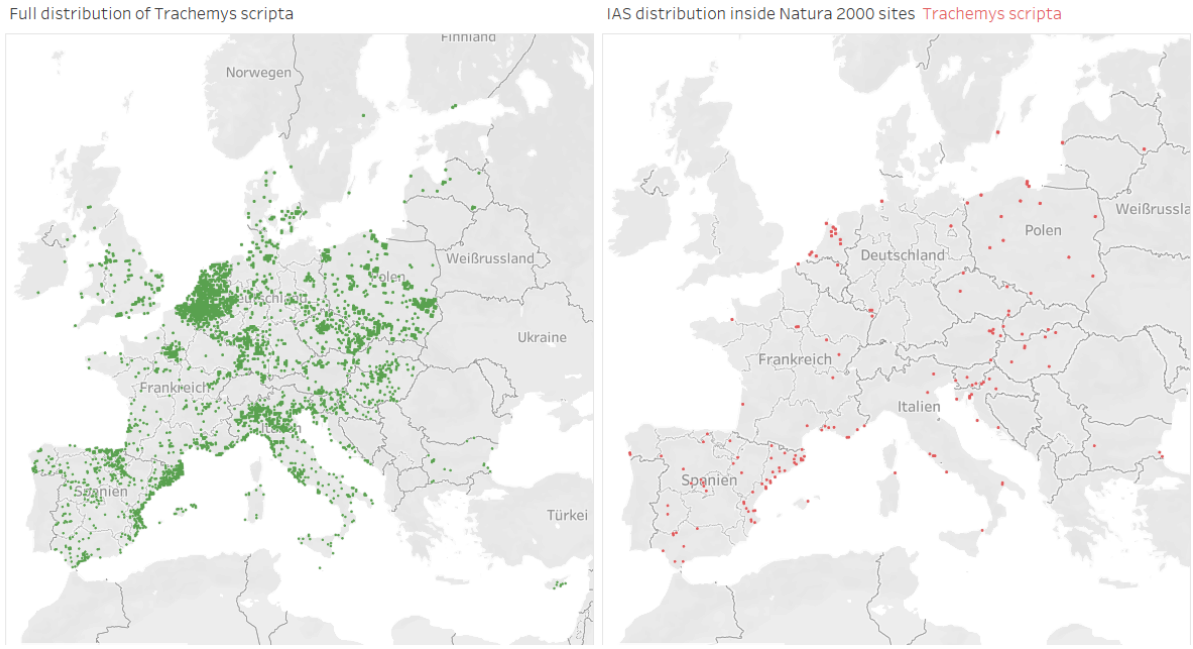
Maps 4-2 provides an example where targeted management action against an IAS of Union concern (*Threskiornis aethiopicus*) could be prioritized within Member States for the benefit of Natura2000 sites and BD species (e.g. *Bubulcus ibis*, *Chlidonias hybridus*, *C. niger*, *Sterna sandvicensis*, *Vanellus vanellus*). The Sacred Ibis is present in Natura2000 sites in France, the Netherlands and Italy, and there is evidence of impacts due to egg predation (Scalera et al. 2020). In case of mobile species, such as birds, of course, adjoining Natura2000 sites should be included in management actions as re-invasion from such areas is very likely. In such a case, cooperation between adjoining Member States is highly recommended.

Map 4-3 provides a similar example, indicating occurrences of *Baccharis halimifolia* in isolated coastal Natura2000 sites (e.g. 1230, 1330, 1410, 1420) within some Member states that possibly could be priority targets for management or eradication. This tree outcompetes native vegetation and has negative impacts on bird species (e.g. on the “Vulnerable” (VU) Aquatic Warbler *Acrocephalus paludicola* in Spain).

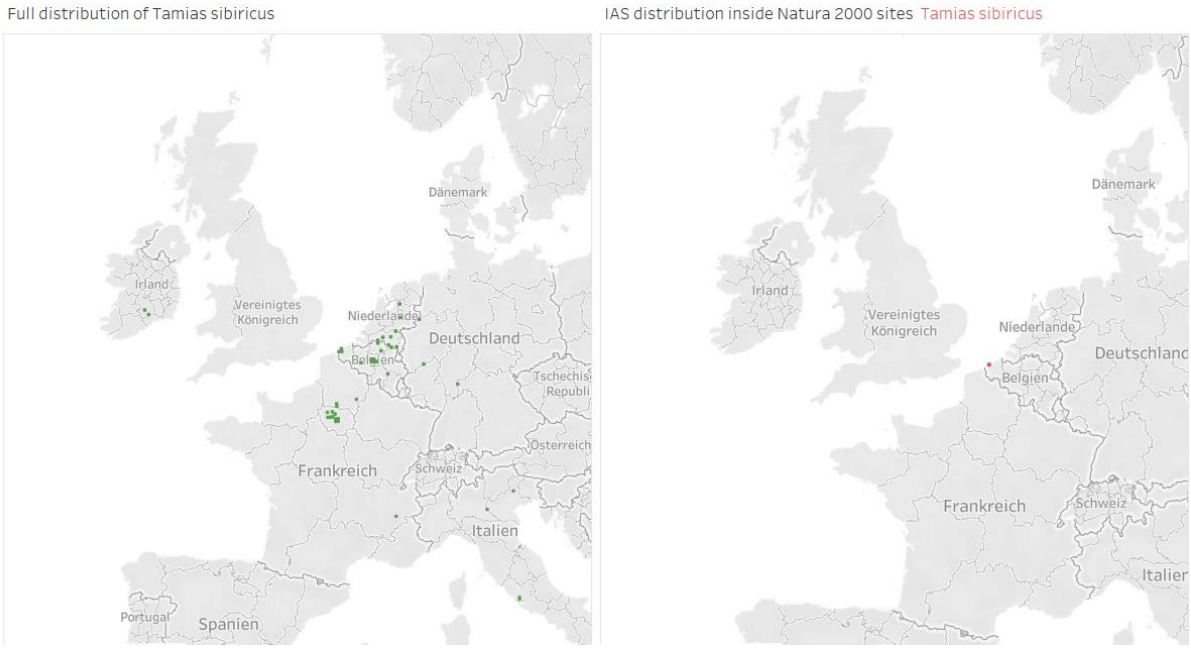
Map 4-3 **Full distribution (left) and distribution inside Natura2000 sites (right) of *Baccharis halimifolia*, based on a threshold of 50 % coverage of the grid cell being within a Natura2000 site**



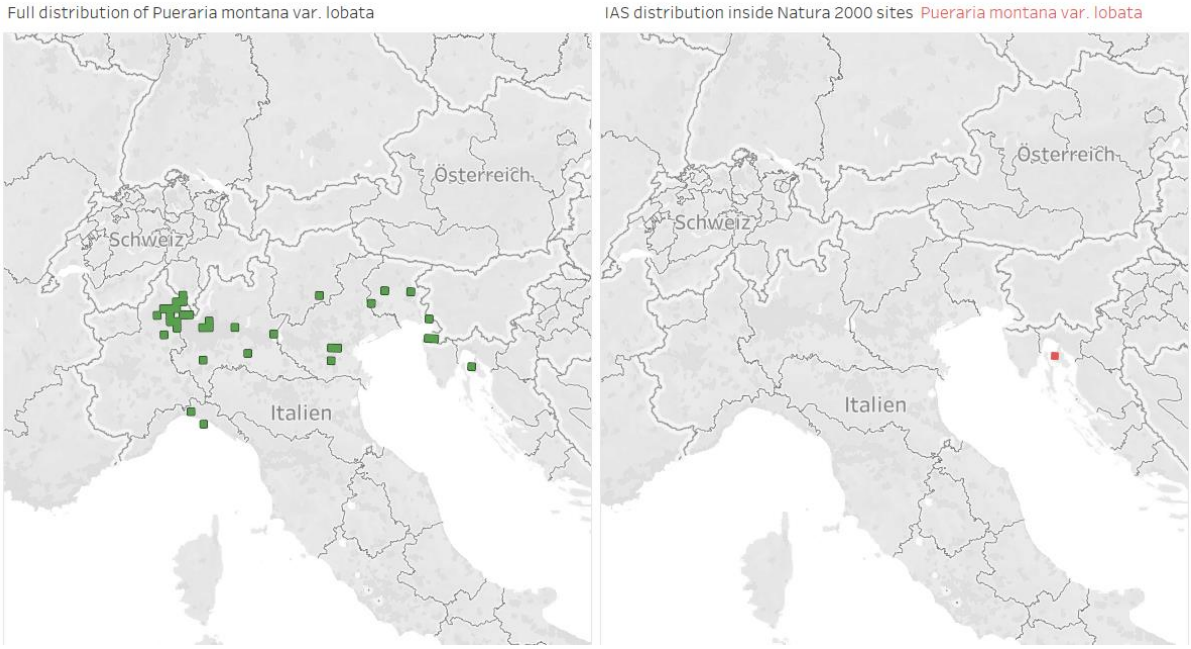
Map 4-4 **Full distribution (left) and distribution inside Natura2000 sites (right) of *Trachemys scripta*, based on a threshold of 50 % coverage of the grid cell being within a Natura2000 site**



Map 4-5 **Full distribution (left) and distribution inside Natura2000 sites (right) of *Tamias sibiricus*, based on a threshold of 50 % coverage of the grid cell being within a Natura2000 site**



Map 4-6 **Full distribution (left) and distribution inside Natura2000 sites (right) of *Pueraria montana* var. *lobata*, based on a threshold of 50 % coverage of the grid cell being within a Natura2000 site**

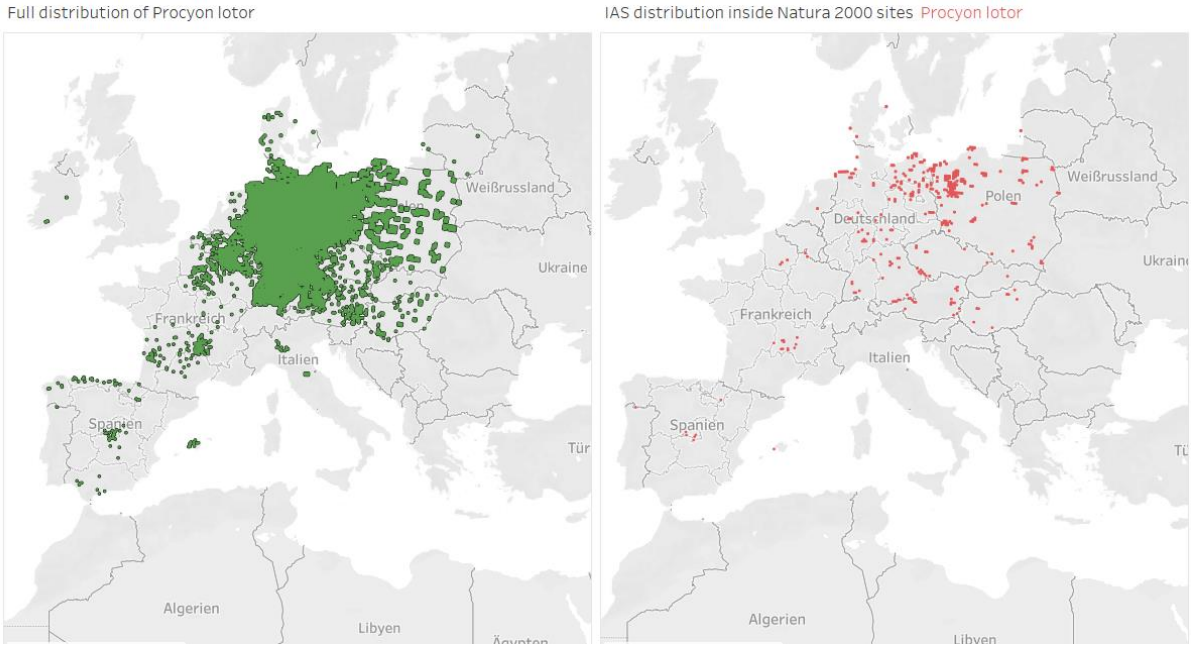


Maps 4-4, 4-5 and 4-6 provide examples of IAS of Union concern with a smaller representation inside Natura2000 sites. *Trachemys scripta* is recorded from numerous, but widely separated Natura2000

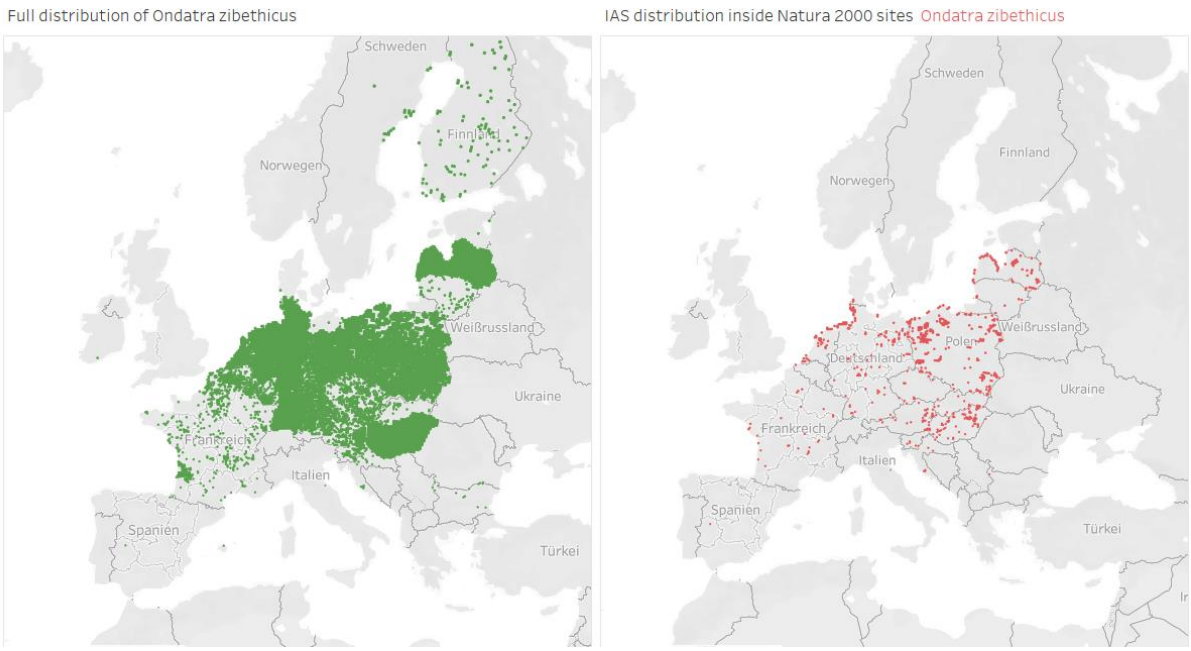
sites, which is a characteristic spatial pattern for repeated, independent releases at different sites with little (if any) natural spread. Negative effects are documented for European turtles and amphibians. *Tamias sibiricus* is usually found in urban and semi-natural habitats (parks, gardens), in forests, and rarely in pristine areas. *Pueraria montana* var. *lobata*, the Kudzu vine, colonizes forests, forest edges and river banks, but also fallow land, and private and public gardens. It can form monodominant stands that outcompete other plants.

Management measures against widespread species are particularly difficult and often not cost-efficient. However, to limit their further spread in yet uncolonized areas can still be useful and provide conservation benefits. While it is impossible to eradicate raccoon (*Procyon lotor*) from Germany (Map 4-7), its spread into neighbouring countries can possibly be slowed down, if not stopped, by taking action. Opportunistic, generalist species that can survive in different habitats are likely to be found also in Natura2000 sites, even more so if widely distributed. If re-colonization from areas outside the protected areas cannot be controlled or stopped, however, the management must be continued *ad infinitum*. Similarly, muskrat (*Ondatra zibethicus*) is widespread in central Europe, but limitation of its spread to the north and south should be limited as much as possible (Map 4-8). Muskrats can change the vegetation in HD habitats 3150 and 6430 and exert predation pressure on HD species (molluscs and fish).

Map 4-7 **Full distribution (left) and distribution inside Natura2000 sites (right) of *Procyon lotor*, based on a threshold of 50 % coverage of the grid cell being within a Natura2000 site**

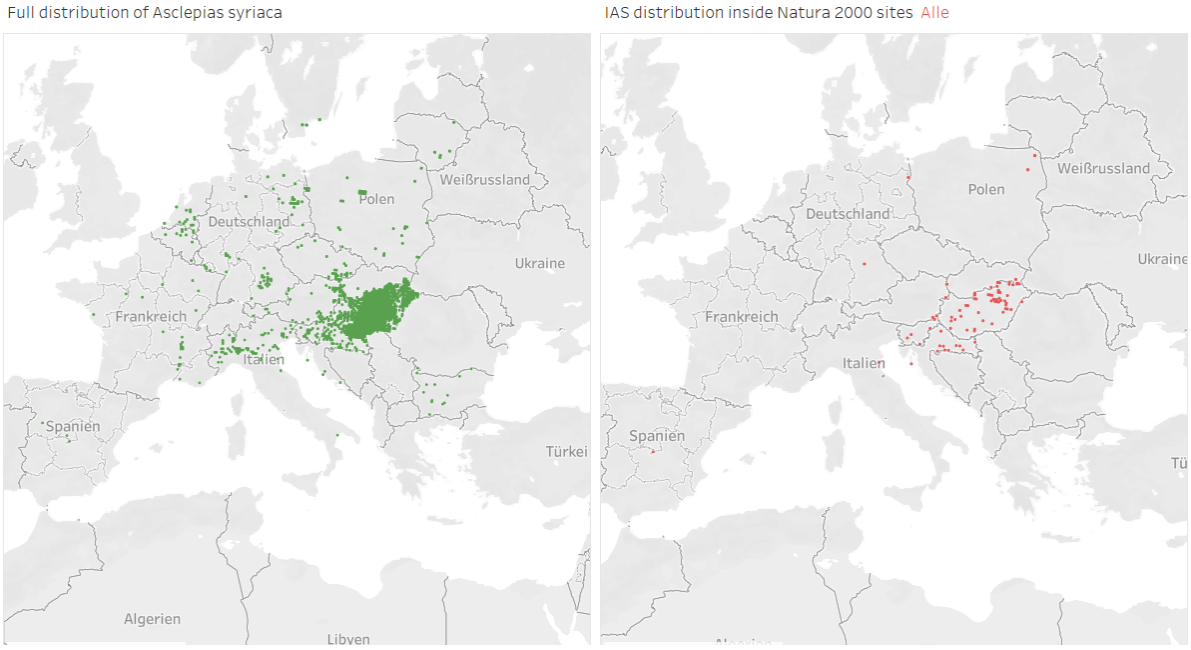


Map 4-8 **Full distribution (left) and distribution inside Natura2000 sites (right) of *Ondatra zibethicus*, based on a threshold of 50 % coverage of the grid cell being within a Natura2000 site**



The comparison of the distribution inside and outside of Natura2000 sites can also be useful in terms of foresight-looking and serve as a tool to trigger management actions at an early stage of an invasion. For example, the common milkweed *Ascelpias syriaca* is particularly widespread in Hungary, with several Natura2000 affected (Map 4-9), and preferred habitats (e.g. sandy and dry grasslands, dune areas and river valleys) are under future threat in other Member States once the species becomes more widespread in Europe.

Map 4-9 **Full distribution (left) and distribution inside Natura2000 sites (right) of *Asclepias syriaca*, based on a threshold of 50 % coverage of the grid cell being within a Natura2000 site**



5 Discussion and recommendations for future reporting periods

It is pivotal to streamline the IAS-impact information by facilitating and strongly encouraging Member States to report such information in future reportings. It is worth discussing if a smaller number of impacted habitats (e.g. by aggregating similar habitats) would help assessors providing an answer without losing much information. Similarly, in specific cases, affected species could be grouped, e.g. all American crayfish pose pressure on all European crayfish. Beside the use of qualifiers of certainty (high-medium), it is also worth discussing if assessors should be encouraged to only select the most important affected habitats (e.g. the top five) or if any other method of prioritization can be applied.

If "IAS of Union concern" are selected in the pressure or threat category within Article 12 and 17 reporting, a drop-down menu must be provided to further specify a) the species, b) the certainty of the impact and c) an additional compulsory comment field for providing more details. If "Other IAS" are selected in the pressure or threat category, a compulsory open field must be provided to add which species is concerned.

Because there is no agreed definition of "impact" (see e.g. Jeschke et al. 2014, Kumschick et al. 2015), and although it is inherently difficult, assessors need better instructions to harmonize impact data. This might be achieved by organizing dedicated workshops to discuss improvements of the guidelines, e.g. within the advisory groups for reporting, or seminars to support streamlining and comparability of data, e.g. via the NADEG and IASEG groups of experts. Possible links between the Red List Status of species or habitats and impacts from IAS need to be explored, not the least within the new EU-Biodiversity Strategy 2030 and its key commitment 9: "There is a 50 % reduction in the number of Red List species threatened by invasive alien species".

It is strongly encouraged that responsible reporting organisations and the assessors in Member States cooperate, share and discuss these information before submission of final reports. There are clear links and dependencies between IAS and species and habitats of the Nature Directives and these need to be better worked out. The cross-compliance of the different EU Nature Directives, also including the Water Framework Directive and the Marine Strategy Framework Directive, specifically with regard to Invasive Alien Species, therefore needs to be improved in future reportings.

One of the 2030 global action targets of the CBD is 'Control all pathways for the introduction of invasive alien species, achieving by 2030 a [50 %] reduction in the rate of new introductions, and eradicate or control invasive alien species to eliminate or reduce their impacts by 2030 in at least [50 %] of priority sites.' The new EU Biodiversity strategy is calling for a 50 % reduction in the number of Red List species threatened by IAS. Thus, the reduction of threat caused by IAS on the Natura 2000 network should be monitored. Although the spatial resolution of the IAS reporting does not fit well when looking at single Natura2000 sites, the analysis shown in section 4 of the report could contribute to monitor – on the European scale – status and trends of the distribution of the IAS of Union concern in relation to the Natura 2000 network.

References

CABI (2015): *Impatiens glandulifera* (Himalayan balsam). http://www.cabi.org/isc/datasheet/28766

DAISIE (2009): Handbook of Alien Species in Europe. Springer, 399 pp.

EPPO (2013) Pest risk analysis for Baccharis halimifolia. EPPO, Paris. Available at http://www.eppo.int/QUARANTINE/Pest_Risk_Analysis/PRA_intro.htm

Ficetola, G.F., Coïc, C., Detaint, M., Berroneau, M., Lorvelec, O. and Miaud, C. (2006): Pattern of distribution of the American bullfrog *Rana catesbeiana* in Europe. Biol. Invasions 9: 767-772.

Gallé R., Erdélyi N., Szpisjak N., Tölgyesi C. & Maák I. (2015): The effect of the invasive *Asclepias syriaca* on the ground-dwelling arthropod fauna. Biologia 70: 104-112.

Kelemen A., Valkó O., Kröel-Dulay Gy., Deák B., Török P., Tóth K., Miglécz, T. & Tóthmérész B. (2016): The invasion of common milkweed (*Asclepias syriaca* L.) in sandy old-fields – Is it a threat to the native flora? Applied Vegetation Science 19: 218-224.

Kumschick, S., Bacher, S., Blackburn, T.M., Dick, J.T.A., Essl, F., Evans, T., Gaertner, M., Hulme, P.E., Jeschke, J.M., Kühn, I., Mrugala, A., Pergl, J., Pyšek, P., Rabitsch, W., Ricciardi, A., Richardson, D.M., Sendek, A., Vilà, M. & Winter, M. (2015): Ecological impacts of alien species: quantification, scope, caveats and recommendations. BioScience 65: 55-63.

Jeschke, J., Bacher, S., Blackburn, T., Dick, J.T.A., Essl, F., Evans, T., Gaertner, M., Hulme, P.E., Kühn, I., Mrugala, A., Pergl, J., Pyšek, P., Rabitsch, W., Ricciardi, A., Richardson, D.M., Sendek, A.A., Vilà, M., Winter, M., Kumschick, S. (2014): Defining the impact of non-native species: resolving disparity through greater clarity. Conservation Biology 28: 1188-1194.

Lambdon PW, Pyšek P, Basnou C, Hejda M, Arianoutsou M, Essl F, Jarošík V, Pergl J, Winter M, Anastasiu P, Andriopoulo P, Bazo I, Brundu G, Celesti-Grapow L, Chassot P, Delipetou P, Josefsson M, Kark S, Klot S, Kokkori Y, Kühn I, Marchante H, Perglová I, Pino J, Vilà M, Ziko A, Roy D & Hulme P (2008): Alien flora of Europe: species diversity, temporal trends, geographical patterns and research needs. Preslia 80: 101-149.

Matthews J., Beringen R., Huijbregts M.A.J., van der Mheen H. J., Ode B., Trindade L., van Valkenburg J.LC.H., van der Velde G. & Leuven R.S.E.W. (2015): Horizon scanning and environmental risk analyses of non-native biomass crops in the Netherlands. Reports Environmental Science 506: 253 pp.

Pisarczyk, E. & Tokarska-Guzik, B. (2015) Risk Assessment of *Impatiens glandulifera*. 27 pp.

Pyšek, P., Jarosik, V., Hulme, P., Kühn, I., Wild, J., Arianoutsou, M., Bacher, S., Chiron, F., Didziulis, V., Essl, F., Genovesi, P., Gherardi, F., Hejda, M., Kark, S., Lambdon, P.W., Desprez-Loustau, A.-M., Nentwig, W., Pergl, J., Poboljsaj, K., Rabitsch, W., Roques, A., Roy, D., Shirley, S., Solarz, W., Vilá, M. & Winter, M. (2010): Disentangling the role of environmental and human pressures on biological invasions across Europe. Proceedings of the National Academy of Sciences 107: 12157-12162.

Scalera, R., Genovesi, P., Essl, F. & Rabitsch, W. (2012): The impacts of invasive alien species in Europe. EEA-Technical Report 16/2012, 118 pp.

Scalera, R., Rabitsch, W. & Underwood, E. (2020): FAQs on how the Invasive Alien Species Regulation interacts with the EU Nature Directives. European Commission, Brussels, 65 pp.

Tokarska-Guzik, B. & Pisarczyk, E. (2015) Risk Assessment of *Asclepias syriaca*. 27 pp.

Annex 1 IAS of Union concern affecting Annex I habitats according to Member States reports under the Habitats Directive

IAS	Habitat group	Code	Habitat
Asclepias syriaca	Dunes habitats	2340	Pannonic inland dunes
	Forests	91I0	Euro-Siberian steppic woods with Quercus spp.
		91N0	Pannonic inland sand dune thicket (Junipero-Populetum albae)
	Grasslands	6210	Semi-natural dry grasslands and scrubland facies on calcareous substrates (Festuco-Brometalia) (* important orchid sites)
		6250	Pannonic loess steppic grasslands
		6260	Pannonic sand steppes
		6430	Hydrophilous tall herb fringe communities of plains and of the montane to alpine levels
Baccharis halimifolia	Bogs, mires & fens	7210	Calcareous fens with Cladium mariscus and species of the Caricion davallianae
	Coastal habitats	1130	Estuaries
		1140	Mudflats and sandflats not covered by seawater at low tide
		1230	Vegetated sea cliffs of the Atlantic and Baltic Coasts
		1310	Salicornia and other annuals colonizing mud and sand
		1320	Spartina swards (Spartinion maritimae)
		1330	Atlantic salt meadows (Glauco-Puccinellietalia maritimae)
		1420	Mediterranean and thermo-Atlantic halophilous scrubs (Sarcocornetea fruticosi)
	Dunes habitats	2110	Embryonic shifting dunes
		2120	Shifting dunes along the shoreline with Ammophila arenaria ("white dunes")
		2130	Fixed coastal dunes with herbaceous vegetation ("grey dunes")
		2190	Humid dune slacks
	Heath & scrub	4040	Dry Atlantic coastal heaths with Erica vagans
	Sclerophyllous scrubs	5230	Arborescent matorral with Laurus nobilis
Eichhornia crassipes	Freshwater habitats	3150	Natural eutrophic lakes with Magnopotamion or Hydrocharition - type vegetation
Elodea nuttallii	Freshwater habitats	3140	Hard oligo-mesotrophic waters with benthic vegetation of Chara spp.
		3150	Natural eutrophic lakes with Magnopotamion or Hydrocharition - type vegetation
		3260	Water courses of plain to montane levels with the Ranunculion fluitantis and Callitricho-Batrachion vegetation

Heracleum mantegazzianum		Forests	91E0	Alluvial forests with Alnus glutinosa and Fraxinus excelsior (Alno-Padion, Alnion incanae, Salicion albae)
		Grasslands	6430	Hydrophilous tall herb fringe communities of plains and of the montane to alpine levels
Heracleum sosnowskyi		Coastal habitats	1630	Boreal Baltic coastal meadows
		Forests	91E0	Alluvial forests with Alnus glutinosa and Fraxinus excelsior (Alno-Padion, Alnion incanae, Salicion albae)
			91F0	Riparian mixed forests of Quercus robur, Ulmus laevis and Ulmus minor, Fraxinus excelsior or Fraxinus angustifolia, along the great rivers (Ulmenion minoris)
			9020	Fennoscandian hemiboreal natural old broad-leaved deciduous forests (Quercus, Tilia, Acer, Fraxinus or Ulmus) rich in epiphytes
		Grasslands	6270	Fennoscandian lowland species-rich dry to mesic grasslands
			6510	Lowland hay meadows (Alopecurus pratensis, Sanguisorba officinalis)
Hydrocotyle ranunculoides		Freshwater habitats	3130	Oligotrophic to mesotrophic standing waters with vegetation of the Littorelletea uniflorae and/or of the Isoëto-Nanojuncetea
Impatiens glandulifera		Forests	91E0	Alluvial forests with Alnus glutinosa and Fraxinus excelsior (Alno-Padion, Alnion incanae, Salicion albae)
			91F0	Riparian mixed forests of Quercus robur, Ulmus laevis and Ulmus minor, Fraxinus excelsior or Fraxinus angustifolia, along the great rivers (Ulmenion minoris)
			9050	Fennoscandian herb-rich forests with Picea abies
		Freshwater habitats	3130	Oligotrophic to mesotrophic standing waters with vegetation of the Littorelletea uniflorae and/or of the Isoëto-Nanojuncetea
			3140	Hard oligo-mesotrophic waters with benthic vegetation of Chara spp.
			3230	Alpine rivers and their ligneous vegetation with Myricaria germanica
			3260	Water courses of plain to montane levels with the Ranunculion fluitantis and Callitricho-Batrachion vegetation
		Grasslands	6230	Species-rich Nardus grasslands, on siliceous substrates in mountain areas (and submountain areas, in Continental Europe)
			6270	Fennoscandian lowland species-rich dry to mesic grasslands
			6430	Hydrophilous tall herb fringe communities of plains and of the montane to alpine levels
Ludwigia grandiflora		Bogs, mires & fens	7210	Calcareous fens with Cladium mariscus and species of the Caricion davallianae
		Coastal habitats	1130	Estuaries
			1150	Coastal lagoons
		Freshwater habitats	3110	Oligotrophic waters containing very few minerals of sandy plains (Littorelletalia uniflorae)
			3140	Hard oligo-mesotrophic waters with benthic vegetation of Chara spp.
			3150	Natural eutrophic lakes with Magnopotamion or Hydrocharition - type vegetation
			3260	Water courses of plain to montane levels with the Ranunculion fluitantis and Callitricho-Batrachion vegetation

			3270	Rivers with muddy banks with Chenopodion rubri p.p. and Bidention p.p. vegetation
Ludwigia peploides		Coastal habitats	1150	Coastal lagoons
		Freshwater habitats	3150	Natural eutrophic lakes with Magnopotamion or Hydrocharition - type vegetation
Myriophyllum aquaticum		Freshwater habitats	3110	Oligotrophic waters containing very few minerals of sandy plains (Littorelletalia uniflorae)
			3150	Natural eutrophic lakes with Magnopotamion or Hydrocharition - type vegetation
			3260	Water courses of plain to montane levels with the Ranunculion fluitantis and Callitricho-Batrachion vegetation
			3270	Rivers with muddy banks with Chenopodion rubri p.p. and Bidention p.p. vegetation
Myriophyllum heterophyllum		Coastal habitats	1150	Coastal lagoons
		Freshwater habitats	3140	Hard oligo-mesotrophic waters with benthic vegetation of Chara spp.
			3150	Natural eutrophic lakes with Magnopotamion or Hydrocharition - type vegetation
Nyctereutes procyonoides		Coastal habitats	1620	Boreal Baltic islets and small islands
Orconectes limosus		Bogs, mires & fens	7140	Transition mires and quaking bogs
		Freshwater habitats	3150	Natural eutrophic lakes with Magnopotamion or Hydrocharition - type vegetation
Orconectes virilis		Bogs, mires & fens	7140	Transition mires and quaking bogs
		Freshwater habitats	3150	Natural eutrophic lakes with Magnopotamion or Hydrocharition - type vegetation
Oxyura jamaicensis		Coastal habitats	1150	Coastal lagoons
			1310	Salicornia and other annuals colonizing mud and sand
			1410	Mediterranean salt meadows (Juncetalia maritimi)
			1420	Mediterranean and thermo-Atlantic halophilous scrubs (Sarcocornetea fruticosi)
		Freshwater habitats	3140	Hard oligo-mesotrophic waters with benthic vegetation of Chara spp.
Pennisetum setaceum		Sclerophyllous scrubs	5210	Arborescent matorral with Juniperus spp.
			5330	Thermo-Mediterranean and pre-desert scrub
Procambarus clarkii		Bogs, mires & fens	7140	Transition mires and quaking bogs
			7210	Calcareous fens with Cladium mariscus and species of the Caricion davallianae
		Coastal habitats	1150	Coastal lagoons
			1310	Salicornia and other annuals colonizing mud and sand
			1410	Mediterranean salt meadows (Juncetalia maritimi)
			1420	Mediterranean and thermo-Atlantic halophilous scrubs (Sarcocornetea fruticosi)
		Forests	91B0	Thermophilous Fraxinus angustifolia woods
		Freshwater habitats	3110	Oligotrophic waters containing very few minerals of sandy plains (Littorelletalia uniflorae)
			3140	Hard oligo-mesotrophic waters with benthic vegetation of Chara spp.
			3150	Natural eutrophic lakes with Magnopotamion or Hydrocharition - type vegetation

			3260	Water courses of plain to montane levels with the Ranunculion fluitantis and Callitricho-Batrachion vegetation
			3270	Rivers with muddy banks with Chenopodion rubri p.p. and Bidention p.p. vegetation
			3280	Constantly flowing Mediterranean rivers with Paspalo-Agrostidion species and hanging curtains of Salix and Populus alba
Procyon lotor		Freshwater habitats	3110	Oligotrophic waters containing very few minerals of sandy plains (Littorelletalia uniflorae)
			3260	Water courses of plain to montane levels with the Ranunculion fluitantis and Callitricho-Batrachion vegetation
			3270	Rivers with muddy banks with Chenopodion rubri p.p. and Bidention p.p. vegetation
Threskiornis aethiopicus		Freshwater habitats	3150	Natural eutrophic lakes with Magnopotamion or Hydrocharition - type vegetation
			3230	Alpine rivers and their ligneous vegetation with Myricaria germanica
		Grasslands	6430	Hydrophilous tall herb fringe communities of plains and of the montane to alpine levels
Trachemys scripta		Coastal habitats	1150	Coastal lagoons
			1310	Salicornia and other annuals colonizing mud and sand
			1420	Mediterranean and thermo-Atlantic halophilous scrubs (Sarcocornetea fruticosi)
		Forests	91B0	Thermophilous Fraxinus angustifolia woods
		Freshwater habitats	3110	Oligotrophic waters containing very few minerals of sandy plains (Littorelletalia uniflorae)
			3140	Hard oligo-mesotrophic waters with benthic vegetation of Chara spp.
			3150	Natural eutrophic lakes with Magnopotamion or Hydrocharition - type vegetation
			3230	Alpine rivers and their ligneous vegetation with Myricaria germanica
			3260	Water courses of plain to montane levels with the Ranunculion fluitantis and Callitricho-Batrachion vegetation
			3270	Rivers with muddy banks with Chenopodion rubri p.p. and Bidention p.p. vegetation
		Grasslands	6430	Hydrophilous tall herb fringe communities of plains and of the montane to alpine levels
Vespa velutina nigrithorax		Forests	91B0	Thermophilous Fraxinus angustifolia woods
			92A0	Salix alba and Populus alba galleries
			92D0	Southern riparian galleries and thickets (Nerio-Tamaricetea and Securinegion tinctoriae)
			9540	Mediterranean pine forests with endemic Mesogean pines
		Freshwater habitats	3150	Natural eutrophic lakes with Magnopotamion or Hydrocharition - type vegetation
			3230	Alpine rivers and their ligneous vegetation with Myricaria germanica
		Grasslands	6430	Hydrophilous tall herb fringe communities of plains and of the montane to alpine levels

Please note: The data result from an optional field in the Article 17 report format and thus might not be comprehensive.

Annex 2 Annex I habitats affected by IAS of Union concern according to Member States reports under the Habitats Directive

Habitat group	Habitat	IAS
Bogs, mires & fens	7140 -Transition mires and quaking bogs	Orconectes limosus
		Orconectes virilis
		Procambarus clarkii
	7210 -Calcareous fens with Cladium mariscus and species of the Caricion davallianae	Baccharis halimifolia
		Ludwigia grandiflora
		Procambarus clarkii
Coastal habitats	1130 -Estuaries	Baccharis halimifolia
		Ludwigia grandiflora
	1140 -Mudflats and sandflats not covered by seawater at low tide	Baccharis halimifolia
	1150 -Coastal lagoons	Ludwigia grandiflora
		Ludwigia peploides
		Myriophyllum heterophyllum
		Oxyura jamaicensis
		Procambarus clarkii
		Trachemys scripta
	1230 -Vegetated sea cliffs of the Atlantic and Baltic Coasts	Baccharis halimifolia
	1310 -Salicornia and other annuals colonizing mud and sand	Baccharis halimifolia
		Oxyura jamaicensis
		Procambarus clarkii
		Trachemys scripta
	1320 -Spartina swards (Spartinion maritimae)	Baccharis halimifolia
	1330 -Atlantic salt meadows (Glauco-Puccinellietalia maritimae)	Baccharis halimifolia
	1410 -Mediterranean salt meadows (Juncetalia maritimi)	Oxyura jamaicensis
		Procambarus clarkii
	1420 -Mediterranean and thermo-Atlantic halophilous scrubs (Sarcocornetea fruticosi)	Baccharis halimifolia
		Oxyura jamaicensis
		Procambarus clarkii
		Trachemys scripta
	1620 -Boreal Baltic islets and small islands	Nyctereutes procyonoides
	1630 -Boreal Baltic coastal meadows	Heracleum sosnowskyi
Dunes habitats	2110 -Embryonic shifting dunes	Baccharis halimifolia
	2120 -Shifting dunes along the shoreline with Ammophila arenaria ("white dunes")	Baccharis halimifolia
	2130 -Fixed coastal dunes with herbaceous vegetation ("grey dunes")	Baccharis halimifolia

	2190 -Humid dune slacks	Baccharis halimifolia
	2340 -Pannonic inland dunes	Asclepias syriaca
Forests	91B0 -Thermophilous Fraxinus angustifolia woods	Procambarus clarkii
		Trachemys scripta
		Vespa velutina nigrithorax
	91E0 -Alluvial forests with Alnus glutinosa and Fraxinus excelsior (Alno-Padion, Alnion incanae, Salicion albae)	Heracleum mantegazzianum
		Heracleum sosnowskyi
		Impatiens glandulifera
	91F0 -Riparian mixed forests of Quercus robur, Ulmus laevis and Ulmus minor, Fraxinus excelsior or Fraxinus angustifolia, along the great rivers (Ulmenion minoris)	Heracleum sosnowskyi
		Impatiens glandulifera
	91I0 -Euro-Siberian steppic woods with Quercus spp.	Asclepias syriaca
	91N0 -Pannonic inland sand dune thicket (Junipero-Populetum albae)	Asclepias syriaca
	92A0 -Salix alba and Populus alba galleries	Vespa velutina nigrithorax
	92D0 -Southern riparian galleries and thickets (Nerio-Tamaricetea and Securinegion tinctoriae)	Vespa velutina nigrithorax
	9020 -Fennoscandian hemiboreal natural old broad-leaved deciduous forests (Quercus, Tilia, Acer, Fraxinus or Ulmus) rich in epiphytes	Heracleum sosnowskyi
	9050 -Fennoscandian herb-rich forests with Picea abies	Impatiens glandulifera
	9540 -Mediterranean pine forests with endemic Mesogean pines	Vespa velutina nigrithorax
Freshwater habitats	3110 -Oligotrophic waters containing very few minerals of sandy plains (Littorelletalia uniflorae)	Ludwigia grandiflora
		Myriophyllum aquaticum
		Procambarus clarkii
		Procyon lotor
		Trachemys scripta
	3130 -Oligotrophic to mesotrophic standing waters with vegetation of the Littorelletea uniflorae and/or of the Isoëto-Nanojuncetea	Hydrocotyle ranunculoides
		Impatiens glandulifera
	3140 -Hard oligo-mesotrophic waters with benthic vegetation of Chara spp.	Elodea nuttallii
		Impatiens glandulifera
		Ludwigia grandiflora
		Myriophyllum heterophyllum
		Oxyura jamaicensis
		Procambarus clarkii
		Trachemys scripta
	3150 -Natural eutrophic lakes with Magnopotamion or Hydrocharition - type vegetation	Eichhornia crassipes
		Elodea nuttallii
		Ludwigia grandiflora
		Ludwigia peploides
		Myriophyllum aquaticum
		Myriophyllum heterophyllum
		Orconectes limosus
		Orconectes virilis
		Procambarus clarkii
		Threskiornis aethiopicus

		Trachemys scripta
		Vespa velutina nigrithorax
	3230 -Alpine rivers and their ligneous vegetation with Myricaria germanica	Impatiens glandulifera
		Threskiornis aethiopicus
		Trachemys scripta
		Vespa velutina nigrithorax
	3260 -Water courses of plain to montane levels with the Ranunculion fluitantis and Callitricho-Batrachion vegetation	Elodea nuttallii
		Impatiens glandulifera
		Ludwigia grandiflora
		Myriophyllum aquaticum
		Procambarus clarkii
		Procyon lotor
		Trachemys scripta
	3270 -Rivers with muddy banks with Chenopodion rubri p.p. and Bidention p.p. vegetation	Ludwigia grandiflora
		Myriophyllum aquaticum
		Procambarus clarkii
		Procyon lotor
		Trachemys scripta
	3280 -Constantly flowing Mediterranean rivers with Paspalo-Agrostidion species and hanging curtains of Salix and Populus alba	Procambarus clarkii
Grasslands	6210 -Semi-natural dry grasslands and scrubland facies on calcareous substrates (Festuco-Brometalia) (* important orchid sites)	Asclepias syriaca
	6230 -Species-rich Nardus grasslands, on siliceous substrates in mountain areas (and submountain areas, in Continental Europe)	Impatiens glandulifera
	6250 -Pannonic loess steppic grasslands	Asclepias syriaca
	6260 -Pannonic sand steppes	Asclepias syriaca
	6270 -Fennoscandian lowland species-rich dry to mesic grasslands	Heracleum sosnowskyi
		Impatiens glandulifera
	6430 -Hydrophilous tall herb fringe communities of plains and of the montane to alpine levels	Asclepias syriaca
		Heracleum mantegazzianum
		Impatiens glandulifera
		Threskiornis aethiopicus
		Trachemys scripta
		Vespa velutina nigrithorax
	6510 -Lowland hay meadows (Alopecurus pratensis, Sanguisorba officinalis)	Heracleum sosnowskyi
Heath & scrub	4040 -Dry Atlantic coastal heaths with Erica vagans	Baccharis halimifolia
Sclerophyllous scrubs	5210 -Arborescent matorral with Juniperus spp.	Pennisetum setaceum
	5230 -Arborescent matorral with Laurus nobilis	Baccharis halimifolia
	5330 -Thermo-Mediterranean and pre-desert scrub	Pennisetum setaceum

Please note: The data result from an optional field in the Article 17 report format and thus might not be comprehensive.

Annex 3 IAS of Union concern affecting Annex II species according to Member States reports under the Habitats Directive

IAS	Group	Species name
Asclepias syriaca	Arthropods	Coenonympha oedippus
		Eriogaster catax
		Gortyna borelii lunata
		Proserpinus proserpina
	Reptiles	Emys orbicularis
		Lacerta agilis
		Lacerta viridis
		Podarcis taurica
		Vipera ursinii rakosiensis
	Vascular plants	Colchicum arenarium
		Crambe tataria
		Dianthus diutinus
		Iris aphylla subsp. hungarica
		Iris humilis subsp. arenaria
		Pulsatilla grandis
		Pulsatilla patens
		Pulsatilla pratensis subsp. hungarica
		Thlaspi jankae
Eichhornia crassipes	Arthropods	Austropotamobius pallipes
		Macromia splendens
	Fish	Pseudochondrostoma duriense
Elodea nuttallii	Amphibians	Pelophylax esculentus
		Pelophylax lessonae
Eriocheir sinensis	Arthropods	Astacus astacus
		Austropotamobius torrentium
Heracleum sosnowskyi	Amphibians	Bufotes viridis
		Pelophylax lessonae
		Pelophylax ridibundus
		Rana arvalis
	Vascular plants	Angelica palustris
Herpestes javanicus	Reptiles	Elaphe quatuorlineata
		Emys orbicularis
		Hierophis gemonensis
		Ophisaurus apodus
		Platyceps najadum
		Podarcis melisellensis
		Podarcis siculus
		Telescopus fallax

		Vipera ammodytes
		Zamenis situla
Impatiens glandulifera	Arthropods	Proserpinus proserpina
	Vascular plants	Lycopodium spp.
Ludwigia grandiflora	Arthropods	Austropotamobius pallipes
		Macromia splendens
Myocastor coypus	Mammals	Lutra lutra
Myriophyllum aquaticum	Arthropods	Macromia splendens
Nyctereutes procyonoides	Amphibians	Bufotes viridis
		Pelophylax lessonae
		Pelophylax ridibundus
		Rana arvalis
	Mammals	Mustela putorius
Ondatra zibethicus	Molluscs	Margaritifera margaritifera
		Unio crassus
		Unio elongatulus
Orconectes limosus	Arthropods	Astacus astacus
		Austropotamobius pallipes
		Austropotamobius torrentium
Orconectes virilis	Arthropods	Astacus astacus
		Austropotamobius torrentium
Pacifastacus leniusculus	Amphibians	Alytes cisternasii
		Alytes dickhilleni
		Alytes obstetricans
		Calotriton arnoldi
		Calotriton asper
		Chioglossa lusitanica
		Discoglossus galganoi
		Discoglossus pictus
		Epidalea calamita
		Hyla meridionalis
		Hyla molleri
		Pelobates cultripes
		Pelophylax perezi
		Rana dalmatina
		Rana iberica
		Rana pyrenaica
		Rana temporaria
		Triturus marmoratus
		Triturus pygmaeus
	Arthropods	Astacus astacus
		Austropotamobius pallipes
		Austropotamobius torrentium
		Coenagrion mercuriale

		Oxygastra curtisii
	Fish	Achondrostoma arcasii
		Anaecypris hispanica
		Aphanius iberus
		Cobitis calderoni
		Cobitis paludica
		Cobitis vettonica
		Cottus hispaniolensis
		Iberochondrostoma lemmingii
		Pseudochondrostoma duriense
	Molluscs	Margaritifera auricularia
		Margaritifera margaritifera
		Unio crassus
	Reptiles	Emys orbicularis
		Mauremys leprosa
Perccottus glenii	Amphibians	Rana arvalis
	Fish	Aspius aspius
		Cobitis taenia Complex
		Eudontomyzon mariae
		Gymnocephalus baloni
		Gymnocephalus schraetzer
		Misgurnus fossilis
		Pelecus cultratus
		Romanogobio kesslerii
		Romanogobio vladykovi
		Umbra krameri
Procambarus clarkii	Amphibians	Alytes cisternasii
		Alytes dickhilleni
		Alytes obstetricans
		Calotriton arnoldi
		Calotriton asper
		Chioglossa lusitanica
		Discoglossus galganoi
		Discoglossus pictus
		Epidalea calamita
		Hyla meridionalis
		Hyla molleri
		Pelobates cultripes
		Pelophylax perezi
		Rana dalmatina
		Rana iberica
		Rana pyrenaica
		Rana temporaria
		Triturus marmoratus
		Triturus pygmaeus

	Arthropods	Astacus astacus
		Austropotamobius pallipes
		Austropotamobius torrentium
		Macromia splendens
	Fish	Achondrostoma arcasii
		Anaecypris hispanica
		Aphanius iberus
		Cobitis calderoni
		Cobitis paludica
		Cobitis vettonica
		Cottus hispaniolensis
		Iberochondrostoma lemmingii
		Pseudochondrostoma duriense
	Molluscs	Margaritifera auricularia
		Margaritifera margaritifera
	Reptiles	Emys orbicularis
		Mauremys leprosa
Procyon lotor	Arthropods	Macromia splendens
	Mammals	Mustela putorius
	Molluscs	Margaritifera margaritifera
		Unio crassus
Pseudorasbora parva	Amphibians	Pelophylax perezi
	Arthropods	Austropotamobius pallipes
	Fish	Aspius aspius
		Cobitis calderoni
		Cobitis paludica
		Cobitis taenia Complex
		Cobitis vettonica
		Cottus hispaniolensis
		Eudontomyzon mariae
		Gymnocephalus baloni
		Gymnocephalus schraetzer
		Misgurnus fossilis
		Pelasgus prespensis
		Pelecus cultratus
		Phoxinellus alepidotus
		Rhodeus amarus
		Romanogobio kesslerii
		Romanogobio vladykovi
		Umbra krameri
	Molluscs	Unio elongatulus
	Reptiles	Emys orbicularis
Threskiornis aethiopicus	Amphibians	Rana arvalis
	Arthropods	Astacus astacus

	Molluscs	Unio elongatulus
	Reptiles	Emys orbicularis
Trachemys scripta	Amphibians	Alytes cisternasii
		Alytes dickhilleni
		Alytes obstetricans
		Discoglossus galganoi
		Discoglossus pictus
		Epidalea calamita
		Hyla meridionalis
		Hyla molleri
		Pelobates cultripes
		Pelophylax perezi
		Rana arvalis
		Triturus marmoratus
		Triturus pygmaeus
	Arthropods	Astacus astacus
		Austropotamobius pallipes
		Macromia splendens
	Fish	Achondrostoma arcasii
		Anaecypris hispanica
		Aphanius iberus
		Cobitis calderoni
		Cobitis paludica
		Cobitis vettonica
		Cottus hispaniolensis
		Pseudochondrostoma duriense
	Molluscs	Unio elongatulus
	Reptiles	Emys orbicularis
		Mauremys leprosa
		Mauremys rivulata
Vespa velutina nigrithorax	Amphibians	Rana arvalis
	Arthropods	Astacus astacus
	Molluscs	Unio elongatulus
	Reptiles	Emys orbicularis

Please note: The data result from an optional field in the Article 17 report format and thus might not be comprehensive.

Annex 4 Annex II species affected by IAS of Union concern according to Member States reports under the Habitats Directive

Group	Species name	IAS
Amphibians	Alytes cisternasii	Pacifastacus leniusculus
		Procambarus clarkii
		Trachemys scripta
	Alytes dickhilleni	Pacifastacus leniusculus
		Procambarus clarkii
		Trachemys scripta
	Alytes obstetricans	Pacifastacus leniusculus
		Procambarus clarkii
		Trachemys scripta
	Bufotes viridis	Heracleum sosnowskyi
		Nyctereutes procyonoides
	Calotriton arnoldi	Pacifastacus leniusculus
		Procambarus clarkii
	Calotriton asper	Pacifastacus leniusculus
		Procambarus clarkii
	Chioglossa lusitanica	Pacifastacus leniusculus
		Procambarus clarkii
	Discoglossus galganoi	Pacifastacus leniusculus
		Procambarus clarkii
		Trachemys scripta
	Discoglossus pictus	Pacifastacus leniusculus
		Procambarus clarkii
		Trachemys scripta
	Epidalea calamita	Pacifastacus leniusculus
		Procambarus clarkii
		Trachemys scripta
	Hyla meridionalis	Pacifastacus leniusculus
		Procambarus clarkii
		Trachemys scripta
	Hyla molleri	Pacifastacus leniusculus
		Procambarus clarkii
		Trachemys scripta
	Pelobates cultripes	Pacifastacus leniusculus
		Procambarus clarkii
		Trachemys scripta
	Pelophylax esculentus	Elodea nuttallii

	Pelophylax lessonae	Elodea nuttallii
		Heracleum sosnowskyi
		Nyctereutes procyonoides
	Pelophylax perezi	Pacifastacus leniusculus
		Procambarus clarkii
		Pseudorasbora parva
		Trachemys scripta
	Pelophylax ridibundus	Heracleum sosnowskyi
		Nyctereutes procyonoides
	Rana arvalis	Heracleum sosnowskyi
		Nyctereutes procyonoides
		Perccottus glenii
		Threskiornis aethiopicus
		Trachemys scripta
		Vespa velutina nigrithorax
	Rana dalmatina	Pacifastacus leniusculus
		Procambarus clarkii
	Rana iberica	Pacifastacus leniusculus
		Procambarus clarkii
	Rana pyrenaica	Pacifastacus leniusculus
		Procambarus clarkii
	Rana temporaria	Pacifastacus leniusculus
		Procambarus clarkii
	Triturus marmoratus	Pacifastacus leniusculus
		Procambarus clarkii
		Trachemys scripta
	Triturus pygmaeus	Pacifastacus leniusculus
		Procambarus clarkii
		Trachemys scripta
Arthropods	Astacus astacus	Eriocheir sinensis
		Orconectes limosus
		Orconectes virilis
		Pacifastacus leniusculus
		Procambarus clarkii
		Threskiornis aethiopicus
		Trachemys scripta
		Vespa velutina nigrithorax
	Austropotamobius pallipes	Eichhornia crassipes
		Ludwigia grandiflora
		Orconectes limosus
		Pacifastacus leniusculus
		Procambarus clarkii
		Pseudorasbora parva
		Trachemys scripta
	Austropotamobius torrentium	Eriocheir sinensis

		Orconectes limosus
		Orconectes virilis
		Pacifastacus leniusculus
		Procambarus clarkii
	Coenagrion mercuriale	Pacifastacus leniusculus
	Coenonympha oedippus	Asclepias syriaca
	Eriogaster catax	Asclepias syriaca
	Gortyna borelii lunata	Asclepias syriaca
	Macromia splendens	Eichhornia crassipes
		Ludwigia grandiflora
		Myriophyllum aquaticum
		Procambarus clarkii
		Procyon lotor
		Trachemys scripta
	Oxygastra curtisii	Pacifastacus leniusculus
	Proserpinus proserpina	Asclepias syriaca
		Impatiens glandulifera
Fish	Achondrostoma arcasii	Pacifastacus leniusculus
		Procambarus clarkii
		Trachemys scripta
	Anaecypris hispanica	Pacifastacus leniusculus
		Procambarus clarkii
		Trachemys scripta
	Aphanius iberus	Pacifastacus leniusculus
		Procambarus clarkii
		Trachemys scripta
	Aspius aspius	Perccottus glenii
		Pseudorasbora parva
	Cobitis calderoni	Pacifastacus leniusculus
		Procambarus clarkii
		Pseudorasbora parva
		Trachemys scripta
	Cobitis paludica	Pacifastacus leniusculus
		Procambarus clarkii
		Pseudorasbora parva
		Trachemys scripta
	Cobitis taenia Complex	Perccottus glenii
		Pseudorasbora parva
	Cobitis vettonica	Pacifastacus leniusculus
		Procambarus clarkii
		Pseudorasbora parva
		Trachemys scripta
	Cottus hispaniolensis	Pacifastacus leniusculus
		Procambarus clarkii

		Pseudorasbora parva
		Trachemys scripta
	Eudontomyzon mariae	Perccottus glenii
		Pseudorasbora parva
	Gymnocephalus baloni	Perccottus glenii
		Pseudorasbora parva
	Gymnocephalus schraetzer	Perccottus glenii
		Pseudorasbora parva
	Iberochondrostoma lemmingii	Pacifastacus leniusculus
		Procambarus clarkii
	Misgurnus fossilis	Perccottus glenii
		Pseudorasbora parva
	Pelasgus prespensis	Pseudorasbora parva
	Pelecus cultratus	Perccottus glenii
		Pseudorasbora parva
	Phoxinellus alepidotus	Pseudorasbora parva
	Pseudochondrostoma duriense	Eichhornia crassipes
		Pacifastacus leniusculus
		Procambarus clarkii
		Trachemys scripta
	Rhodeus amarus	Pseudorasbora parva
	Romanogobio kesslerii	Perccottus glenii
		Pseudorasbora parva
	Romanogobio vladykovi	Perccottus glenii
		Pseudorasbora parva
	Umbra krameri	Perccottus glenii
		Pseudorasbora parva
Mammals	Lutra lutra	Myocastor coypus
	Mustela putorius	Nyctereutes procyonoides
		Procyon lotor
Molluscs	Anisus vorticulus	Hydrocotyle ranunculoides
	Margaritifera auricularia	Pacifastacus leniusculus
		Procambarus clarkii
	Margaritifera margaritifera	Ondatra zibethicus
		Pacifastacus leniusculus
		Procambarus clarkii
		Procyon lotor
	Unio crassus	Ondatra zibethicus
		Pacifastacus leniusculus
		Procyon lotor
	Unio elongatulus	Ondatra zibethicus
		Pseudorasbora parva
		Threskiornis aethiopicus
		Trachemys scripta
		Vespa velutina nigrithorax

	Unio tumidiformis	
Reptiles	Elaphe quatuorlineata	Herpestes javanicus
	Emys orbicularis	Asclepias syriaca
		Herpestes javanicus
		Pacifastacus leniusculus
		Procambarus clarkii
		Pseudorasbora parva
		Threskiornis aethiopicus
		Trachemys scripta
		Vespa velutina nigrithorax
	Hierophis gemonensis	Herpestes javanicus
	Lacerta agilis	Asclepias syriaca
	Lacerta viridis	Asclepias syriaca
	Mauremys leprosa	Pacifastacus leniusculus
		Procambarus clarkii
		Trachemys scripta
	Mauremys rivulata	Trachemys scripta
	Ophisaurus apodus	Herpestes javanicus
	Platyceps najadum	Herpestes javanicus
	Podarcis melisellensis	Herpestes javanicus
	Podarcis siculus	Herpestes javanicus
	Podarcis taurica	Asclepias syriaca
	Telescopus fallax	Herpestes javanicus
	Vipera ammodytes	Herpestes javanicus
	Vipera ursinii rakosiensis	Asclepias syriaca
	Zamenis situla	Herpestes javanicus
Vascular plants	Angelica palustris	Heracleum sosnowskyi
	Colchicum arenarium	Asclepias syriaca
	Crambe tataria	Asclepias syriaca
	Dianthus diutinus	Asclepias syriaca
	Iris aphylla subsp. hungarica	Asclepias syriaca
	Iris humilis subsp. arenaria	Asclepias syriaca
	Lycopodium spp.	Impatiens glandulifera
	Pulsatilla grandis	Asclepias syriaca
	Pulsatilla patens	Asclepias syriaca
	Pulsatilla pratensis subsp. hungarica	Asclepias syriaca
	Thlaspi jankae	Asclepias syriaca

Annex 5 Other IAS mentioned as causing high ranking pressure on target habitats and species of the Habitats Directive

Other Ias Speciesname	Featuretype	Featurename
Abies sp.	Habitat	Old sessile oak woods with Ilex and Blechnum in the British Isles
Abutilon theophrasti	Habitat	Olea and Ceratonia forests
Acer pseudoplatanus	Habitat	Alluvial forests with Alnus glutinosa and Fraxinus excelsior (Alno-Padion, Alnion incanae, Salicion albae)
		Old sessile oak woods with Ilex and Blechnum in the British Isles
		Taxus baccata woods of the British Isles
Achondrostoma arcasii	Species	Parachondrostoma arrigonis
Acipenser baerii	Species	Acipenser ruthenus
Aesculus hippocastanum	Habitat	Alluvial forests with Alnus glutinosa and Fraxinus excelsior (Alno-Padion, Alnion incanae, Salicion albae)
Agave americana	Habitat	Olea and Ceratonia forests
Alburnus alburnus	Species	Alosa alosa
		Alosa fallax
		Anaecypris hispanica
		Parachondrostoma arrigonis
		Parachondrostoma turiense
		Unio tumidiformis
Ameiurus melas	Species	Achondrostoma arcasii
		Alosa alosa
		Alosa fallax
		Anaecypris hispanica
		Cobitis calderoni
		Cobitis paludica
		Cottus aturi
		Cottus hispaniolensis
		Iberochondrostoma lemmingii
		Iberochondrostoma oretanum
		Iberocypris palaciosi
		Luciobarbus comizo
		Luciobarbus graellsii
		Luciobarbus guiraonis
		Luciobarbus microcephalus
		Luciobarbus sclateri
		Margaritifera auricularia
		Margaritifera margaritifera
		Parachondrostoma miegii
		Pseudochondrostoma duriense
		Pseudochondrostoma polylepis

		Pseudochondrostoma willkommii
		Squalius alburnoides
Araujia sericifera	Habitat	Olea and Ceratonia forests
Arundo donax	Habitat	Arborescent matorral with Laurus nobilis
		Olea and Ceratonia forests
	Species	Unio tumidiformis
Batrachochytrium dendrobatidis	Species	Alytes muletensis
Campylopus introflexus	Habitat	Dry sand heaths with Calluna and Genista
		Inland dunes with open Corynephorus and Agrostis grasslands
Castor canadensis	Species	Castor fiber
Clematis vitalba	Habitat	Taxus baccata woods of the British Isles
Corbicula fluminea	Species	Coregonus pollan
		Margaritifera auricularia
		Margaritifera margaritifera
		Unio ravoisieri
		Unio tumidiformis
Crassula helmsii	Habitat	Humid dune slacks
		Oligotrophic waters containing very few minerals of sandy plains (Littorelletalia uniflorae)
Cyprinus carpio	Species	Achondrostoma arcasii
		Alosa alosa
		Alosa fallax
		Aphanius iberus
		Cobitis calderoni
		Cobitis paludica
		Cottus aturi
		Cottus hispaniolensis
		Margaritifera auricularia
		Margaritifera margaritifera
		Parachondrostoma arrigonis
		Parachondrostoma turiense
		Unio ravoisieri
		Valencia hispanica
Dreissena polymorpha	Species	Margaritifera auricularia
		Margaritifera margaritifera
		Unio ravoisieri
Esox lucius	Species	Achondrostoma arcasii
		Cobitis calderoni
		Cobitis paludica
		Cottus aturi
		Cottus hispaniolensis
		Iberochondrostoma lemmingii
		Iberochondrostoma oretanum
		Iberocypris palaciosi

		Luciobarbus comizo
		Luciobarbus graellsii
		Luciobarbus guiraonis
		Luciobarbus microcephalus
		Luciobarbus sclateri
		Parachondrostoma arrigonis
		Parachondrostoma miegii
		Parachondrostoma turiense
		Pseudochondrostoma duriense
		Pseudochondrostoma polylepis
		Pseudochondrostoma willkommii
		Squalius alburnoides
Fagus sylvatica	Habitat	Alluvial forests with Alnus glutinosa and Fraxinus excelsior (Alno-Padion, Alnion incanae, Salicion albae)
		Old sessile oak woods with Ilex and Blechnum in the British Isles
		Taxus baccata woods of the British Isles
Fundulus heteroclitus	Species	Aphanius baeticus
		Aphanius iberus
Gambusia holbrooki	Species	Achondrostoma arcasii
		Aphanius baeticus
		Aphanius iberus
		Cobitis calderoni
		Cobitis paludica
		Cottus aturi
		Cottus hispaniolensis
		Luciobarbus comizo
		Luciobarbus graellsii
		Luciobarbus guiraonis
		Parachondrostoma arrigonis
		Rutilus prespensis
		Valencia hispanica
Gobio lozanoi	Species	Parachondrostoma arrigonis
		Parachondrostoma turiense
Hucho hucho	Species	Achondrostoma arcasii
		Cobitis calderoni
		Cobitis paludica
		Cottus aturi
		Cottus hispaniolensis
Impatiens glandulifera	Habitat	Alluvial forests with Alnus glutinosa and Fraxinus excelsior (Alno-Padion, Alnion incanae, Salicion albae)
Ipomoea indica	Habitat	Olea and Ceratonia forests
Lepomis gibbosus	Species	Achondrostoma arcasii
		Alosa alosa
		Alosa fallax
		Anaecypris hispanica
		Aphanius baeticus

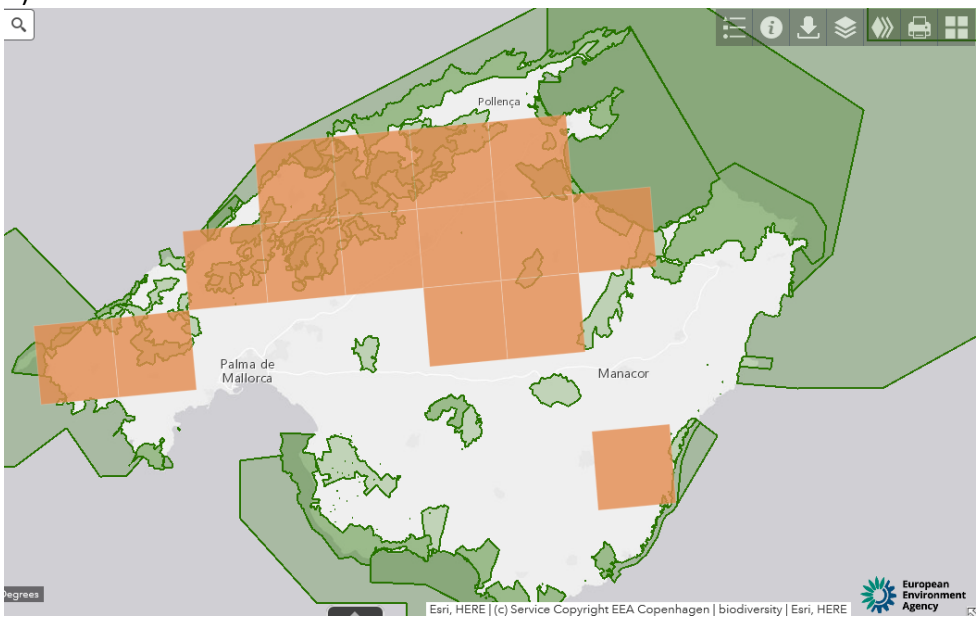
		Aphanius iberus
		Cobitis calderoni
		Cobitis paludica
		Cottus aturi
		Cottus hispaniolensis
		Iberochondrostoma lemmingii
		Iberochondrostoma oretanum
		Iberocypris palaciosi
		Luciobarbus comizo
		Luciobarbus graellsii
		Luciobarbus guiraonis
		Luciobarbus microcephalus
		Luciobarbus sclateri
		Parachondrostoma arrigonis
		Parachondrostoma miegii
		Parachondrostoma turiense
		Pseudochondrostoma duriense
		Pseudochondrostoma polylepis
		Pseudochondrostoma willkommii
		Squalius alburnoides
		Unio ravoisieri
		Unio tumidiformis
		Valencia hispanica
Micropterus salmoides	Species	Achondrostoma arcasii
		Alosa fallax
		Anaecypris hispanica
		Aphanius baeticus
		Aphanius iberus
		Cobitis calderoni
		Cobitis paludica
		Cottus aturi
		Cottus hispaniolensis
		Iberochondrostoma lemmingii
		Iberochondrostoma oretanum
		Iberocypris palaciosi
		Luciobarbus comizo
		Luciobarbus graellsii
		Luciobarbus guiraonis
		Luciobarbus microcephalus
		Luciobarbus sclateri
		Parachondrostoma arrigonis
		Parachondrostoma miegii
		Parachondrostoma turiense
		Pseudochondrostoma duriense

		Pseudochondrostoma polylepis
		Pseudochondrostoma willkommii
		Squalius alburnoides
		Unio ravoisieri
		Unio tumidiformis
		Valencia hispanica
Misgurnus anquillicaudatus	Species	Misgurnus fossilis
Natrix maura	Species	Alytes muletensis
Oncorhynchus mykiss	Species	Achondrostoma arcasii
		Cobitis calderoni
		Cobitis paludica
		Cottus aturi
		Cottus hispaniolensis
		Salmo pelagonicus
Opuntia maxima	Habitat	Olea and Ceratonia forests
Oryctolagus cuniculus	Species	Cheirolophus junonianus
Oxalis pes-caprae	Habitat	Arborescent matorral with Laurus nobilis
		Olea and Ceratonia forests
Pangasius hypophthalmus	Species	Unio tumidiformis
Picea sitchensis	Habitat	Old sessile oak woods with Ilex and Blechnum in the British Isles
Pittosporum tobira	Habitat	Olea and Ceratonia forests
Prunus laurocerasus	Habitat	Taxus baccata woods of the British Isles
Prunus serotina	Habitat	Old acidophilous oak woods with Quercus robur on sandy plains
Pseudochondrostoma polylepis	Species	Parachondrostoma arrigonis
Psittacula krameri	Species	Nyctalus lasiopterus
Rhododendron ponticum	Habitat	Old sessile oak woods with Ilex and Blechnum in the British Isles
Ribes sp.	Habitat	Alluvial forests with Alnus glutinosa and Fraxinus excelsior (Alno-Padion, Alnion incanae, Salicion albae)
Salmo trutta	Species	Salmo pelagonicus
Sander lucioperca	Species	Luciobarbus microcephalus
		Luciobarbus sclateri
		Parachondrostoma arrigonis
Silurus glanis	Species	Achondrostoma arcasii
		Acipenser naccarii
		Alosa alosa
		Alosa fallax
		Cobitis calderoni
		Cobitis paludica
		Cottus aturi
		Cottus hispaniolensis
		Margaritifera auricularia
Sinanodonta woodiana	Species	Unio ravoisieri
Solidago canadensis	Habitat	Hydrophilous tall herb fringe communities of plains and of the montane to alpine levels

Stizostedion lucioperca	Species	Iberochondrostoma lemmingii
		Iberochondrostoma oretanum
		Iberocypris palaciosi
		Parachondrostoma miegii
		Pseudochondrostoma duriense
		Pseudochondrostoma polylepis
		Pseudochondrostoma willkommii
		Squalius alburnoides

Annex 6 Distribution of Nasua nasua and location of Natura 2000 sites

A)



B) Area of Natura 2000 sites covered by the distribution grids (10x10 km) of *Nasua nasua*

EASINcode	CellCode	N2k polygon area [km2] inside the cell	Threshold 10 %	Threshold 50 %	Threshold 90 %
R09857	10 kmE366N186	31	31		
	10 kmE367N186	22	22		
	10 kmE368N187	37	37		
	10 kmE369N187	53	53	53	
	10 kmE369N188	52	52	52	
	10 kmE370N187	23	23		
	10 kmE370N188	72	72	72	
	10 kmE371N186	0			
	10 kmE371N187	0			
	10 kmE371N188	50	50	50	
	10 kmE372N186	1			
	10 kmE372N187	1			
	10 kmE372N188	29	29		
	10 kmE373N184	2			
	10 kmE373N187	37	37		
Grand Total		**411**	**407**	**227**	**0**

C) Results of choosing different thresholds for the coverage of distribution grids

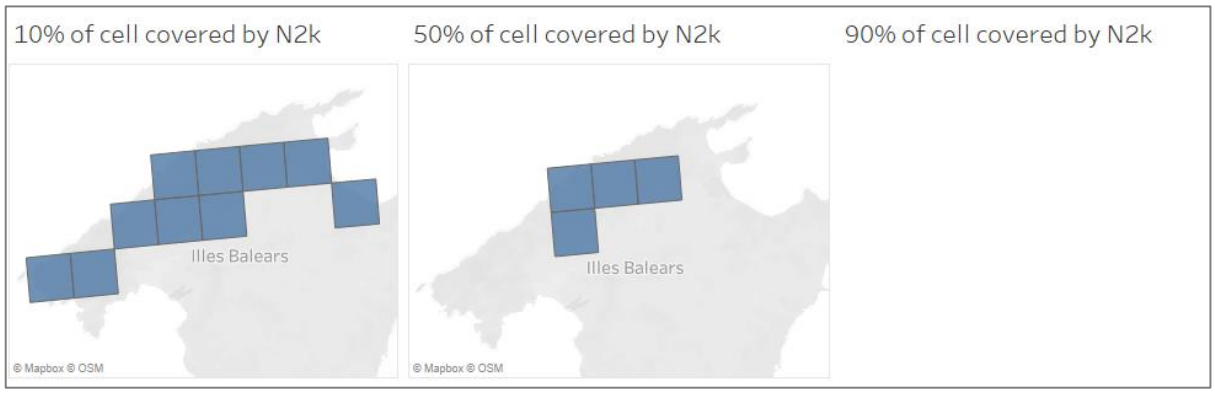


Figure A) shows the distribution of *Nasua nasua* (orange grid cells 10x10 km) and the distribution of Natura 2000 sites (green polygons). In order to build statistics on the coverage of the Natura 2000 network with the distribution of IAS of Union concern on the European level 3 thresholds have been tested: 10 %, 50 % and 90 % coverage. A threshold of 50 % means that a grid cell with the distribution of an IAS of Union concern is at least to 50 % covered by Natura 2000 sites. Figure B) shows the area of Natura2000 sites that is within a specific grid cell and for each of the 3 thresholds the grids cells that would be used for the statistic. These grid cells are shown in figure C). 5 grid cells are covered with less than 10 % Natura 2000 sites

The choice of the optimum threshold depends on the mobility of the IAS.