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DRAFT

**ASSESSMENT OF EXISTING LISTS OF INVASIVE
ALIEN SPECIES FOR EUROPE,
WITH PARTICULAR FOCUS ON SPECIES ENTERING
EUROPE THROUGH TRADE, AND PROPOSED
RESPONSES**

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INTRODUCTION

The number of unwanted alien species invading Europe is dramatically increasing, and scientifically documented clues of their ecological, economic and health impacts are being collected. For this reason European member states and institutions are urgently requested to develop effective policies based on sound stringent rules to prevent further unwanted introductions and, when feasible and appropriate, to manage the impact of those species already established.

Several international and regional provisions and recommendations underline the pivotal role of trade regulations for preventing biological invasions of alien species, based on a system of lists of unwanted, authorised, and un-screened species.

The European Strategy on Invasive Alien Species, adopted by the Standing Committee of the Bern convention with recommendation n. 99/2003, calls Member States to prevent the introduction of invasive alien species (IAS) in Europe through a coordinate framework of legal and management measures, including measures for the regulation of trade and possession of alien species, based on an authorisation system. The authorisation process shall take into account the mandatory rules of those agreements related to the European Community free-market policy and to the WTO provisions, according to which any trade restriction must be justified by a case by case evaluation, based on a objective risk analysis.

The Convention on Biological Diversity (CBD) imposes to Parties to ‘prevent the introduction of, control or eradicate those alien species which threaten ecosystems, habitats or species’ (art. 8(h)), preventing, as a matter of priority, the introduction of invasive or potentially invasive alien species into the region.

A report produced in 2006 by the Institute for European Environmental Policy for the European Commission on European policies on alien species (IEEP 2006), recommends to consider producing a “black list” of species prohibited for import into the Community, giving priority to those species which carry a high risk of being invasive and which might cause a negative impacts on the conservation of regional biodiversity.

An overview of the existing international/regional mechanisms to ban or restrict trade in potentially invasive alien species in Europe (Shine 2006) concluded that a robust level of protection consistent with WTO rules (i.e. SPS standards), based on regional risk assessment, is needed.

In order to substantially reduce the impact on European biodiversity, the European Union approved in 2006 a policy document (Biodiversity Communication (COM(2006)216): http://ec.europa.eu/environment/nature/biodiversity/current_biodiversity_policy/biodiversity_com_2006/index_en.htm) that underlines as “invasive alien species were identified in the 6th EAP as a priority for action”. The document also states that “while support has been given to some localised eradication programmes via LIFE funding [see Scalera and Zaghi 2004], the Community has still to develop a comprehensive strategy to address this issue”. A specific objective of such strategy should be “to substantially reduce the impact on EU biodiversity of invasive alien species and alien genotypes”. The document states that “various measures for the prevention and control of invasive alien species are in place but some policy gaps may remain; a comprehensive EU strategy should be developed for this purpose as well as specific actions including an early warning system”.

In regard to the above considerations, the objectives of this report are to: 1) review and collate existing lists of known IAS for Europe, 2) analyse the role of trade in the introduction of the IAS included in the existing lists, 3) review gaps and potentialities of the existing IAS listing systems for Europe, 4) propose recommendations for a more effective response by European Institutions and States in regard to trade regulations based on a listing system.

This draft presents a preliminary overview of the points listed above, providing an overview of the existing lists and a preliminary analysis of the role of trade in the introduction of the IAS included in such lists. The first part of the work has been devoted to collate the available lists of species, to associate each species to the main category of trade that is considered to be related to its introduction, and to identify major patterns of trade related invasions. A more comprehensive discussion of the issue and more specific recommendations to European States and Institutions will be produced on the basis

of the conclusions of the workshop that will be held next May 21-26 in Iceland, and will be included in the final version of the report, to be released by next September 2007.

Legal aspects of trade regulations with respect to biological invasions have already been comprehensively addressed by other recent reports (i.e. IEEP 2006, Shine 2006) and thus the present report will specifically focus on the role of trade in the patterns of invasions.

I. ROLE OF TRADE IN THE INTRODUCTION OF INVASIVE ALIEN SPECIES

An alien species is defined as a species, subspecies or lower *taxon*, introduced outside its natural past or present distribution by human agency, either directly or indirectly (for a review see Genovesi and Shine 2004). This definition thus implies an active movement by humans, and covers both intentional and unintentional movements of species. Transport can in fact be voluntary— as in the case of species traded for forestry, agriculture, or angling – and accidental, as in the case of hitchhikers or species transported through ballast water.

A synthesis of the different known pathways is reported in figure 1 (source: Lodge et al. 2006), where it is evident the role of different types of commerce in the movement of alien species worldwide. There is in fact a very array of trade related activities that to cause the movement of species, ranging from the direct trade of live animals and plants as food, to the movement of marine and freshwater species for aquaculture, to the commerce of pet and horticultural species, to the movement of species for research, fur farming, hunting, angling, etc.

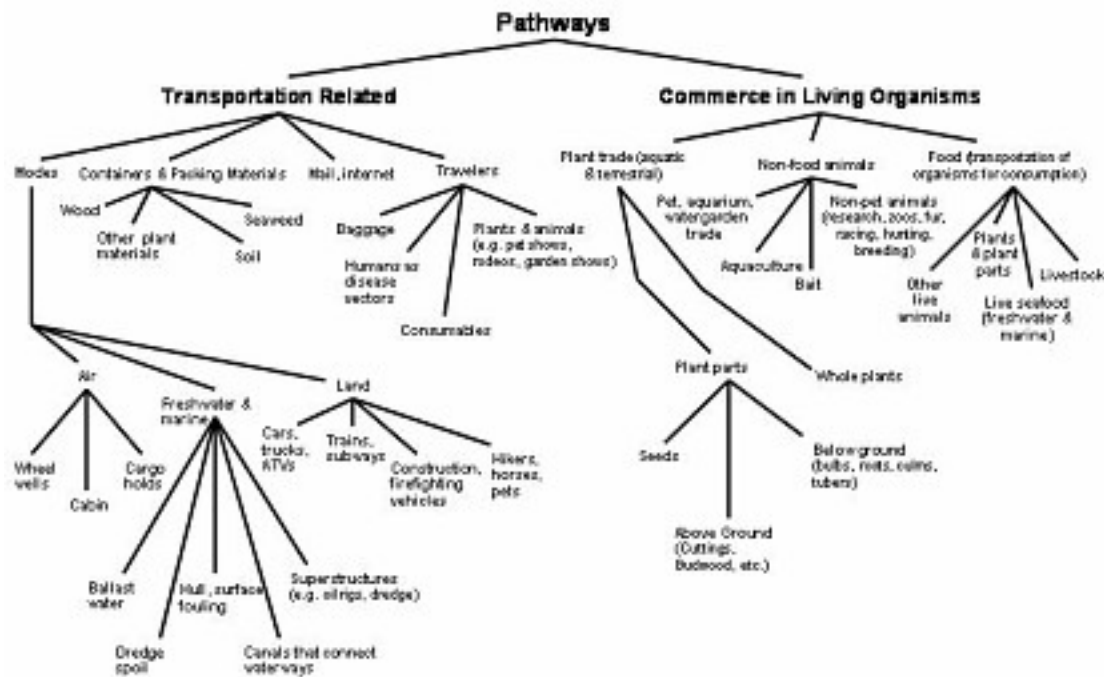


Figure 1. Pathways of introduction of alien species (from Lodge et al 2006)

An aspect that makes the role of commerce particularly critical with regard to biological invasions, is that regulation of trade may contradict the free trade policy that is the fundament of the World Trade Organisation and of the European Community treaty (IEEP 2006, Shine 2006). Therefore, from the one hand any prevention policy based on trade regulations has to address the compatibility with the general free trade policies, and on the other hand regional and national institutions may be reluctant to introduce bans or regulation, because of the prevalent importance given to free trade in respect to nature protection (Genovesi 2007).

II. POLICIES AND TRADE REGULATIONS WITH REGARD TO ALIEN SPECIES MOVEMENTS

1. European scale

Trade rules with relevant provisions in regard to IAS are active both at the regional (i.e. European Union) and the national scale (in particular for non-EU Member States).

In 2006 the Institute for European Environmental Policy published a report reviewing European Community policies on alien species. In regard to legal restrictions to trade, the report concluded that, at the EU scale, some legislation regulating the imports and exports of potential IAS into and out of the European Community is already established and enforced. The sectors somehow covered are those related to wildlife protection and to the spread of plants' pests, animal pathogens, and genetically modified organisms. According to IEEP (2006) and Shine (2006), the European Community legislation does not cover issues related to the introduction of other groups of species. For instance, with the exception of four species listed under the Wildlife Trade Regulations (see Scalera, in press), no European legislation covers the movement of non-genetically modified animals and plants, as well as potential alien invertebrates that fall outside the definition of 'harmful organism' given in the plant health Directive 2000/29/EC.

2. National scale

At the State level, the framework of IAS trade restrictions is largely different and partly incoherent among countries. Several states have in fact established bans of import of some species or groups (i.e. alien crayfishes in Sweden), or have legal tools imposing general prohibitions of import for certain species or groups of species, but with a very variable level of enforcement (Shine 2006) and in many cases with purposes not explicitly directed to prevent the unwanted introduction of IAS. IEEP (2006) summarised the following gaps in the national trade rules with regard to alien species in EU member states:

- restrictions on possession and trade in known or potential IAS do not exist in all Member States;
- where restrictions do exist, they vary widely in terms of scope and purpose, e.g. taxonomic groups affected, scientific analysis undertaken, scale of implementation, etc;
- there are no mechanisms in place to support harmonisation or basic consistency of approach between neighbouring countries or countries in the same sub-region;
- fragmented measures of this kind are unlikely to make a substantial contribution to lowering the risks posed by IAS to European ecosystems;
- the limited ECJ case law so far does not provide individual MS with full legal certainty about the kinds of IAS possession/domestic trade/internal movement restrictions that are compatible with EU laws;
- the measures that are already in place in some MS are not sufficient in their current form to provide a foundation for wider application as part of a future EU framework on IAS, although there is some good practice occurring.

In order to regulate trade of IAS, it is critical to develop reference lists. The European Strategy in Invasive Alien Species calls for the establishment of a policy where any proposed introduction is assessed through a comprehensive screening system based on risk analysis, and introduction is allowed only for species unlikely to threaten biodiversity. For this aim, the Strategy underlines the need to work towards a regional or subregional species listing system consistent with European and international law.

Such listing system should include a list of species whose introduction is strictly regulated (black list), a list of species classified as low risk whose introduction may be authorised without restriction or under conditions (white list), and - lastly - a list including any species not included in the black or white lists, or which is data-deficient, that should therefore be subject to risk assessment prior to a decision on authorisation is taken.

Such approach requires the developments of lists based on a risk assessment, with particular reference to alien species known as invasive or potentially invasive, to be included in the black list. In regard to this need, in the following pages we synthesise the availability of lists of known IAS in Europe and compare the criteria and contents of these lists.

III. EXISTING LISTS OF KNOWN INVASIVE ALIEN SPECIES IN EUROPE

Several European institutions and organisms have produced lists of alien species causing impacts on health, economic activities and biological diversity. Following we provide a synthesis of the existing lists, with a description of major features in term of aims, legal power, criteria for inclusion, geographical scope, and taxonomic coverage.

1. EPPO

EPPO is a European intergovernmental organization with 48 member States, aimed at protecting plants, developing international strategies against the introduction and spread of dangerous pests and promoting safe and effective control methods.

Aims: to prevent impacts on plant health, environment and biodiversity in the EPPO region.

Geographical scope: EPPO region covers all Europe, Israel, Turkey, several countries of Eastern Europe, including Russia, and some countries of North Africa. Two lists of species have been developed: the A1 includes species which are not yet present in the EPPO region, while the A2 includes species already present in the EPPO region.

Taxonomic scope: EPPO activities focus on cultivated and non cultivated plants. Listing systems cover a wide range of plant pests, parasites and pathogens, among which several invertebrates, virus and fungi.

Legal power: EPPO is an inter-governative body, producing non-binding recommendations to its 48 Member States. The A1 and A2 lists have been formally approved by EPPO Council in September 2006. EPPO recommends its member countries to regulate the pests listed in A1 and A2 as quarantine pests. Beside the A1 and A2 lists, EPPO also developed a specific list of invasive alien plants for which States are requested to take measures to prevent their introduction and spread or to manage unwanted populations (for example with publicity, restrictions on sale and planting, controls).

Criteria: species included in A1 and A2 lists are pests presenting risks and for which phytosanitary measures should be taken. Inclusion in EPPO lists - at least in the last years - is based on transparent Standards on Pest Risk Analysis. The prioritization procedure for the realisation of the list of invasive alien plants is based on several factors including: plant/agent considered invasive or potentially invasive; plant/agent absent from Europe or still containable; potential for spread and damage; reported to be actively spreading or increasing impacts.

Number of species included in list: EPPO A1 list comprises 181 species; A2 list: 120 species; list of invasive alien plants: 44 species.

2. EEA/SEBI 2010 List of worst invasive alien species

SEBI2010 is a Pan European initiative launched by the EEA in 2004, aimed at compiling a set of biodiversity indicators to assess and inform about progress towards the European 2010 targets. Indicators cover several aspects, and include a specific set on invasive alien species.

Aims: to contribute to the general indicator *Trends in invasive alien species* - and to the indicator *Cumulative numbers of alien species in Europe since 1900* - by distinguishing a number of most harmful IAS in Europe with respect to their changing abundance or range and their impacts upon European biodiversity.

Geographical scope: Europe

Taxonomic scope: SEBI deals with most harmful IAS in all environments and taxonomic groups. It should be interpreted as an information tool and a basis for indicators to assess trends in relation to the 2010 target, but it is not an inventory of IAS in Europe.

Criteria: selection is based on experts opinions, and not on a formal Risk Analysis. Species are selected based on recognition of causing impact on biological diversity of Europe. Impacts are evaluated by different criteria, including: severe impacts on ecosystem structure and function; replacement of native species throughout its range; hybridization with native species; posing threats to unique biodiversity; species having - in addition to its impact on biodiversity - negative consequences for human activities, health and/or economic interests (e.g. is a pest, pathogen or a vector of disease).

Number of species included in list: EEA/SEBI2010 list of worst invasive alien species comprises 168 species.

3. NOBANIS Fact sheets on Invasive Alien Species

NOBANIS is a network for cooperation between competent authorities of the Baltic region in the field of IAS. One of the products of NOBANIS is a database of alien species, identifying actual and potential invasive ones. For invasive species identified as most invasive, fact sheets are produced, providing key information on distribution and recommended preventive, eradication and control measures.

Aims: NOBANIS is aimed at providing tools for preventing the unintentional dispersal of invasive alien species, and promoting regional cooperation for the eradication, control and mitigation of ecological effects of IAS.

Geographical scope: countries participating to NOBANIS are Denmark, Estonia, Finland, Faroe Islands, Germany, Greenland, Iceland, Latvia, Lithuania, Norway, Poland, Sweden and the European part of Russia.

Taxonomic coverage: worst invasive species include some of the IAS of the Baltic region, including both animals and plants as well as micro-organisms.

Criteria: Worst IAS are defined on the basis of experts' opinion, and the fact sheets are not to be regarded as a consensus list of worst invasive alien species for the region. The fact sheets fall in several categories, some can indeed be regarded as the worst invaders of the entire region, while others are only a problem in one or a few countries.

Number of species included in list: NOBANIS fact sheets of IAS comprise so far 48 species; 12 will be added in the future.

4. DAISIE

DAISIE (www.europe-aliens.org) is a three year project supported by the European Commission under the Sixth Framework Programme that aims to create an inventory of all alien species present in Europe, with particular reference to the invasive species that threaten European terrestrial, fresh-water and marine environments. DAISIE is a consortium that comprises an outstanding team of partners from 15 nations and collaborators from an additional 9 countries. Among the deliverables of the project, one is a list of 100 of the worst IAS in Europe.

Aims: to undertake an inventory of all terrestrial, freshwater and marine *taxa* known to be invasive in Europe, based on common definitions and criteria, and present the distribution of known invasions graphically.

Geographical scope: all Europe, including Israel and European Russia.

Taxonomic coverage: all taxonomic groups, including viruses.

Criteria: the "100 of the worst IAS of Europe" has been identified by DAISIE experts. Main criteria for inclusion in the list is the known impact to biodiversity, based on published evidences. In establishing the list, DAISIE experts also tried to provide example among the different taxonomic groups and environments. The DAISIE list excludes species native in some part of Europe, and domestic forms.

Number of species included in list: DAISIE List of 100 among the worst IAS in Europe comprises 100 species in all taxonomic groups.

5. EU Wildlife Trade Regulation (WTR)

Wildlife Trade Regulation is aimed at implementing the Washington Convention on International trade in endangered species of wild fauna and flora (also known as CITES) within the EU.

Aims: Wildlife trade regulations deal with imports and exports of wildlife and wildlife products to and from the EU, as well as trade between and within individual Member States. All CITES provisions are incorporated in these regulations, in addition to other measures in order to be coherent with the overall EU nature conservation policy.

Geographical scope: all 25 EU Member States.

Taxonomic coverage: potentially all *taxa*.

Criteria: According to Article 9(6) of Council Regulation (EC) No 338/97: the Commission may establish restrictions on the import of “live specimens of species for which it has been established that their introduction into the natural environment of the Community present an ecological threat to wild species of fauna and flora indigenous to the Community”. Such restrictions are adopted in consultation with the countries of origin concerned, taking account of the views of the Scientific Review Group (SRG). The SRG consists of representatives of each Member State and is chaired by a representative of the Commission. Proposals for listing may be raised by the chairman or any SRG member (see also European Commission, 2003).

Number of species included in list: Reg. (EC) n. 338/97 (as amended) comprises only 4 species of vertebrates (see Community Regulation (EC) No 252/2005 suspending the introduction into the Community of specimens of certain species of wild fauna and flora).

IV.A “METALIST” OF INVASIVE ALIEN SPECIES IN EUROPE

1. Materials and Methods

Data on the different lists were excerpted from websites, published reports and through direct contacts with database managers. All collected data have been collated in a single, cumulative list (hereafter called “metalist”). In the metalist, we included information on the lists where each species (or group of species) is included.

The cumulative list of the European worst lists so far available includes 515 taxa (mostly at the species level) listed in the 6 European “worst lists” described above (see Annex I).

The following 24 taxonomic groups are considered within the lists (in alphabetical order): amphibians and reptiles, annelids, ascidians and sessile tunicates, birds, bryophytes, bryozoans, cestoda, comb jellies, crustaceans, fish, flatworms, fungi, hydroids, jellyfish, sea anemones and corals, insect, macroalgae, mammals, molluscs, nematodes, phytoplankton, plants, prokaryotes, protists, protozoa, viruses.

As shown in the graphic below, insects are the most represented *taxa* (28% of total), followed by plants (14%) and fungi (13%). This clearly reflects the considerable effort to list invasive species made by EPPO for the purpose of protecting plant health. On the other hand bryophytes, protists and cestoda are represented by just one single species each, confirming the limited attention given to these *taxa* by most tools and initiatives. Vertebrates (including mammals, birds, amphibians and reptiles, and fish) account for 10% of total number of *taxa*.

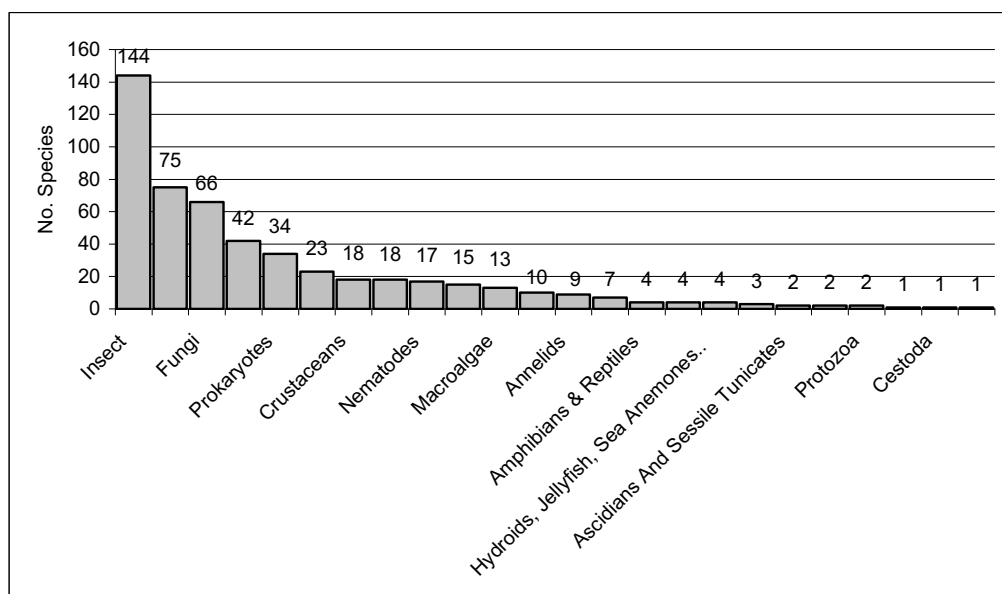


Figure 2. Taxa covered by the existing lists of known invasive alien species for Europe

Of the 515 included in the metalist, 79% (corresponding to 406 species) is included in only one of the 6 lists considered in this work, while not a single species is present in more than 4 lists. This pattern reflects the major contribution given by the lists developed by EPPO, and the fact that such species are considered harmful only relatively to plant health and thus are not covered by the other lists. However, also excluding the 3 EPPO lists from this analysis, over half (60%) of the 177 species included in one of the three other lists are not included in any other list. Of the total 512 species included in at least one of the existing lists, 72 (14%) are covered by 2 lists, 32 (6%) by 3 lists, and only 5 species (1%) are considered in 4 lists out of the 6 considered in this analysis. These are 4 plants (*Crassula helmsii*, *Impatiens glandulifera*, *Prunus serotina*, and the group *Fallopia japonica*, *F. sachalinensis*, *Fallopia x bohemica*) and one reptile (*Trachemys scripta elegans*).

This limited overlap partly reflects the different criteria used for producing the different lists considered for the analysis, but indeed also shows the limited completeness of the overall set of available lists in Europe.

5. CLASSIFICATION OF SPECIES INCLUDED IN THE METALIST WITH REGARD TO TRADE

With the aim of analysing the influence of trade in the presence of known IAS for Europe, with the support of leading experts in the different groups we classified all species in regard to the known pathway of introduction into the region.

The classification was based on several categories, developed also on the basis of comments received from several experts. We identified the following four categories:

- A) the alien species is intentionally introduced, as the commodity itself, for being released into the environment (i.e. game species, freshwater fishes, tree species of interest for forestry, biocontrol agents, etc.)
- B) the alien species is intentionally introduced as the commodity itself (i.e. ornamental plants, agricultural plants, pets, crayfishes, etc.) in a containment facility or in a controlled environment (i.e. botanic gardens, greenhouses, agricultural land, zoos, animal-breeding establishments, fish farms, etc.).
- C) the alien species is unintentionally introduced as a contaminant of a specific commodity (i.e. *Anoplophora chinensis* introduced in Italy through import of bonsai; parasites of specific fishes species, fruit flies, microcell disease *Bonamia ostreae* transported with oyster shipments, etc)

- D) the alien species is unintentionally introduced with movements of people or of machinery (i.e. pests in wood packaging, hull fouling, ballast waters, contaminants in containers, hitchhikers on planes, etc.).

Considering the specific purposes of this report, we excluded from our classification species entering into a country through natural dispersal from a neighbouring country.

1. Causes of introduction

On the basis of information collected on literature and provided by contacted experts, 67.9 % of the 515 species included in the metalist (corresponding to 355 *taxa*) were assigned a category. The species not yet associated to a trade category (either because they did not enter Europe by means of trade related activities, or because we did not manage to get exhaustive information) have not been considered within the analysis. In the following table we summarize all data concerning the *taxa* associated to a trade category are summarised:

Taxa	No. Species	No. Species associated	A	B	C	D
Insect	144	144	1		134	32
Plants	75	75	38	9	31	21
Fungi	66	6			5	1
Viruses	42					
Prokaryotes	34					
Fish	23	23	13	3	1	11
Crustaceans	18	18	8	5		11
Molluscs	18	18	7	5	6	10
Nematodes	17	17			13	12
Mammals	15	15	5	9		1
Macroalgae	13	5	1		1	4
Phytoplankton	10	8				8
Annelids	9	9			1	8
Birds	7	7	1	6		
Amphibians & Reptiles	4	4	1	3		
Flatworms	4					
Hydroids, Jellyfish, Sea Anemones & Corals	4	3				3
Comb Jellies	3	1				1
Ascidians And Sessile Tunicates	2	1				1
Bryozoans	2					
Protozoa	2					
Bryophytes	1					
Cestoda	1					
Protists	1	1			1	

In particular, the groups for which we collected limited information are the following: are the following: ascidians and sessile tunicates, comb jellies, fungi, hydroids, jellyfish, sea anemones & corals, macroalgae, phytoplankton. Viruses were excluded from the analysis (44 *taxa*), as well as bryophytes, bryozoans, cestoda, flatworms, prokaryotes and protozoa. Two *taxa* included in the metalist are native, and were thus not considered for the analysis.

In general, of the 355 species covered by this analysis, 89.8% (319 *taxa*) was associated to a single category, while the rest were assigned to 2 or more categories (thus sum of percentages can be over 100).

On the total of the species, 19.6% were introduced intentionally (categories A, B: 101 *taxa*) and - of these – a large proportion (75 *taxa*) were predominantly introduced through trade for being released into the environment (cat A). It should be noted that species classified as A include IAS causing major impacts in Europe, as for example the American bullfrog (*Rana catesbeiana*), the American beaver (*Castor canadensis*), the Sika deer (*Cervus nippon*), the alien crayfish *Pacifastacus leniusculus*, the mosquitofish (*Gambusia affinis*), or several particularly invasive plants as the giant hogweed (*Heracleum mangenzianum*), the Japanese knotweed (*Fallopia japonica*) or the tree of heaven (*Ailanthus altissima*). It is thus evident that effective trade regulation of such species would have prevented a significant proportion of the biological invasions affecting our region.

About 40 species have been introduced into Europe through trade for being held in some form of containment facilities or controlled environment (cat B), and then managed to establish invasive population into the wild. These include several pet species - as the American grey squirrel (*Sciurus carolinensis*), the Ruddy duck (*Oxyura jamaicensis*) and the red eared terrapin (*Trachemys scripta elegans*). These examples highlight that effective trade regulation of species, imposing measures for preventing release escape into the wild (i.e. sterilisation of traded animals, control of containment facilities, polluter pays principles, etc) would have prevented many severe impacts on European biodiversity.

Category C and D (species introduced unintentionally) account for 52% of all known IAS of Europe (268 species; 58.2%). It should also be noted that most unclassified species are likely to have been introduced unintentionally. Known cases of unintentional introductions occurred through activities related to trade (cat C; 193 species) include species whose arrival would have been prevented by regulating some specific trade activities (i.e. citrus longhorned beetle *Aplophora chinensis* introduced into Italy through import of ornamental bonsai species).

In the case of “hitchhikers” or species transported as “stowaway” within the movement of people and goods (cat D: 122 species), prevention would have required effective interception measures (i.e. treatments of ballast water, application of anti-fouling systems, regulation of movement of soils).

Species listed in category A account for 21.1% of the whole metalist. As shown in the figure 3, over 50% of species introduced intentionally as the commodity itself are plants, that are often planted intentionally into the wild for forestry, landscaping, revegetation, roadside planting, erosion control, watercourse management, etc. Other most numerous *taxa* are vertebrates (mammals, birds, amphibians, reptiles and fish, which all together account for 26%), crustaceans (11%) and molluscs (9%). Macroalgae and insects account for 1% each.

Species listed in category B account for 11.3% of the metalist. As shown in figure 4, the *taxa* listed in this category are the same of those occurring in category A, with the exception of macroalgae and insects. However, the proportion of vertebrates and plants differ significantly in the two categories. In fact, over 50% of species listed in category B are vertebrates, reflecting the high number of pet or farmed species escaped from captivity, and 22% are plants.

Category C is the most numerous of the metalist, including 54.4% of species considered in the analyses. Insects have the highest percentage (68%), followed by plants (15%) and nematodes (7%). Other groups of species included in this category are molluscs and fungi (3% each), followed by macroalgae, protist, anellids and fish (each one with 1%) (fig. 5).

Category D has been associated to 34.4% of species introductions. In this category – that covers species involuntarily introduced as “stowaway” or “hitchhikers” – nearly all *taxa* are present, and even those *taxa* that are not listed as D - like amphibians and reptiles, whose species included in the metalist are not known to have entered Europe in this way, or viruses, that were not considered in this analysis – have the potentiality to be introduced unintentionally as a consequence of the movements of people or of machinery (Fig. 6). This category includes also those species that have likely entered the Mediterranean sea by Lessepsian migration.

Figure 3 proportion of different taxonomic groups listed as category A (species introduced intentionally as the commodity itself for being released into the environment)

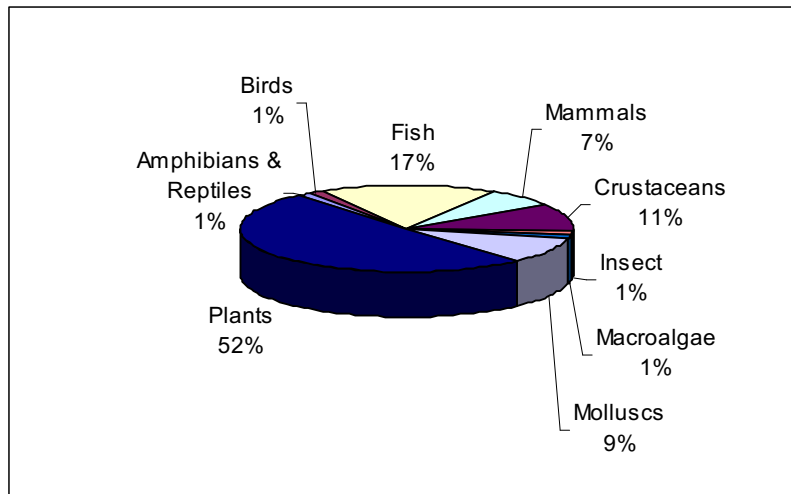


Figure 4 proportion of different taxonomic groups listed as category B (species introduced intentionally as the commodity itself for being kept in a controlled environment)

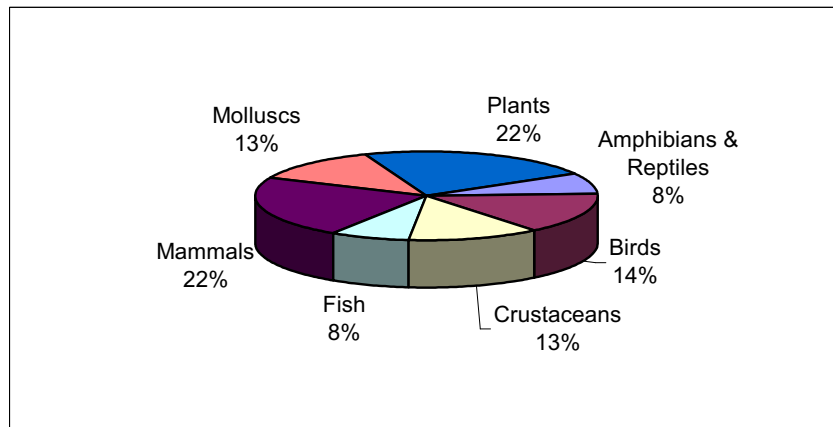


Figure 5 proportion of different taxonomic groups listed as category C (sp. unintentionally introduced as a contaminant of a specific commodity: n = 193 species)

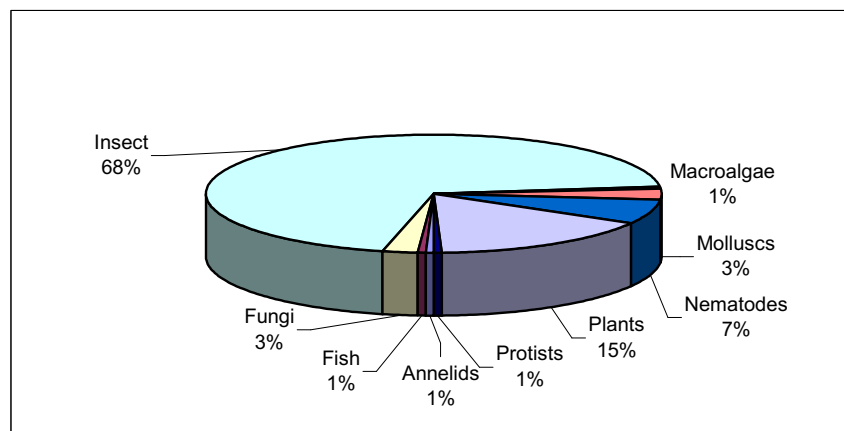
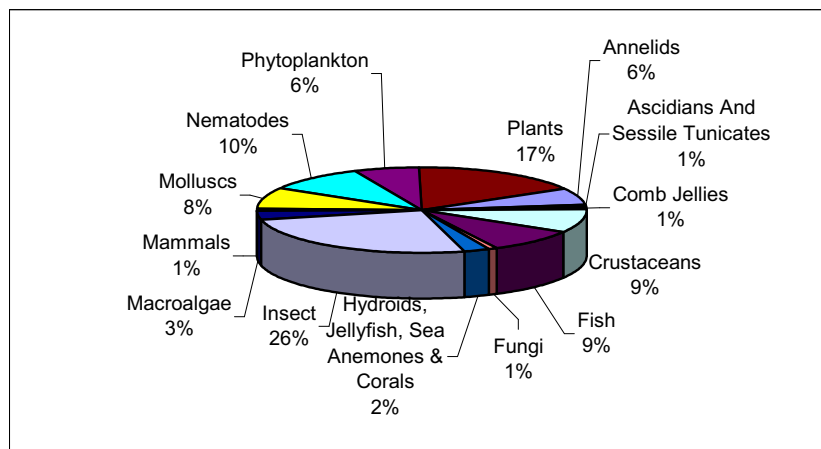


Figure 6 proportion of different taxonomic groups listed as category D (sp. unintentionally introduced with movements of people or of machinery; n = 124 species)



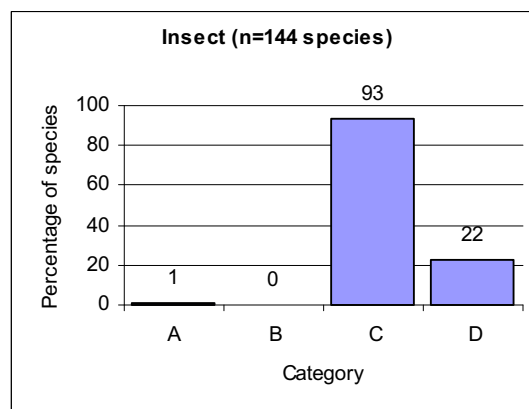
2. Analysis by taxonomic groups

We also analysed the situation for those *taxa* including more than 20 species, namely insects, plants and fish. We included in our analysis terrestrial vertebrates as a new group, including mammals, birds, amphibians and reptiles together. Fungi, viruses and prokaryotes were not considered. Note that the total sum of the percentages in the 4 columns is different from 100% because a single species might be associated to more than one category.

Insects

Actually, insects are clearly introduced mainly unintentionally, as a contaminant of a specific commodity (category C) or as “hitchhiker” (category D). A few species are also introduced purposefully for biological control of arthropod pests, like in the classical case of the multicolored Asian lady beetle *Harmonia axyridis*. A major contribution for preventing the spread of alien insects would therefore come from improving the possibility to intercept their transport with other goods (i.e. plants, food, soil, wood, etc.).

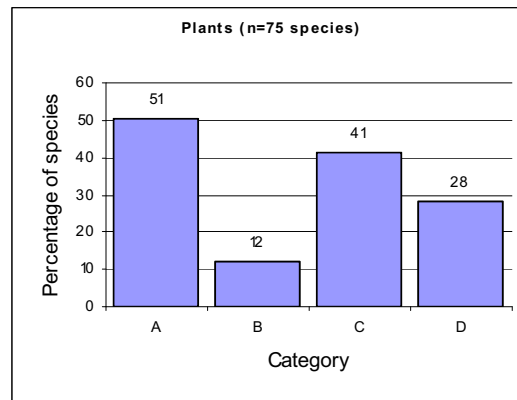
Figure 7 proportion of species in each trade category: insects



Plants

Plants are frequently introduced either intentionally or unintentionally. However, a slightly higher number (52 versus 47) is known to have entered Europe as a contaminant of a specific commodity (category C) or otherwise passively transported (category D) rather than imported as the commodity itself (category A and B).

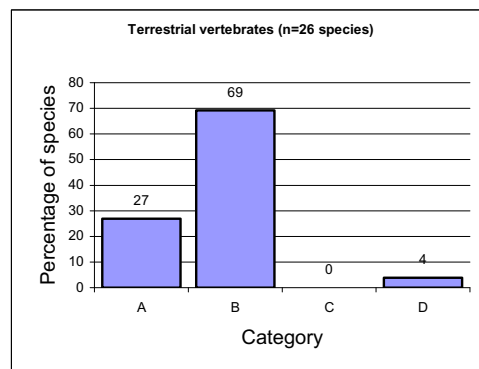
Figure 8 proportion of species in each trade category: plants



Terrestrial vertebrates

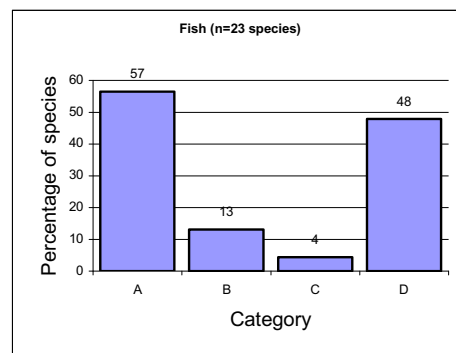
It is quite interesting to notice that most vertebrates (including mammals, birds, amphibians and reptiles) have been introduced intentionally as the commodity itself (i.e. for ornamental purpose, for hunting or fishing, for food or for the fur trade, etc.). Actually, only one species among those in the metalist, namely *Rattus norvegicus*, is known to have entered Europe as “stowaway” (category D). In this case it is therefore important to notice that a good regulation of trade and possession of those species would reduce almost totally the chance of terrestrial vertebrates to get established outside their natural range.

Figure 9 proportion of species in each trade category: terrestrial vertebrates



Fishes

Like plants, fish are known to have entered Europe either intentionally or unintentionally, in similar percentage. This distribution apparently reflects the different pathways related to introduction of two fish groups: freshwater species and marine species, the former being usually introduced intentionally as the commodity itself (category A and B), and the latter entering especially the Mediterranean sea as a consequence of Lessepsian migration (4 species) or through Gibraltar (3 species) (category D). As a consequence, although it would be quite impossible to deal with marine species, a good regulation of trade on freshwater species would give a major contribution in preventing further introduction of invasive fish.

Figure 10 proportion of species in each trade category: fishes

IV. GAPS AND LIMITS OF EXISTING EUROPEAN IAS LISTS

1. Actual lists

The existing lists of known IAS in Europe cover a large number of species in all taxonomic groups, but have major gaps that limit their use for improving responses to invasions. The different lists focus on inconsistent geographical ranges, varying from the regional scale (Nobanis), to EU (WTR), to a wider European area (EEA/SEBI) encompassing part of the Middle East (DAISIE, EPPO) and Northern Africa (EPPO).

Taxonomic scope is also very variable. Only DAISIE list tried to cover all taxonomic groups, while in other cases (i.e. WTR, NOBANIS, EEA/SEBI) there is a prevalence of vertebrates. EPPO list reflects the specific aims of the organisation related to agriculture, while in the case of the SEBI list species were selected for providing indicators of trend. In some cases the lists reflect the demonstration scope of the programmes; in fact, the lists produced within NOBANIS, DAISIE and SEBI were also aimed at providing examples of IAS in all main taxonomic groups and affecting different ecosystems, and therefore cannot be considered as a list of the most impacting species.

Despite the general gaps and limits synthesised above, it must be stressed that the lists present several common traits: for example all lists are also aimed at providing tools for response to invasions; furthermore, the lists reflect the available knowledge for Europe, and take into account the opinion of leading experts in the region.

Despite these common traits, the comparison of the lists has highlighted the limited overlap of species included in the different lists. Also in this regard, for allowing a potential use of the existing lists as a basis for a legal regulation of species it would be critical to revise the criteria adopted for developing these tools, taking into account a more solid and justified decision process for inclusion/exclusion in the lists.

2. Metalist

The metalist produced for the present report is the first attempt to collate all the existing information on known IAS in Europe, and provides a reference tool for identifying priority cases of invasions to be addressed in the region.

The metalist has several gaps and limits, partly descending from the datasets used to produce it. The merged list is nor comprehensive neither exhaustive. The geographical range of the metalist is wide, and covers all Europe, including some Mediterranean range countries. Taxonomic scope reflects the differences in the source datasets, with a prevalence of vertebrates and plant species over invertebrates. Among invertebrates, agricultural pests are more represented than species impacting biodiversity.

Furthermore, the list also reflects the different criteria used for developing the source datasets. For example, the metalist includes species causing only limited impacts (i.e. *Eutamias sibiricus*) and - on the other hand - it under-represents domestic alien species as the domestic cat (*Felis catus*), the ferret

(*Mustela furo*) or the goat (*Capra hircus*), although these are internationally considered as top invasive alien species (i.e. Lowe et al 2000).

Only a portion of the species included in the metalist has been identified through a formal risk analysis. Considering the requirements of the SPS standards under the WTO, the lack of a sound scientifically based evaluation of IAS included in the metalist, may limit the legal power of the metalist as a justification of trade regulations.

As a preliminary exercise, in order to test the comprehensiveness of the metalist, we compared this list with an independent list of known IAS for Europe, developed by the IUCN SSC Invasive Species Specialist Group for the World Bank (De Poorter and Pagad 2007). The report includes a list of species considered concern IAS in protected areas of Europe. The list combines two different dataset, both produced by questionnaires circulated by the Ramsar Convention, and the ISSG Global Invasive Species Database (GISD). Considering the different sources of information, we assumed that this list can be considered an independent dataset in respect to the metalist.

A comparison of the metalist with the list of IAS of concern for Protected Areas in Europe shows that only 50% of species included in the IAS PAs list are reported in the metalist (27 out of a total of 54), confirming the scarce comprehensiveness of the metalist.

Another consideration that raises from this comparison, is that the species shared by both the metalist and the list of species threatening protected areas in Europe (indicated with an asterisk (*) in annex I), reflect the growing concern of biological invasions in regard to protected areas. In fact, there is a large number of particularly harmful IAS that affect protected areas and require urgent responses by wildlife manager and administrations; need of response in this regard is particular relevant for the Natura 2000 network within the EU (Scalera and Zaghi 2004) as well as for the Emerald network within the Council of Europe. Species of major concern in protected areas include mostly plants (17 species), followed by mammals (4 species), fishes (3 species), crustaceans (2 species) and macroalgae (1 species).

3. The metalist as a tool for preventing biological invasions in Europe

The best predictor of a species invasiveness in a new area, is whether the species has shown invasive patterns in other areas. Therefore, the list of alien species known to cause impacts in some parts of Europe represents the best available dataset of IAS for the region, with reference to European countries not yet invaded, and it provides a summary of priority species to address by European institutions and states.

As far as trade is regarded, the metalist indeed permits to identify priority IAS for which trade regulations are needed, and also provides critical information for designing such regulations.

However, the metalist should not be considered as a complete list of IAS that should be regulated. In fact, the list has been realised by merging heterogeneous existing lists, made for different purposes than regulating trade. As an example, the metalist also includes species that have had a commercial interest in the past although they no longer have an economic value, and that are at present widespread in Europe (i.e. the coypu *Myocastor coypus*). In this case a regulation of trade would likely have a limited effect from a commercial perspective, and would unlikely contribute in preventing further spread of the species.

However, it should be noted that the metalist also includes several species that maintain a commercial value and that are still very localised, (i.e. *Callosciurus fynlaisonii*, several plant species, etc.), for which a regulation of trade would have a major prevention effect. For this reason such typology of species should be given priority for applying trade regulations.

Another aspect of particular relevance for the aims of the present report, is that, for preventing further biological invasions in Europe, priority should be given also to halting the introduction of species not yet present in the region, while the metalist is mostly composed of species already present and established in the region. For instance, a group of species which should be considered for inclusion within the metalist, is the one of the so-called “replacement species” (see Adrados and Briggs 2002). Replacement species are those *taxa* to which the market could switch its interest after having suspended/regulated trade on certain closely related species (either ecologically or

taxonomically). Adrados and Briggs (2002) emphasise the need to foresee adequate measures to control their trade once they are found to occur on the market above a recommended threshold.

In this regard, we highlight that the implementation of a comprehensive, exhaustive list of IAS or potential IAS not yet present in Europe, and whose trade should be regulated, appears an unrealistic objective. In fact, Europe is characterised by a wide variety of ecosystems and climate conditions, ranging from the arctic tundra and polar deserts to boreal forests and steppes, and from subarctic climates, to humid subtropical and semiarid ones. It is thus evident that almost any living organism in the world can potentially establish in some part of Europe, and a list of potential alien species for the region would likely include hundreds of thousands species.

To give an idea of the order of magnitude of such a list, we synthesise the preliminary results of the GRIS project. The IUCN SSC Invasive Species Specialist Group (ISSG) has been developing plans for a Global Register of Invasive Species (GRIS), aimed at producing a list of all known invasive animal species with annotations providing evidence of their invasiveness in order to support pre-import screening for proposed imports. A prototype has been compiled from multiple sources including the Global Invasive Species Database, dataset referred to 16 countries in the world, plus records from and any other authoritative databases and scientific sources that list potentially invasive or harmful animals. The resulting register includes 16,051 *taxa*, of which 1,453 have records of invasiveness and 14,121 are considered potentially invasive according to sources that have conducted risk assessments (Browne et al 2007).

In this regard, we believe that – also in accord with the recommendations of the European Strategy on IAS, a more dynamic system of lists should be established, based on a black, white and grey lists approach. The metalist developed for the present report could be the basis for developing a black list system, and can indeed provide an effective tool for prevention. The existing lists can immediately be used for defining priority species to be regulated.

However, no existing lists can be seen as a substitute of a grey list approach. Establishing a comprehensive list of all potential IAS for Europe is in fact an unrealistic objective. The metalist produced for the present report should thus be considered as a provisional black list, and in addition provides a valuable reference to discuss the priorities to be envisaged in prevention actions. Results should thus be used for improving response to invasions by regional institutions and member states.

Such an approach will require strict regulation of species already known as IAS. Any proposed introduction into Europe of alien species not yet known as IAS or low risk should be conditioned to a risk analysis, based on a case by case evaluation.

For this reason, together with a list of those IAS known to occur in Europe and to have an impact on ecosystems, economy and plant, animal and human health, an *ad hoc* metalist for regulating trade on alien species, should include also a list of potential IAS not yet known to occur in Europe. While the former list will be soon available for all *taxa* as a major output from the above mentioned DAISIE project, the latter could be developed selecting those species included in other global database (i.e. see the GRIS database developed by the ISSG). In particular, the list of potential IAS should be a dynamic tool, where species can be included on a case by case basis, following specific risk assessments. For this purpose, either for IAS actually or potentially occurring in Europe, a standardized prioritization process, taking into account the experience accumulated within other sectors (i.e. for weed management, see EPPO), should be developed in order to consider only those species not yet widespread in Europe, and which have the potential to get invasive.

Having stressed the complexity of establishing a comprehensive list of all potential IAS for Europe, the metalist produced for the present report provides a basis for identifying priorities to be envisaged in prevention actions, and the results should be used for improving response to invasions by regional institutions and member states.

VII. PRELIMINARY RECOMMENDED ACTIONS:

- 1) Promote the development of an *ad hoc* list IAS for Europe, through a Risk Assessment based on objective and scientific criteria. Such list should include all IAS already present in Europe or expected to arrive in the next future. It should give priority to species that are not yet widespread.
- 2) Consider a regional ban of trade for species classified as A category, and for which trade is still an actual and direct pathway of introduction.
- 3) Consider a regional regulation of trade and/or stringent regulation of containment facilities for species classified as B category, and for which trade is still an actual although indirect pathway of introduction.
- 4) For species classified as C category, and for which trade is still an actual pathway of introduction, , in all relevant involved sectors (i.e. transport, agriculture, fishery, etc.).
- 5) For species classified as D category, monitor pathway of introduction and consider regulation of related vectors in all relevant involved sectors (i.e. transport, agriculture, fishery, etc.).
- 6) Any trade regulation shall be accompanied – when feasible and appropriate - by stringent management provisions (i.e. regulation of containment facilities; eradication of already established populations; enforcement of control/containment campaigns, awareness raising at custom points, effective communication campaigns, etc.).
- 7) Support the development of international comprehensive registers of IAS, such as the Global Register of Invasive Species (GRIS) being developed by IUCN ISSG.

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APPENDIX I METALIST OF KNOWN INVASIVE ALIEN SPECIES FOR EUROPE

Species / Group of species	Trade category	EPPO A1 list	EPPO A2 list	EPPO list of invasive alien plants	EEA/ SEBI	Nobanis	Daisie	Reg. 338/97
*species listed in deported and pagad 2007								
Mammals								
Ammotragus lervia	A				1			
Callosciurus finlaysoni	B				1			
Castor canadensis	A				1	1		
Cervus nippon	A				1		1	
Eutamias sibiricus	B						1	
Herpestes javanicus *	A				1			
Muntiacus reevesii	A				1			
Mustela vison *	B				1	1	1	
Myocastor coypus	B				1		1	
Nyctereutes procyonoides	B				1	1	1	
Ondatra zibethicus	B				1	1	1	
Oryctolagus cuniculus *	B				1			
Procyon lotor	B				1		1	
Rattus norvegicus *	D				1		1	
Sciurus carolinensis	B				1		1	
Birds								
Acridotheres tristis	B				1			
Alopochea aegyptiacus	B				1			
Brauna canadensis	B				1		1	
Corvus splendens	B				1			
Oxyura jamaicensis	A				1		1	1
Pittakula krameri	B						1	
Threskiornis aethiopicus	B				1		1	
Amphibians & reptiles								
Chisemys picta	B							1
Rana catesbeiana	A				1		1	1
Trachemys scripta elegans	B				1	1	1	1

Xenopus laevis	B					1				
Fishes										
Ameiurus nebulosus	A					1				
Aphanius dispar	D								1	
Carassius auratus gibelio	A					1				
Carpio haematopterus/Cyprinus carpio *	A					1				
Fistularia commersoni	D					1			1	
Gambusia affinis	A					1				
Lepomis gibbosus *	A					1				
Liza haematocheila ex Mugil soiny	A, B, D					1				
Micropterus salmoides	A					1				
Neogobius melanostomus *	D, C?					1		1		1
Oncorhynchus mykiss	A					1		1		
Percottus glenii	B, D					1				
Phoxinus phoxinus	D							1		
Pseudorasbora parva	A					1		1		1
Salmo salar	A, B					1		1		
Salvelinus fontinalis	A					1			1	
Sander lucioperca	A							1		
Saurida undosquamis	D					1			1	
Seriola fasciata	D					1				
Siganus luridus	D					1				
Siganus rivulatus	D					1			1	
Silurus glanis	A					1				
Sphaeroides pachygaster	D					1				
Crustaceans										
Acartia tonsa	D					1			1	
Balanus improvisus	D								1	
Cercopagis pengoi	D					1		1		
Charbydis logicoilis	D								1	
Chelicorophium curvispinum	D					1				
Dicoregammarus villosus	A, D					1			1	
Elminius modestus	D					1				

Eriocheir sinensis	D					1		1		1	
Gammarus tigrinus	D					1					
Homarus americanus	B							1			
Marsupenaeus japonicus	A, B									1	
Metapenaeus (Marsupenaeus) japonicus	A, B					1					
Oreocetes limosus *	A					1					
Pacifastacus leniusculus	A					1		1			
Paralithodes camtschatica	A					1		1		1	
Percnon gibbesi	B, D					1				1	
Pontogammarus robustoides	A, D							1			
Procambarus clarkii *	A, B					1				1	
Insects											
Acleris Gloverana A1/281	C		1								
Acleris variata A1/32	C		1								
Aculops fuchsiae A1/185	C		1								
Aedes albopictus	D									1	
Aeolesthes sarta A2/307	C			1							
Agrius planipennis A1/322	C		1								
Aleurocanthus spiniferus A1/186	C		1								
Aleurocanthus woglumi A1/103	C		1								
Anauromyza maculosa A1/152	C		1								
Anastrepha fraterculus A1/229	C		1								
Anastrepha ludens A1/230	C		1								
Anastrepha obliqua A1/231	C		1								
Anastrepha suspensa A1/200	C		1								
Anoplophora chinensis A1/187	C		1			1				1	
Anoplophora glabripennis A1/296	D, C		1			1				1	
Anthonomus bisignifer A1/189	C		1								
Anthonomus eugenii A1/202	C		1								
Anthonomus grandis A1/34	C		1								
Anthonomus signatus A1/164	C		1								
Aphis gossypii	C									1	
Bactrocera cucumis A1/203	C		1								

Bactrocera cucurbitae A1/232	C	1							
Bactrocera dorsalis A1/233	C	1							
Bactrocera minax A1/234	C	1							
Bactrocera tryoni A1/235	C	1							
Bactrocera tsumeonis A1/236	C	1							
Bactrocera zonata A1/302	C	1							
Bemisia tabaci A2/178	C		1						
Blitopertha orientalis A1/33	D, C	1							
Cacoecimorpha pronubana A2/104	C		1						
Cacyreus marshalli A2/181	C		1						
Cameraria ohridella	D, C				1			1	
Caposina sasaki A2/163	C		1						
Ceratitis capitata A2/105	C		1					1	
Ceratitis rosa A1/237	C	1							
Choristoneura conflictana A1/205	C	1							
Choristoneura fumiferana A1/206	C	1							
Choristoneura occidentalis A1/207	C	1							
Choristoneura rosaceana A1/208	C	1							
Conotrachelus nenuphar A1/35	D	1							
Corythucha arcuata	C					1			
Cydia inopinata A2/193	C, D		1						
Cydia packardii A1/209	C, D	1							
Cydia prunivora A1/36	C, D	1							
Dacus ciliatus A2/238	C		1						
Dendroctonus adjunctus A1/43	C	1							
Dendroctonus brevicornis A1/263	C	1							
Dendroctonus frontalis A1/264	C	1							
Dendroctonus ponderosae A1/265	C	1							
Dendroctonus pseudotsugae A1/266	C	1							
Dendroctonus rufipennis A1/267	C	1							
Dendrolimus sibiricus A2/308	C		1						
Dendrolimus superans A2/330	C		1						
Diabrotica barberi A1/210	C, D	1							
Diabrotica speciosa A1/303	C, D	1							

Diabrotica undecimpunctata A1/292	C, D	1	1						
Diabrotica virgifera A2/199	C, D		1					1	
Diaphorina citri A1/37	C	1							
Dryocoetes confusus A1/268	C	1							
Dryocosmus kuriphilus A2/317	C		1						
Epitrix cucumeris A1/299	D	1							
Epitrix tuberis A1/165	D	1							
Erschoviella musculana A2/318	C, D		1						
Eutetranychus orientalis A2/288	C		1						
Frankliniella occidentalis A2/177	C		1					1	
Gnathotrichus sulcatus A1/269	C	1							
Gonipterus gibberus A1/301	C, D	1							
Gonipterus scutellatus A2/38	C, D		1						
Hamonia axyridis	A					1			1
Helicoverpa armigera A2/110	C		1						
Helicoverpa zea A1/195	C	1							
Heteronychus arator A1/297	C, D	1							
Honalodisca coagulata A1/336	C	1							
Hyphantria cunea	C					1			
Ips calligraphus A1/270	C	1							
Ips confusus A1/271	C	1							
Ips grandicollis A1/272	C	1							
Ips hauseri A2/326	C		1						
Ips lecontei A1/273	C	1							
Ips pini A1/274	C	1							
Ips plagiographus A1/275	C	1							
Ips subelongatus A2/325	C		1						
Lasius neglectus	D					1			
Lepidosaphes ussuriensis A2/319	C		1						
Leptinotarsa decemlineata A2/113	C		1					1	
Limoniatus californicus A1/304	D, C	1							
Linepithema humile	D					1			1
Lirionmyza huidobrensis A2/283	C		1						1

<i>Lirionmyza sativae</i> A2/282	C			1					
<i>Lirionmyza trifolii</i> A2/131	C				1				
<i>Listronotus bonariensis</i> A1/168	C, D		1						
<i>Lopholeucaspis japonica</i> A2/289	C				1				
<i>Lymantia mathura</i> A2/331	D, C				1				
<i>Maconelliococcus hirsutus</i> A1/314	C		1						
<i>Malacosoma americanum</i> A1/276	C		1						
<i>Malacosoma disstria</i> A1/213	C		1						
<i>Malacosoma parallela</i> A2/320	C				1				
<i>Margarodes priekaensis</i> A1/214	D, C		1						
<i>Margarodes vitis</i> A1/215	D, C		1						
<i>Margarodes vredendalensis</i> A1/216	D, C		1						
<i>Melanotus communis</i> A1/305	D		1						
<i>Naupactus leucoloma</i> A1/293	C, D		1						
<i>Numonia piriorella</i> A2/184	C				1				
<i>Oligonychus perditus</i> A1/217	C		1						
<i>Opogona sacchari</i> A2/154	C				1				
<i>Orygia pseudotsugata</i> A1/218	C		1						
<i>Paysandisia archon</i> A2/338	C				1				
<i>Pisodes nemorensis</i> A1/44	C		1						
<i>Pisodes strobi</i> A1/258	C		1						
<i>Pisodes terminalis</i> A1/259	C		1						
<i>Popillia japonica</i> A2/40	D, C				1				
<i>Premnotyphes latithorax</i> , <i>P. suturalis</i> & <i>P. vorax</i> A1/143	C		1						
<i>Quadraspidiotus perniciosus</i> A2/117	C				1				
<i>Rhagoletis cingulata</i> A2/239	C				1				
<i>Rhagoletis fausta</i> A1/241	C		1						
<i>Rhagoletis indifferens</i> A1/242	C		1						
<i>Rhagoletis mendax</i> A1/243	C		1						
<i>Rhagoletis pomonella</i> A1/41	C		1						
<i>Rhizococcus hibisci</i> A1/300	C		1						
<i>Rhynehophorus ferrugineus</i> A2/339	C				1				
<i>Rhynehophorus palmarum</i> A1/332	C		1				1		

Scirtothrips aurantii A1/221	C	1						
Scirtothrips citri A1/222	C	1						
Scirtothrips dorsalis A2/223	C		1					
Scolytus morawitzi A2/309	C			1				
Sirex ernaki A2/327	D, C			1				
Spodoptera eridania A1/196	C	1						
Spodoptera frugiperda A1/197	C	1						
Spodoptera littoralis A2/120	C			1			1	
Spodoptera litura A1/42	C	1						
Sternochetus mangiferae A1/286	C	1						
Strobilomya viaria A2/333	D			1				
Tecia solanivora A2/310	C			1				
Tetropium gracilicorne A2/311	C			1				
Thrips palmi A1/175	C	1						
Toxoptera citricida A1/45	C	1						
Trialeurodes vaporarum	C							1
Trioza erythrae A1/46	C	1						
Trogoderma granarium A2/121	D			1				
Tuta absoluta A1/321	C	1						
Unaspis citri A1/226	C	1						
Viteus vitifoliae A2/106	C			1				
Xylotrechus altaiacus A2/312	C			1				
Xylotrechus namanaganensis A2/328	C			1				
Anellids								
Artioposthia triangulata	C					1		
Ficopomatus enigmaticus	D					1		1
Hydroides dianthus	D					1		
Hydroides elegans	D					1		
Hydroides ezoensis	D					1		
Marenzelleria neglecta	D					1	1	
Marenzelleria viridis	D					1		1
Pileolaria berkeleyana	D					1		
Spirorbis marioni	D					1		

[illegible]

<i>Alianthus altissima</i> *	A				1	1		1	
<i>Ambrosia artemisiifolia</i> *	C, D				1	1		1	
<i>Amelanchier spicata</i>	A, B				1		1		
<i>Amorpha fruticosa</i> *	A, D				1	1			
<i>Anthriscus sylvestris</i>	Indigenous						1		
<i>Arceuthobium abietinum</i>	C	1							
<i>Arceuthobium americanum</i>	C	1							
<i>Arceuthobium campylopodum</i>	C	1							
<i>Arceuthobium douglasii</i>	C	1							
<i>Arceuthobium laricis</i>	C	1							
<i>Arceuthobium minutissimum</i>	C	1							
<i>Arceuthobium occidentale</i>	C	1							
<i>Arceuthobium pusillum</i>	C	1							
<i>Arceuthobium</i> spp. (non-European) A1/24	C	1							
<i>Arceuthobium tsugense</i>	C	1							
<i>Arceuthobium vaginatum</i>	C	1							
<i>Aster novi-belgii</i> agg.	A					1			
<i>Azolla filiculoides</i>	C, D				1	1	1		
<i>Baccharis halimifolia</i>	A				1				
<i>Bidens frondosa</i>	C, D				1	1			
<i>Buddleia davidii</i>	A				1				
<i>Bunias orientalis</i>	D					1	1		
<i>Campylopus introflexus</i>	C						1	1	
<i>Cabomba caroliniana</i>	B				1				
<i>Carobrotus edulis</i> * & <i>C. spp.</i>	A				1	1		1	
<i>Cenchrus incertus</i>	D				1				
<i>Cenchrus longispinus</i>	D					1			
<i>Cortaderia selloana</i>	A				1	1		1	
<i>Crassula helmsii</i> A2/340 (A2 in 2006)	B, C, D		1		1	1		1	
<i>Cyperus esculentus</i>	C				1				
<i>Echinocystis lobata</i> *	C, D					1		1	
<i>Egeria densa</i>	B, C, D				1				
<i>Elodea canadensis</i>	C, D					1		1	
<i>Elodea nuttallii</i>	C, D				1	1			

<i>Epilobium ciliatum</i>	D				1			
<i>Fallopia japonica</i> *, <i>F. sachalinensis</i> , <i>Fallopia x bohemica</i>	A			1	1	1	1	
<i>Galinsoega quadriradiata</i>	C, D						1	
<i>Grindelia squarrosa</i>	B				1			
<i>Halophila stipulacea</i>	C				1			1
<i>Hedychium gardnerianum</i> *	A					1		1
<i>Helianthus tuberosus</i> *	A			1	1			
<i>Hieracium mantegazzianum</i>	A			1	1			1
<i>Hieracium sosnowskyi</i>	A			1	1		1	
<i>Hydrocotyle ranunculoides</i> A2/334 (A2 in 2005)	A		1	1	1			
<i>Impatiens glandulifera</i> *	B, A			1	1		1	1
<i>Iva (Cyclachena) xanthiifolia</i>	C				1			
<i>Lagerosiphon major</i>	A			1				
<i>Ludwigia peploides</i>	A			1	1			
<i>Ludwigia uruguayensis</i>	A			1				
<i>Lupinus nootkatensis</i> *	A						1	
<i>Lupinus polyphyllus</i> *	A			1			1	
<i>Lysichiton americanus</i> A2/335 (A2 in 2005)	A, B		1	1	1			
<i>Myriophyllum aquaticum</i>	A, B, C			1				
<i>Opuntia ficus-indica</i>	A				1			1
<i>Oxalis pes-caprae</i>	B, C, D			1	1			1
<i>Paspalum paspalodes</i> (= <i>P. distichum</i>)	C			1				1
<i>Pinus mugo</i> *	A						1	
<i>Prunus serotina</i> *	A			1	1		1	1
<i>Pueraria lobata</i> A2/341	A		1					
<i>Pueraria montana</i> var. <i>lobata</i> (A2 in 2006)	A			1				
<i>Rhododendron ponticum</i> *	A			1	1			1
<i>Robinia pseudacacia</i> *	A				1			1
<i>Rosa rugosa</i>	A				1		1	1
<i>Sambucus nigra</i>	Indigenous						1	
<i>Senecio inaequidens</i>	C, D			1	1		1	
<i>Sicyos angulatus</i>	C, D			1				

<i>Alternaria mali</i> A1/277			1						
<i>Anisogramma anomala</i> A1/201			1						
<i>Aphanomyces astaci</i>	C					1		1	
<i>Apiosporina morbosus</i> A1/10			1						
<i>Atopellis pinicola</i> A1/5			1						
<i>Atopellis piniphila</i> A1/280			1						
<i>Botryosphaeria laricina</i> A2/12				1					
<i>Ceratomyces fagacearum</i> and its vectors A1/6			1						
<i>Ceratomyces fimbriata</i> f.sp. platani A2/136	D			1					
<i>Chrysomyxa arctostaphyli</i> A1/8			1						
<i>Ciboria camelliae</i> A2/190	C			1					
<i>Cronartium coleosporioides</i> A1/248			1						
<i>Cronartium comandrae</i> A1/249			1						
<i>Cronartium comploniae</i> A1/250			1						
<i>Cronartium fusiforme</i> A1/9			1						
<i>Cronartium himalayense</i> A1/251			1						
<i>Cronartium kantschaticum</i> A2/18				1					
<i>Cronartium quercuum</i> A1/252			1						
<i>Cryphonectria parasitica</i> A2/69	C			1					
<i>Deuterophoma tracheiphila</i> A2/287				1					
<i>Diaporthe vaccinii</i> A1/211			1						
<i>Didymella ligulicola</i> A2/66				1					
<i>Endocronartium harknessii</i> A1/11			1						
<i>Fusarium oxysporum</i> f.sp. albedinis A2/70				1					
<i>Gibberella circinata</i> A1/306			1						
<i>Glomerella gossypii</i> A2/71				1					
<i>Guignardia citricarpa</i> A1/194			1						
<i>Gymnosporangium asiaticum</i> A2/13				1					
<i>Gymnosporangium clavipes</i> A1/253			1						
<i>Gymnosporangium globosum</i> A1/254			1						
<i>Gymnosporangium juniperi-virginianae</i> A1/255			1						
<i>Gymnosporangium yamadac</i> A1/257			1						
<i>Melampsora farlowii</i> A1/15			1						

Melampora medusae A2/74				1					
Melamporiidium hirsutakanum							1		
Monilia fructicola A2/153				1					
Mycosphaerella dearnessii A2/22					1				
Mycosphaerella gibsonii A1/7			1						
Mycosphaerella laticis-leptolepidis A1/16			1						
Mycosphaerella populorum A1/17			1						
Ophiostoma novo-ulmi						1			1
Ophiostoma wageneri A1/179			1						
Phaeoramularia angolensis A1/298			1						
Phellinus weirii A1/19			1						
Phialophora cinerescens A2/77				1					
Phoma andigena A1/141			1						
Phyllosticta solitaria A1/20			1						
Phymatotrichopsis omnivora A1/21			1						
Phytophthora cinnamomi						1		1	
Phytophthora fragariae A2/79				1					
Phytophthora lateralis A1/337			1						
Phytophthora ramorum							1		
Pseudophytophthora minutissimus			1						
Pseudophytophthora pruinosus			1						
Puccinia horiana A2/80				1					
Puccinia pitieriana A1/155			1						
Sciridium cardinale	C							1	
Septoria lycopersici var. malagutii A1/142			1						
Sirococcus clavigignenti-juglandacearum A1/329			1						
Stegophora ulmea A1/315			1						
Stenocarpella macrospora A2/67				1					
Stenocarpella maydis A2/68				1					
Synchytrium endobioticum A2/82	C			1					
Thecaphora solani A1/4			1						
Tilletia indica A1/23			1						

Verticillium albo-atrum & V. dahliae (hop-infecting strains) A2/85				1						
Protoists										
Bonania ostreae	C					1				
Prokaryotes										
Apple proliferation phytoplasma A2/87				1						
Burkholderia caryophylli A2/55				1						
Clavibacter michiganensis subsp. insidiosus A2/49				1						
Clavibacter michiganensis subsp. michiganensis A2/50				1						
Clavibacter michiganensis subsp. sepedonicus A2/51				1						
Curtobacterium flaccumfaciens pv. flaccumfaciens A2/48				1						
Elm phloem necrosis phytoplasma A1/26			1							
Erwinia amylovora A2/52				1						
Erwinia chrysanthemi A2/53				1						
Grapevine flavescence dorée phytoplasma A2/94				1						
Liberobacter africanum & L. asiaticum A1/151			1							
Palm lethal yellowing phytoplasma A1/159			1							
Pantoea stewartii pv. stewartii A2/54				1						
Peach rosette phytoplasma A1/138			1							
Peach X-disease phytoplasma A1/140			1							
Peach yellows phytoplasma A1/139			1							
Pear decline phytoplasma A2/95				1						
Potato purple-top wilt phytoplasma A1/128			1							
Pseudomonas syringae pv. persicae A2/145				1						
Ralstonia solanacearum A2/58				1						
Stolbur phytoplasma A2/100				1						
Vibrio cholerae						1				
Xanthomonas arboricola pv. corylina A2/134				1						
Xanthomonas arboricola pv. pruni A2/62				1						
Xanthomonas axonopodis pv. citri A1/1			1							
Xanthomonas axonopodis pv. dieffenbachiae A2/180				1						

Xanthomonas axonopodis pv. phaseoli A2/60				1						
Xanthomonas axonopodis pv. vesicatoria and Xanthomonas vesicatoria A2/157				1						
Xanthomonas fragariae A2/135				1						
Xanthomonas oryzae pv. oryzae A1/2			1							
Xanthomonas oryzae pv. oryzicola A1/3			1							
Xanthomonas translucens pv. translucens A2/183				1						
Xylella fastidiosa A1/166			1							
Xylophilus ampelinus A2/133				1						
Viruses										
American plum line pattern virus (Ilarvirus) A1/28			1							
Andean potato latent virus (Tymovirus) A1/244			1							
Andean potato mottle virus (Comovirus) A1/245			1							
Bean golden mosaic virus (Begomovirus) A1/204			1							
Beet leaf curl virus A2/90				1						
Beet necrotic yellow vein virus (Benyvirus) A2/160				1						
Blueberry leaf mottle virus (Nepovirus) A2/198				1						
Cherry rasp leaf virus (Cheravirus) A1/127			1							
Chrysanthemum stem necrosis virus (Tospovirus) A1/313			1							
Chrysanthemum stunt viroid (Pospiviroid) A2/92				1						
Citrus blight disease A1/278			1							
Citrus leprosis virus A1/284			1							
Citrus mosaic virus (Badnavirus) A1/285			1							
Citrus tatter leaf virus (Capillovirus) A1/191			1							
Citrus tristeza virus (Closterovirus) A2/93				1						
Coconut cadang-cadang viroid (Cocadviroid) A1/192			1							
Cucumber vein yellowing virus (Ipomovirus) A2/316				1						
Cucurbit yellow stunting disorder virus (Crimivirus) A2/324				1						
Impatiens necrotic spot virus (Tospovirus) A2/291				1						
Lettuce infectious yellows virus (Crimivirus) A1/212			1							
Peach mosaic virus (Trichovirus) A1/27			1							
Peach rosette mosaic virus (Nepovirus) A1/219			1							

