



# Pathways for non-native species in Denmark

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**Citation**

Madsen, C. L., Dahl, C. M., Thirslund, K. B., Grousset, F., Johannsen, V. K. and Ravn, H. P. (2014): Pathways for non-native species in Denmark. Department of Geosciences and Natural Resource Management, University of Copenhagen, Frederiksberg. 131 pp.

**Publisher**

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Natural Resource Management  
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**Responsible under the press law**

Niels Elers Koch

**ISBN**

978-87-7903-656-7

**Cover**

Karin Kristensen

**Cover Photos**

Hans Ulrik Riisgård  
Hans Peter Ravn  
Jonas Roulund

**Published**

This report is only published at [www.ign.ku.dk](http://www.ign.ku.dk)

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## 1. Preface

This report is a collaboration between the Danish Nature Agency and Department for Geosciences and Natural Resource Management, University of Copenhagen. It is an update and analysis of knowledge on introduction pathways for non-native species into Denmark in order to meet the demands for common efforts addressing challenges from alien invasive species. The project period was October 1<sup>st</sup> to December 31<sup>st</sup> 2013.

The rate of introductions of non native species is increasing exponentially. With increased globalization the number of pathways from which species may spread, is enormous. Species being introduced outside their natural environment may be able to establish and disperse in new environments occasionally having an adverse effect on native biodiversity. These species are alien invasive species.

In order to evaluate the importance of different pathways, we have sought out detailed documentation for when and how non-native species were introduced to Denmark. Using the NOBANIS database with approximately 2.700 introduced species, we have identified pathways of introduction and scored each species for effects. For this we followed the HARMONIA guidelines, and added evaluations of adverse economic and human health impacts. An analysis of introduction pathways was made for each species group, as well as for all organisms. Finally a prioritization of species based on cumulative scores was made. The main out-come of this project is the updated NOBANIS database with added columns on economic and human health impacts and the possibilities for analysis it provides. Essentially it makes out a background for prioritizing future countermeasures. In this report we shall present the methods used and the overall results from the work.

Since the situation is non-static and ever-changing the documentary part of this work and its conclusions are time specific and evaluated impacts could – and should – be debated. However we believe results could create a fair foundation for further tracking of introductions and for the debate on impacts and prioritization.

Frederiksberg, April 2014

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## Contents

1. Preface.....	3
2. Summary.....	6
3. Resume .....	7
4. Introduction.....	9
5. Methods .....	11
Data material .....	11
Assessments and the scoring system .....	11
Pathway categories .....	14
EPPO species.....	16
Literature search .....	17
Specialist reviews .....	17
6. Analyses of species-groups.....	19
Angiosperma.....	20
Bryophyta .....	24
Coniferae .....	25
Fungi .....	26
Macroalgae .....	30
Phytoplankton .....	31
Annelida.....	32
Arthropoda .....	33
Aves .....	39
Ctenophora.....	40
Pisces .....	41
Platyhelminthes.....	42
Mammalia.....	43

Mollusca .....	45
Nematoda .....	47
Reptilia and amphibia.....	48
7. Analysis of pathways .....	49
Analysis of impact.....	58
High risk species .....	59
Analysis of development over time.....	61
8. Constraints and recommendations .....	63
NOBANIS.....	63
The assessments.....	63
9. Conclusion .....	66
10. Acknowledgements .....	67
11. References.....	68
<b>Appendices.....</b>	<b>72</b>
Appendix 1. Danish Nature Agency’s Black list.....	72
Appendix 2. Danish Nature Agency’s Observation list .....	76
Appendix 3. Reviewed EPPO species (List A1 and A2).....	78
Appendix 4. Species added by specialists.....	115
Appendix 5. Guide to evaluation and a project description for specialists.....	119
Appendix 6. Species with high scores.....	121
Appendix 7. Additional tables .....	127
Appendix 8. Structure of spreadsheet, incl. codelists .....	128
Appendix 9. Excel spreadsheet (electronic).....	131
Appendix 10. Publication references for the database (electronic, in separate files) .....	131
Appendix 11. Web link references for the database (electronic, in separate files) .....	131

## 2. Summary

This report is the result of a collaboration between the Danish Nature Agency and the Department of Geoscience and Natural Resource Management, University of Copenhagen. The timeframe for this project has been October 1 until December 31.

Introduced (or non-native) species are species, which have spread from their natural range of distribution with assistance from man. Invasive species represent a small proportion of non-native species. They are characterized by their ability to disperse and negatively affect the native environment and biodiversity. The purpose of this project was to provide an updated overview and analysis of pathways of introduction of non-native species in Denmark. In order to achieve this, an evaluation of adverse (e.g. harmful or negative) effects on the environment and human interests such as the economy and public health was performed.

The NOBANIS database has formed the basis for identifying non-native species pathways of introduction and possible vectors. The database includes 2.690 species, and an additional 109 species were added. An extensive literature search was completed for 2.079 of these species (77.3 %). For each of these, the adverse effects on four environmental categories were evaluated based on the Belgian HARMONIA method (also called ISEIA guidelines, HARMONIA information system (version 2.5)). An assessment of adverse effects on health and economics was also added. Furthermore 213 of the examined species were assessed by external specialists.

The main outcome of this project was the analysis of introduction pathways along with an updated database with added columns for introduction pathways and effects on the environment and society. An analysis of the identified Pathways of Introduction, Mode of Entry and vectors was performed for each species group. The most common pathways, modes and vectors were identified for each species group. An analysis of Pathways of Introduction was performed across all species groups.

As a result of this method it was possible to identify species that have considerable adverse effects on environment, health and economy in Denmark. The Danish Black list consists of 62 species and the Observation list consists of 47 species. By using this method, it was possible to place the assessed species on the Black list and Observation list based on objective evaluations and their scores on environmental impact. Based on the ISEIA score categorization by HARMONIA, 31 species should be allocated to the Black list and 71 species to the Observation list. By adding the assessment of adverse effects on economy and health an additional 10 species were identified and should be added to the Black list. The species with scores matching high risks were identified.

This method represents an effective method to evaluate nonnative species effect objectively. However, there were concerns that should be addressed. There was a general lack of literature on pathways of introduction for many species, as well as on their "Adverse impacts on native species" and "Alteration of ecosystem functions". The categories "Dispersion potential" and "Colonisation of high conservation value habitats" often caused problems when dealing with marine species. This project has identified pathways of introduction for non-native and invasive species. By identifying these pathways, it may be possible to prevent introductions of new species, or to limit further introductions of problematic species already recorded in Denmark. This assessment provides an objective method that provides a framework for future decisions on which species should be targeted with management plans.

### 3. Resume

Denne rapport er resultatet af et samarbejde mellem Naturstyrelsen og Institut for Geovidenskab og Naturforvaltning, Københavns Universitet. Projektperioden har været 1. oktober til 31. december 2013.

Introducerede (eller ikke-hjemmehørende) arter er arter, som har spredt sig uden for deres naturlige udbredelsesområde ved menneskets hjælp. Invasive arter betegner en lille del af de ikke-hjemmehørende arter, og disse kendetegnes ved at de ved deres spredning og konkurrenceevne er i stand til at skade den hjemmehørende natur og true den biologiske mangfoldighed.

Formålet med dette projekt har været at levere en opdateret oversigt og analyse af introduktionsveje for de væsentligste ikke-hjemmehørende arter i Danmark. Det har desuden været formålet, at vurdere de introducerede arters aktuelle og potentielle skadelighed under vore danske forhold.

NOBANIS databasen har dannet udgangspunkt for at identificere introduktionsveje og eventuelle vektorer for spredningen til Danmark. Databasen over de introducerede organismer omfatter 2.690 arter, og udover disse blev der tilføjet 109 arter, der endnu ikke er registreret i Danmark, men kan forventes at have betydning i fremtiden. Litteratursøgningen er blevet gennemført for 2.079 af disse arter (77,3 %). For hver af de gennemgåede arter blev der foretaget en vurdering af potentielle og aktuelle negative miljø effekter med udgangspunkt i den belgiske HARMONIA-metode (også kaldet ISEIA guidelines, HARMONIA information system (version 2.5)). Desuden blev der tilføjet en vurdering af negative effekter på sundhed og økonomi, som i f.eks. rapporten "Danmarks Havstrategi basisanalyse" udgivet af Miljøministeriet i 2012. Vurderingerne blev foretaget ud fra en tre-trins skala: LAV – MEDIUM - HØJ, og for arter som endnu ikke er registreret i Danmark lagde det potentielle "worst case scenario" grundlag for vurderingen. For 213 af de gennemgåede arter blev der foretaget en vurdering af eksterne specialister.

Hovedresultatet af projektarbejdet er analysearbejde af introduktionsvejene samt det opdaterede NOBANIS-dataark med ekstra kolonner for introduktionsveje, effekter på miljø og samfund, der fremgår af denne rapport.

For hver artsgruppe blev der foretaget en analyse af de identificerede introduktionsveje og vektorer. Artsgrupperne blev opdelt i arter som allerede var registreret i Danmark og i arter som endnu ikke var registreret i landet. Dertil blev Angiosperma og Arthropoder opdelt i terrestriske og akvatiske arter. De mest hyppige introduktionsveje og vektorer for hver artsgruppe blev identificeret.

En analyse af spredningsveje på tværs af artsgrupper blev foretaget. Mange angiospermer blev introduceret gennem landbrug og havebrug. Den mest almindelige introduktionsvej for fugle og pattedyr er undslip fra fangenskab. Introduktionsvejen skovbrug blev ofte identificeret blandt nåletræer og leddyr. Landskabspleje og transport har ofte ført til introduktion af dækfrøede planter og leddyr. I visse tilfælde var det muligt at identificere mere end én introduktionsvej og én vektor for en art. Arter med flere introduktionsveje og vektorer har ofte flere muligheder for og større success med at sprede sig.

Næsten halvdelen af de undersøgte arter viste sig at være blevet introduceret med vilje. Dette gjorde sig især gældende ved havebrug, og disse introduktioner repræsenterer det store antal af prydblister som gennem tiden er blevet bragt til landet ved menneskelig hjælp. Ved introduktionsvejen landbrug blev

størstedelen af arterne utilsigtet introduceret som f.eks. frø fra ukrudtsplanter blandt såsæd eller i fuglefrø. Størstedelen af invasive planter i Danmark er blevet introduceret som pryddplanter til havebrug. De resterende arter, som ifølge denne evaluering betragtes som problematisk, er blevet introduceret via skovbrug, landskabspleje, ballastvand og –jord eller gennem akvariehold. Størstedelen af alle introducerede arter skaber ikke problemer i Danmark og i hver introduktionsvej er størstedelen af arternes negative effekter på miljø, økonomi og sundhed ubetydelige.

Som følge af denne metode var det muligt at identificere arter som har betydelige negative effekter på miljø, sundhed og økonomi. Den danske Sortliste består af 62 arter og Observationslisten af 47 arter. Ved at benytte denne metode var det muligt at opdele de vurderede arter på Sort- og Observationslisten ud fra deres score på miljøfaktorer. Ud fra kategoriseringen fra HARMONIA blev 31 arter identificeret til Sortlisten og 71 arter til Observationslisten. Ved at tilføje vurderingerne af negative effekter på økonomi og helbred blev yderligere 10 arter identificeret til Sortlisten.

Arter med høje score i de gennemførte analyser blev identificeret (Appendix 6). På denne liste var 63 % af arterne på Sortlisten og 45 % af arter på Observationslisten repræsenteret, mens 20 arter på Sortlisten ikke blev vurderet til at have tilstrækkelige negative effekter til at være på listen.

Den benyttede metode repræsenterer en effektiv metode til at vurdere og klassificere ikke-herhjemmehørende arters betydning objektivt. Der er dog dele af metoden, hvortil der bør knyttes bemærkninger. Der var generelt manglende data på introduktionsveje for mange arter og i endnu større grad mangel på dokumenteret effekt på især miljø parametrene "Påvirkning af hjemmehørende arter" og "Påvirkning af økosystemfunktioner". Der var desuden ofte indvendinger ved vurderingen af de resterende miljøparametre "Spredningspotentiale" og "Levestedets bevarings- eller naturværdi" for marine arter, især arter med en planktonisk livcyklus.

Projektets formål er at identificere introduktionsveje for introducerede og invasive arter. Rapporten danner grundlag for forebyggelse af introduktioner af nye arter, og mulighed for at begrænse yderligere introduktioner af problematiske arter, som allerede er registreret i Danmark. Denne vurdering bygger på en objektiv metode, der kan danne ramme for, hvilke bekæmpelses- & formidlingsprojekter samt indsatsplaner, der skal iværksættes for en given art. Da udbredelse af introducerede arter samt deres negative effekter er dynamisk, skal projektet og dets resultater ses som et øjebliksbillede og en metode, der kan og bør udvikles og løbende opdateres. Yderligere er det vigtigt at pointere, at de introducerede arters skadelighed kan danne grundlag for forskellige fortolkninger selv blandt fagfolk. Alligevel er det forventningen, at resultaterne og metoden kan udgøre et rationelt fundament for beslutninger om prioriteringer vedrørende håndteringen af introducerede og invasive arter.

## 4. Introduction

Globalization has vastly increased long-distance travel and commerce, and highly altered waterways. These and other factors have increased the frequency by orders of magnitude by which non-native species are introduced into new areas of the world, sometimes with costly effects. Borders of EU have already been breached by more than 11.000 alien species, at least 15 % of which are invasive and detrimental to biodiversity (EU 2020 Biodiversity Strategy, 2013). In Denmark, as of 2013, 2.690 introduced species are registered in The European Network on Invasive Alien Species (NOBANIS). NOBANIS was founded in 2002 as a database containing information on alien and invasive species in North and Central Europe. Definitions provided by the NOBANIS network are followed here.

All invasions begin with a few individuals that are taken from their native region and transported to a novel environment. A vector is the conveyance that moves non-native propagules to their novel location. Therefore a vector is the *manner* by which a species is carried along a pathway, whereas the pathway is the *route* from the source region and to the subsequent location of release (Lockwood et al. 2007). The pathways and the vectors by which non-native species reach their destination are more diverse and dynamic than natural colonization processes. Traits that would allow for instance a plant to disperse far, such as ability to float, withstand salt-water etc. need not be present if the plant can hitch-hike to a new part of the world via an airplane. Human mediated transports are therefore faster, more diverse, and reach a larger geographical scale than would occur naturally. However, only a fraction of introduced species overcomes all ecological barriers in the invasion process and becomes established, and only a fraction becomes invasive. This fact is sometimes called the Tens Rule, referring to the on average 10 % that successfully transit each of more invasion stages (Lockwood et al. 2007).

Our knowledge about pathways of introduction is far from complete. However, research suggests that most invasive plants originate from botanical gardens/parks (Hulme 2011) or aquarias. Invasive freshwater animals originate from aquaculture or intentional release. Contrary to this, most of the marine invasive species are introduced unintentionally as contaminants e.g. in Ballast water (EU 2020 Biodiversity Strategy, 2013).

As rates of introduction seemingly increase through time, or perhaps even accelerate (Lockwood et al. 2007), the need to prioritize our efforts becomes essential, if we are to mitigate some of the adverse effects to our society and environment. Known invasive species already established in Denmark have already been rated by the Danish Nature Agency for compiling a list with the worst invasive species (hereafter called the 'Black list') (Appendix 1). Potential invasive species have also been listed and are being monitored ('Observation list') (Appendix 2). However, using an objective assessment system such as the HARMONIA information system (Branquart 2007), made it possible to assess and sort species according to their effects in a consistent and reproducibly manner. Our analysis utilizes the NOBANIS database and the work done by the Consultative Working Group on Invasive Alien Species established in 2009. It further builds on the efforts by the official Interagency Group on Invasive Alien Species, as well as the evaluations recently made in 'Danmarks Havstrategi basisanalyse' published by the Danish Ministry of Environment

(2012). Moreover it includes a selection of potential invasive species from the European and Mediterranean Plant Protection Organization (EPPO).

A literature search for >75 % of all species recorded in NOBANIS as introduced to Denmark was conducted. Following the ISEIA protocol from the information system HARMONIA, species were given a score between 1-3 in four categories I) Dispersion potential, II) Colonization of high conservation value habitats, III) Adverse impacts on native species, and IV) Alteration of ecosystem function. In addition an extra two categories were evaluated; V) Economical effects, and VI) Public health effects. Specialists reviewed species that received a score of  $\geq 11$  in the four ecological categories, or a total score  $\geq 14$ .

In total this project delivers:

- Up-to-date literature search on pathways for introduced species in Denmark
- Evaluation of ecological, economical and human health impacts of introduced species
- Analysis and prioritisation of pathways of introduced species
- Suggested priority list of invasive species

## 5. Methods

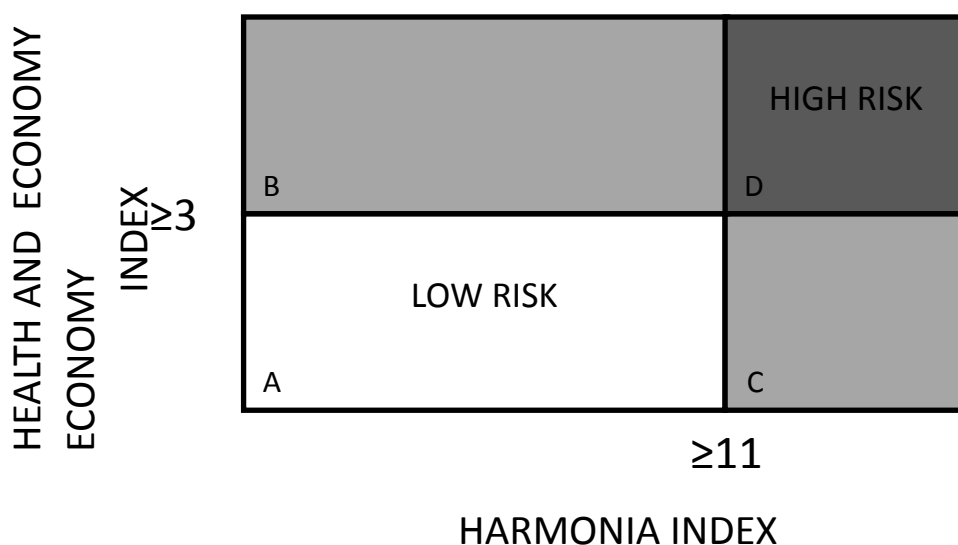
After collecting and sorting the data material, defining the scoring system and literature search protocol, an extensive literature research was made. Specialists were then consulted for a subset of species, and analyses of pathways were carried out. The following offers a detailed description of all methods used.

### Data material

A gross list was compiled of 2690 species from NOBANIS of which 2079 species were part of the literature analysis. There were 344 species on the various EPPO lists. In order to limit the number of species, the list was screened in order to identify species relevant for Denmark (for full description see Appendix 3). Thereby the most important and relevant 85 species from the EPPO list were found for the pathway analysis. In total 213 species with initial scores  $\geq 11$  were reviewed by specialists.

### Assessments and the scoring system

The assessments are based on the environmental impact assessment method HARMONIA (ISEIA guidelines). Figure 1 provides an overview of the scoring system used to identify high risk species.



**Figure 1.** Identification of high risk species. The HARMONIA index is on the x-axis and the 'Health and Economy index' on the y-axis. Species scoring  $\geq 11$  in HARMONIA and  $\geq 3$  in health and economy impacts were considered high risk species. Color grading score how species in section A are low risk species, B and C are medium risk and D are high risk species.

HARMONIA divides environmental hazards into four separate areas of interest (I-IV). Species were assessed using a scale from 1-3 in each category, allowing a maximum of 12 points. Based on similar categories in the recent report 'Danmarks Havstrategi – basisanalyse' published by Danish Ministry of Environment (2012), it was decided to add two new categories of economical- and health impacts (V-VI). Again each category used a scale of 1-3, allowing a maximum of 6 points. If no information could be retrieved the fields were left

blank. The overall sum is based on the available information and blanks are considered '0'. Hence, the total scores are minimum scores based on available information.

## **HARMONIA's four environmental impact assessments**

(NB: wording has been edited from that of the ISEIA protocol)

### **I. Dispersal potential**

Empty: No literature to base assessment on.

1. No or little dispersal potential documented. No spread in the environment due to a low potential for dispersal and low fecundity.
2. Medium dispersal potential documented. Low potential for dispersal, except when assisted by man. Medium to high fecundity.
3. High dispersal potential documented. High potential for dispersal and high fecundity.

### **II. Colonization of high conservation value habitats**

Empty: No literature to base assessment on.

1. No or little colonization documented. Colonization is restricted to man-made habitats.
2. Medium colonization documented. Colonization is usually restricted to low or medium conservation value habitats.
3. High colonization documented. High conservation value habitats are often colonized.

### **III. Adverse impacts on native species**

(Predation, competition, spread of disease to native species, genetic effects etc.)

Empty: No literature to base assessment on.

1. No or little impact documented. Impact on native populations is negligible.
2. Medium impact documented. Causes local changes but the effect is often reversible.
3. High impact documented. Causes severe local changes that often are considered irreversible.

### **IV. Alteration of ecosystem functions**

(Nutrient cycles or resource pools, habitat modifications, succession, food webs etc.)

Empty: No literature to base assessment on.

1. No or little alteration documented. Negligible impact on ecosystem processes and structures.
2. Medium alteration documented. Moderate impact on ecosystem processes and structures that are considered reversible.
3. High alteration documented. Strong impact on ecosystem processes and structure that are considered irreversible.

## **The added Economical and health impact assessments:**

### **V. Economic impacts**

(Negative impacts on production of plants and animals, infrastructure, loss of export, pesticides, management costs etc.)

Empty: No literature to base assessment on.

1. No or little impact documented.
2. Medium but limited impact documented.
3. High impacts documented.

### **VI. Health impacts**

(Negative impacts as a result of contact, bite or ingestion/inhalation etc.)

Empty: No literature to base assessment on.

1. None or merely weak symptoms that do not require treatment.
2. Medium impacts documented. Moderate symptoms, that are easily treated and do not cause permanent damage.
3. High impacts documented. Serious symptoms, treatment is difficult or impossible causing permanent damage or death. Highly frequent and contact allergies are included.

## Pathway categories

Several authors have stressed the importance of knowledge of pathways in invasions (Hulme 2006, Nentwig 2007, NISC 2007, Keller et al. 2011, ISCC 2013, Kelly et al. 2013). A need for consolidation of a common terminology has been pointed out (EU 2013) and work is still in progress in the EU-COST Action TD1209 'ALIEN Challenge'. Categories used to describe the pathways are based on the NOBANIS framework and Hulme et al. 2008. For each species it has been endeavoured to designate:

- Type of Introduction
- Pathway of Introduction and its subcategory
- Mode of Entry

**Type of introduction.** Refers to whether the introductions happen intentionally or unintentionally (NOBANIS).

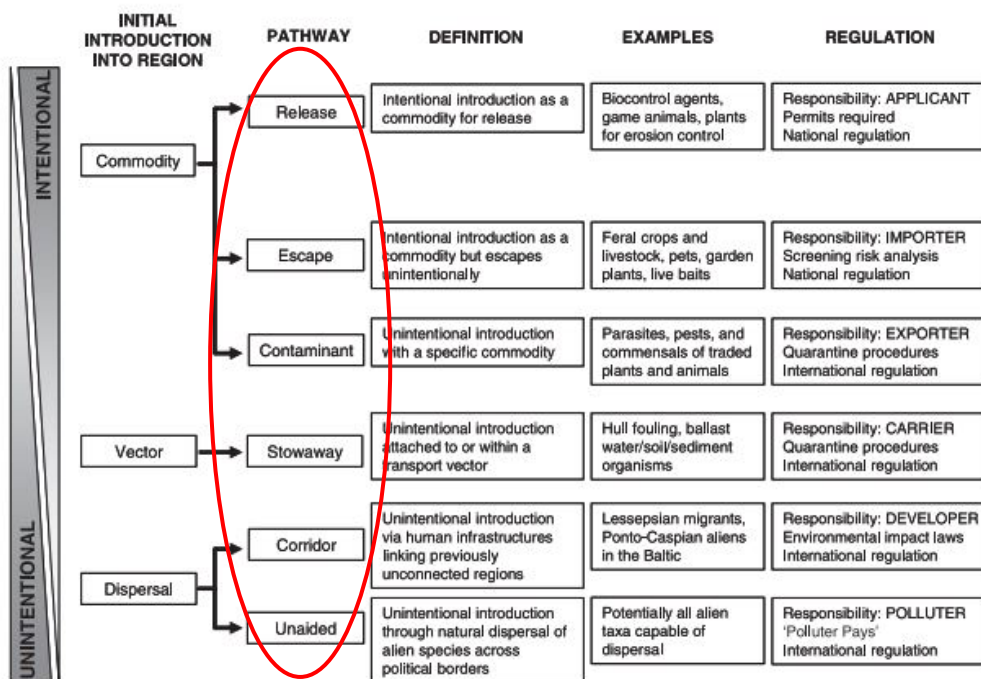
**Pathway of Introduction.** Pathways were based on categories from NOBANIS. A subcategory – Vectors – was added to specify the means of introduction. A single modification was necessary, because NOBANIS did not have a category covering commodities such as groceries, and for instance many arthropods are introduced as contaminants on food-products. The new category has therefore been dubbed Commodity contaminants and marked with asterisks in table 1.

**Table 1.** Pathway of Introduction. First column contains 'Pathway of Introduction' and second column the descriptive 'Sub category (vectors)'. \*Commodity contaminants is a new category, not part of the original NOBANIS framework.

<b>PATHWAY OF INTRODUCTION</b>	<b>SUBCATEGORY (VECTORS)</b>
Agriculture	Cuttings Fruits and vegetables Bird Seeds Grain Plants with roots Seeds Stored products (Other than grain) Other
Angling/Sport	Fishing material
Animal husbandry	(As contaminant)
Aquaculture	
Aquaria	
Ballast water and sediments	
Biological Control	
Escape	Botanical gardens Breeding farms Confinement Farms Pets Research Zoo Other

<b>PATHWAY OF INTRODUCTION</b>	<b>SUBCATEGORY (VECTORS)</b>
Forestry	Bark and wood chips Plants with roots (Incl. Pot plants) Sawn wood (Processed) Seeds Timber (Round wood) Wood packaging material Other
Horticulture	Cut flowers and branches Cuttings Plants with roots (Incl. Pot plants) Seeds Other
Hull fouling	
Hunting	
Landscaping	Cuttings Plants with roots (Incl. Pot plants) Seeds Erosion Control Other
Medicinal	Cuttings Plants with roots (Incl. Pot plants) Seeds Other
Reintroduction	
Secondary introduction	
Transport	Agricultural machinery Aircraft/car/truck/train/ship/leisure boat Military Packaging material (Except wood packaging material) Peoples baggage Other
Other	
Commodity contaminants*	
Not known	

**Mode of Entry.** ‘Mode of Entry’ was used to provide a broad and general pathways’ description. Figure 2 show the six pathways (in the red circle) that were dubbed ‘Mode of Entry’. A seventh category ‘Not known’ was added for cases where no information could be retrieved. Explanations provided in column ‘Definition’ were used as characteristics for ‘Mode of Entry’. For each species ‘Mode of Entry’ was determined using the definition and examples presented in figure 2. For example many angiosperms were intentionally introduced (=Type of Introduction) as garden plants for horticulture (=Pathway of Introduction) from where they have escaped (=Mode of Entry).



**Figure 2.** A simplified framework to categorize pathways of initial introduction of alien species (From Hulme et al. 2008). The red circle highlights the pathways used as Mode of Entry.

## EPPO species

There are 214 species on the EPPO 'A1 List of pests recommended for regulation' (Appendix 3, table 15), 88 species on the EPPO 'A2 list of pests recommended for regulation' (Appendix 3, table 16), and 42 species on the EPPO 'List of invasive alien species' (Appendix 3, table 17). This gave a total of 344 EPPO species. The species that were deemed most important and potentially damaging if introduced to Denmark were added to the analysis. This added 74 species to the NOBANIS list.

It is worth noting that a complete and thorough assessment of each species' potential in Denmark was not possible within this projects scope. Therefore the potential pathways of introduction, along with the probable effects on the environment, economy and health in Denmark are based on available EPPO data sheets or Pest Risk Analysis (PRAs). If the information in the EPPO data sheets is insufficient, other databases were consulted. The collected data is integrated in the analysis despite lacking specificity for Denmark.

### EPPO species were added to the list after:

- A thorough assessment of insects, mites and nematodes based on the EPPO Pest Quarantine Risk (PQR) for host plants and data sheets.
- An assessment of fungi based solely on EPPO data sheets.
- All plants from the 'A2 List' and 'List of invasive alien plants' were added, except for four species that only thrive in tropical or dry climates.
- Bacteria and phytoplasma, parasitic plants and virus and virus-like organisms are not added to the list.

- Species with documented large economic impacts or large fecundity/dispersal potential were included.
- Species that are only found in tropic or sub tropic climates are excluded from the study. So are species from the EPPO lists with the PQR classification 'intercepted', 'no longer present' or 'eradicated' in Denmark. These species are restricted to greenhouses and are therefore not able to survive in nature in Denmark. Species already registered in NOBANIS or placed on the Black or Observation list are however included in the analysis e.i. *Anoplophora glabripennis* and *Ips sexdentatus*.

**Host plants.** The prevalence of host plants in Denmark was examined to determine whether the host plants were native or non-native, cultivated or found in nature. Species that infest for instance *Fraxinus* (i.e. *Agrilus planipennis*) were placed on the list, while species infesting e.g. Palmae (i.e. *Rhynchophorus palmae*, *Paysandisia archon*) was deleted from the list and analysis, despite their importance and effect in other European countries. Neither were species that solely infest cultivated plants (e.g. potato, strawberry and apple) included. Species that infest 'forest' trees (including non-natives and 'plantation') were added to the list, under the assumption that any effect on large areas of forest or plantation, would lead to adverse economic impacts. Species, where the host plants are of importance in Denmark, but only considered minor hosts of the infesting species, were not included (e.g. major host = apple; minor host = citrus), except for a few incidents where many 'minor' native host plants are of importance in Denmark. Finally, species, where the only host plants of importance are considered common 'weeds' in Denmark, were deleted from the list. In a few instances species that had many wild host plants/bushes/trees were included.

## Literature search

A comprehensive literature search was conducted. In order to ensure reproducibility a protocol for the literature search was followed. The research platform Web of Knowledge was used with the actual species name as the first search word. If more than 40 articles were found, the search was narrowed down by including the words: 'introduction' OR 'pathway' OR 'dispersal' OR 'Denmark'. The search was replicated in Google, extending the search to include the actual species name AND 'impact' OR 'consequences' OR 'economic' OR 'environment' OR 'health' OR 'effect'. The search was repeated using the Danish common name of the species and using the Danish translations of each word. Furthermore several alien species databases (NOBANIS, DAISIE, and CABI) were consulted.

Scoring was based on available published literature, which included peer-reviewed journals, books, grey literature (reports etc.) and on-line databases dedicated to invasive species in Europe. For most species literature documenting the effect in Denmark was not available. In order to access as much information as possible, relevant internet sites, periodicals etc. was also included in the literature search. Literature from neighboring countries was only included, when assessing the adverse health effect and the potential spread.

## Specialist reviews

As a supplement to the literature research, an array of specialists were consulted to confirm and add knowledge. The literature search made it clear that it was not possible to score all species in all six categories. This was problematic, because the total score would no longer reflect the true potential

environmental, economic and health impacts. In order to circumvent this, modifying the method used by Jensen 2013, the lists for species to consult specialists was sorted into following:

- Invasive and potentially invasive species (as yet absent)
- Species with a total value equal to or higher than 11
- Species receiving maximum scores in at least two categories

This resulted in 136 species to review with specialists. In addition 77 species were reviewed as a result of extra efforts and upon recommendation from specialists. Therefore a total of 213 species were reviewed. Appendix 4 lists species that were added by specialists, whereas species that were suggested for removal and deleted are listed in the section 'Recommendation'.

The specialists were selected based on a general consensus within the Project group and from recommendations from specialists that for some reasons could not contribute themselves. They were contacted by either mail and/or telephone, and reviews were typically assisted by a person from the Project group. A guide to the evaluation and a project description was composed (Appendix 5). However, many specialists did not provide a score, but rather a text with a discussion of the categories and species. In these cases, the specialists were consulted again and a score was agreed upon.

## 6. Analyses of species-groups

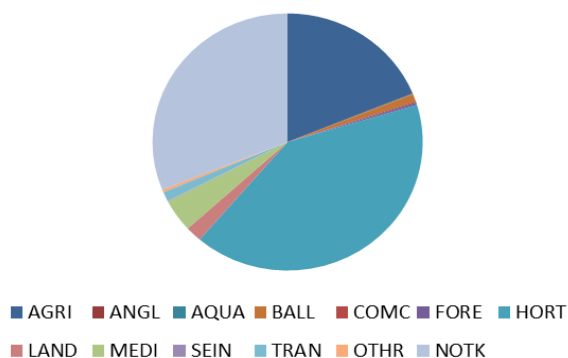
In the following part, the pathway analysis for each taxonomic group is presented. Pie charts present an overview of registered Pathways of Introduction (POI) and Mode of Entry (MOE) for each species group. Type of Introduction (TOI) refers to whether the species were introduced intentionally, unintentionally or both or if its not known. It is important to keep in mind that pie charts reflect that one species can have *multiple* Pathways of Introduction and Modes of Entry. Graphs depict the total number of species in the species group, unless stated otherwise.

## Angiosperma

**Denmark:** There are presently identified 2006 non-native angiosperms in Denmark, of which 1605 have been reviewed in this report. Only in very few cases, a plants introduction to Denmark can be traced with certainty to a specific vector. In most cases the new plant is simply recorded as present in Denmark without any information about date of introduction, MOE, POI or vector (Lange 1999).

**Terrestrial:** The vast majority of non-native angiosperms are terrestrial (n= 1572). Twenty-two of these are already on the Black list (Appendix 1) and 15 are on the Observation list (Appendix 2). Most plants were unintentionally introduced (n= 636), but an almost equal part of angiosperms were intentionally introduced (n= 512) or entered the country both intentionally and unintentionally (n= 413). The most frequent POI were Horticulture, constituting almost half of all registered pathways, but the pathway Agriculture was also frequently registered (Fig. 3).

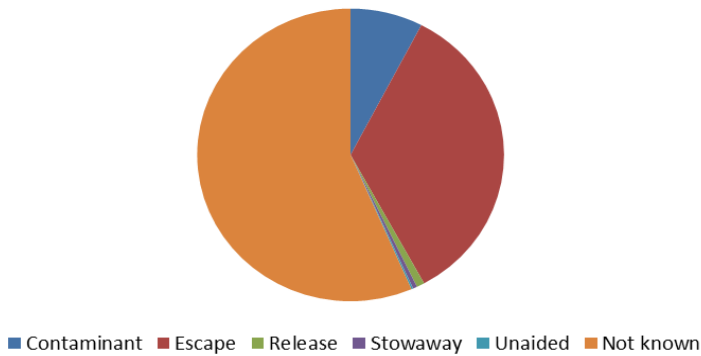
### Pathway of Introduction



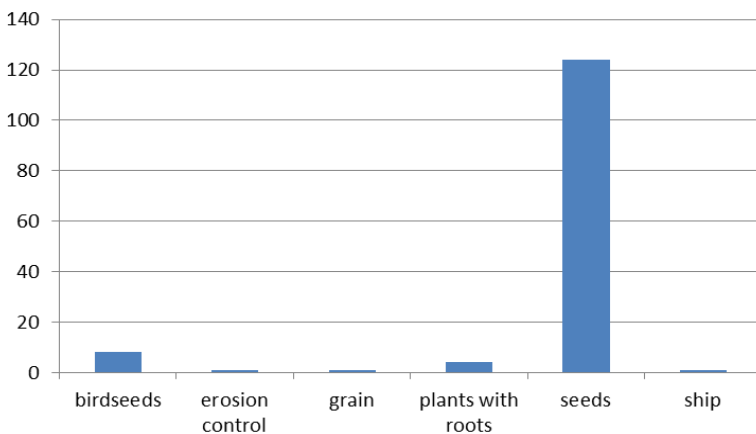
**Figure 3.** Pathway of Introduction for terrestrial non native angiosperms introduced to Denmark (n=1572). Horticulture and Agriculture were the main pathways, but terrestrial angiosperms have also been introduced via Medicinal, Landscaping, Transport and Ballast water and sediments. The remaining pathways were only identified for very few cases. AGRI = Agriculture, ANGL = Angling/Sport, AQUA = Aquaria, BALL = Ballast water and sediments, COMC = Commodity Contaminant, FORE = Forestry, HORT = Horticulture, LAND = Landscaping, MEDI = Medicinal, SEIN = Secondary introduction, TRAN = Transport, OTHR = Other and NOTK = Not known.

Mode of Entry was generally Not known (Fig. 4). Of the identified MOE, Escapes was the most common, although a sizeable amount of angiosperms entered as Contaminants. The remaining MOE (although insignificant in numbers) were Stowaways, Releases and Unaided (Fig. 4).

### Mode of Entry



**Figure 4.** Mode of Entry for non native terrestrial angiosperms in Denmark (n=1572). In most cases the MOE is ‘Not known’. However, ‘Escape’ and ‘Contaminant’ were also common.



**Figure 5.** Vectors of introduction for non native terrestrial angiosperms in Denmark. The columns show numbers of identified cases. Seeds was clearly the most predominant vector for plants.

Most vectors were identified for Agriculture, where seeds clearly were the most common vector (Fig.5). Weed seeds are commonly dispersed as impurities in grain. In recent years the number of weed seeds in commercial cereal seed appears to be decreasing, probably as a result of improved seed cleaning techniques along with the increased use of herbicides (Hodkinson and Thompson 1997). For the remaining pathways very few vectors were identified.

- Horticulture: plants with roots, seeds
- Landscaping: plants with roots, seeds
- Transport: ships

Only six (*Fallopia japonica*, *Solidago gigantea*, *Prunus serotina*, *Solidago Canadensis*, *Rosa rugosa* and *Heracleum mantegazzianum*) of the 22 angiosperms on the Black list were identified as a risk to the environment, economy or health. Of these, only *Fallopia japonica* (39 countries/regions), *Rosa rugosa* (34 countries/regions) and *Heracleum mantegazzianum* (27 countries/regions) are included in the DAISIE 100 worst alien species, but they are also among the most widely-distributed aliens (Pysek et al. 2009).

None of the remaining Black listed species and none of the species on the Observation list were found to pose a risk according to our analysis (Black list and Observation lists are provided in Appendices 1 and 2).

**Aquatic:** There are seven non-native aquatic angiosperms present in Denmark. Three of these are on the Black list: *Crassula helmsii*, *Elodea Canadensis* and *Elodea nuttallii*. The majority of aquatic angiosperms were either introduced intentionally or both intentionally and unintentionally. Only *Elodea nuttallii* was found to have been introduced unintentionally. Aquaria and Horticulture were equally common POI. All known MOE were Escapes. No vectors were identified.

Only two of the Black listed species i.e. *Elodea canadensis* and *Elodea nuttallii* meet the conditions of this assessment method to be regarded as a risk to the environment, economy or health. The aquatic angiosperms *Crassula helmsii* should perhaps be either completely removed or re-classified to the Observation list.

**Not recorded in Denmark:** 25 potential risk species were added either from the EPPO lists or by specialists. The assessment is based upon information from other countries, since the species is not yet recorded in Denmark.

**Terrestrial:** For the 13 terrestrial angiosperms the majority was intentionally introduced. Most were introduced through multiple MOE with Contaminants, Releases and Escapes being the most common and only few examples of Stowaway and Not known. The most common POI was Horticulture followed by Landscaping, Other, Agriculture, Transport, Ballast water and sediments, Forestry and Not Known. Many different vectors were found.

- Horticulture: plants with roots, seeds, other
- Landscaping: plants with roots, seeds, other, erosion control
- Agriculture: plants with roots, seeds, other, birdseeds, grain
- Transport: agricultural machinery, other

Interestingly only *Baccharis halimifolia* was assessed to pose a risk to the environment, economy or health if introduced to Denmark. The remaining potential risk species did not score as many total points, but since this review is based on conjecture, it is still advisable to regard these species as a potential threat.

The wide range of vectors and pathways indicates that preventing the introduction of the potential risk angiosperms to Denmark will demand rather extensive management methods.

**Aquatic:** The remaining 12 potential risk species were aquatic. All were intentionally introduced, but four were unintentionally introduced as well. The MOE was predominately Escapes. *Alternanthera philoxeroides* also entered as a Contaminant and Stowaway and *Hydrocotyle ranunculoides* also entered as a Release. Most had more than one POI with the most frequent being Aquaria and Horticulture. Vectors were only found for two species (*Ludwigia peploides* and *Hydrocotyle ranunculoides*).

- Horticulture: plants with roots, seeds
- Landscaping: other (phytoremediation)

Five aquatic angiosperms (*Egeria densa*, *Lagarosiphon major*, *Ludwigia grandiflora*, *Ludwigia peploides* and *Hydrocotyle ranunculoides*) were identified as a threat to the environment, economy or health if introduced to Denmark. The angiosperm *Hydrocotyle ranunculoides* was recommended for review by specialists and should according to the assessment method, as a minimum be placed on the Observation list in order to monitor its development. *Hydrocotyle ranunculoides* cost the British economy £23.5 million per year and the impacts of invasive non-native species on native species, habitats and economy has resulted in five non-native aquatic plants (*Azolla filiculoides*, *Myriophyllum aquaticum*, *Hydrocotyle ranunculoides*, *Crassula helmsii* and *Ludwigia grandiflora*) being banned from sale in UK from April 2014 (NOBANIS News 2013).

## Bryophyta

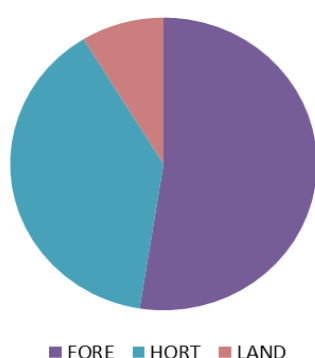
Three non-native bryophytes are currently present in Denmark. Two of these are considered invasive and they are already on the Black list (*Campylopus introflexus*) and Observation list (*Orthodontium lineare*).

All three bryophytes were introduced unintentionally, but otherwise there was no common trend in Mode of Entry or Pathway of Introduction. According to specialists *Campylopus introflexus* and *Orthodontium lineare* have a common pathway, with both presumably entering via transport in cars and trains. Although *C. introflexus* and *O. lineare* are recorded as alien or possibly alien in respectively 21 and 15 counties/regions, and have become as stable as any native species in some areas (Essl and Lampdon 2009), neither of the bryophytes were identified as a serious threat to the environment, economy or health.

## Coniferae

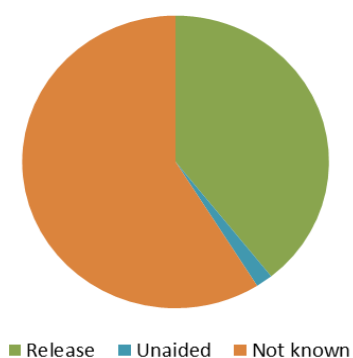
There are 56 non-native coniferous plants registered in Denmark. Seven of these are regarded as invasive and they are already on the Black list (*Pinus contorta*, *Pinus contorta* ssp. *contorta* var. *contorta*, *Pinus contorta* ssp. *murrayana*, *Pinus contorta* ssp. *contorta* var. *latifolia*, *Pinus mugo*, *Pinus mugo* ssp. *Mugo* and *Pinus mugo* ssp., and *Mugo x rotundata*). All coniferous plants were introduced intentionally. The most common POI was Forestry and Horticulture (Fig.6). Modes of Entry were primarily Not known, but when information was available, the majority was Releases (Fig.7). It was not possible to determine the vectors, except for *Pinus contorta*, which had been introduced by the vector Seeds for Forestry and Landscaping purposes.

### Pathway of Introduction



**Figure 6.** Pathway of Introduction for non-native coniferous plants in Denmark (n=56). Forestry was the most common Pathway of Introduction. FORE = Forestry, HORT = Horticulture and LAND = Landscaping.

### Mode of Entry



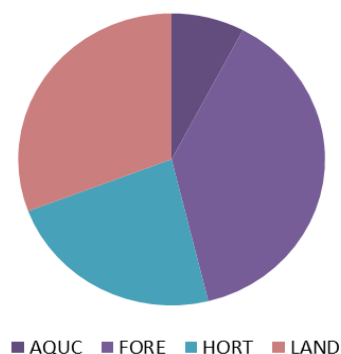
**Figure 7.** Mode of Entry for non-native coniferous plants in Denmark (n=56). 'Not known' and 'Release' are predominant.

Interestingly only *Pinus mugo* was identified as a threat to the environment, of all the coniferous plants that were characterized as invasive or potentially invasive in NOBANIS. This was due to *Pinus mugo*'s colonization of high conservation value habitats and a strong negative impact on ecosystem processes and structures.

## Fungi

**Denmark:** There are seven non-native fungi present in Denmark. Three of these are already on either the Black list (*Aphanomyces astaci* and *Ophiostoma novo-ulmi*) or the Observation list (*Microsphaera alphitoides*). All fungi were unintentionally introduced. Forestry and Landscaping were the main POI, but fungi have also been introduced with Horticulture and Aquaculture (Fig. 8). Common for all fungi except *Microsphaera alphitoides*, was that their MOE was as Contaminant for all pathways.

### Pathway of Introduction



**Figure 8.** Pathway of Introduction for non-native fungi in Denmark (n=7). Forestry were the most common Pathway of Introduction. AQUC = Aquaculture, FORE = Forestry, HORT = Horticulture and LAND = Landscaping.

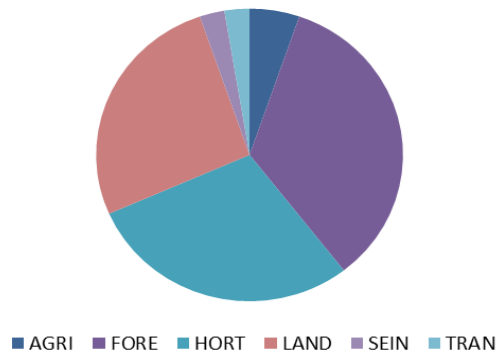
There were no general trends for the vectors, but ‘plants with roots’ were the most frequent vector in Forestry, Landscaping and Horticulture.

- Forestry: plants with roots, bark and wood chips, timber, sawn wood, seeds and wood packaging material, other
- Landscaping: plants with roots, seeds
- Horticulture: plants with roots, seeds, cut flowers and branches, and other (soil)

Interestingly the Black listed fungi *Aphanomyces astaci* and *Microsphaera alphitoides* from the Observation list were *not* identified as a risk to the environment, economy or health. Meanwhile the other Black listed species *Ophiostoma novo-ulmi* and the two species *Chalara fraxinus* and *Phytophthora ramorum* added by the Working Group in 2011, were all considered a threat to the environment and/or economy. We therefore suggest placing the latter two fungi on the Observation list, so the development can be closely monitored.

**Not recorded in Denmark:** 16 potential risk species were added from both EPPO lists and by specialists. The information stems from other countries since the species are not yet recorded in Denmark. All fungi have been introduced as unintentional Contaminants, except for *Monilinia fructicola* that supposedly also spread naturally from non-EU countries. Forestry, Horticulture and Landscaping were the main POI (Fig.9).

## Pathway of Introduction

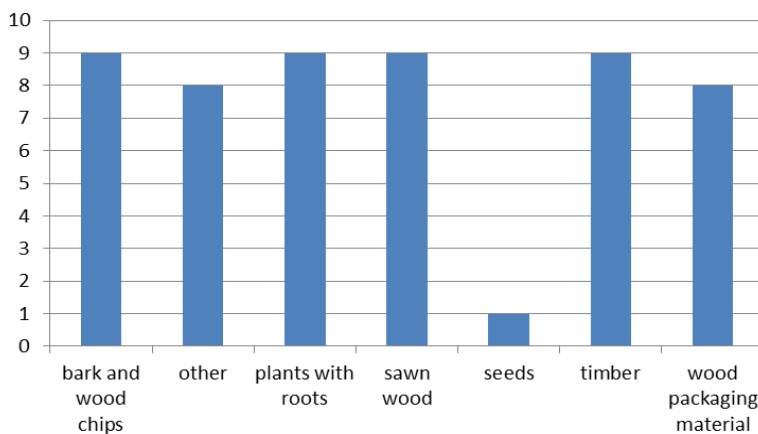


**Figure 9.** Pathway of Introduction for potential risk species of fungi (n=23). Forestry, Horticulture and Landscaping were the main POI. AGRI = Agriculture, FORE = Forestry, HORT = Horticulture, LAND = Landscaping, SEIN = Secondary introduction and TRAN = Transport.

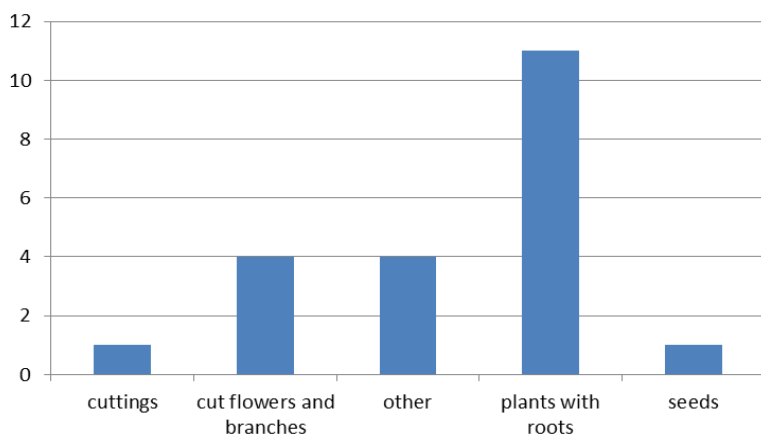
### Vectors

- Agriculture: plants with roots, fruit and vegetables, other
- Forestry: bark and wood chips, plants with roots, sawn wood, timber, seeds, wood packaging material, other
- Horticulture: plants with roots, cuttings, cut flowers and branches, seeds
- Landscaping: plants with roots, seeds, other
- Transport: people's baggage, truck, train, ship, packaging material

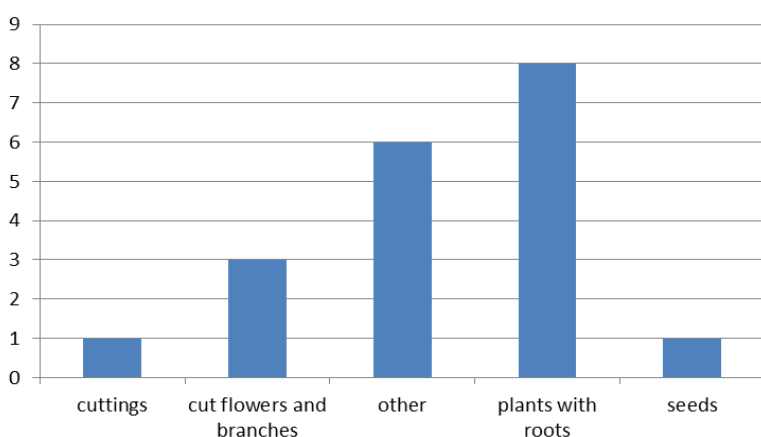
Figure 10-12 shows the distribution of vectors within three predominant pathways. Fungi are able to make use of a wide variety of vectors and therefore managing pathways for fungi will probably require a rather extensive management plan.



**Figure 10.** Distribution of vectors in Forestry for potential risk species of fungi in Europe (n=23). There were many different vectors within Forestry.



**Figure 11.** Distribution of vectors in Horticulture for potential risk species of fungi in Europe (n=11). Plants with roots was the most common vector.



**Figure 12.** Distribution of vectors in Landscaping for potential risk species of fungi in Europe (n=10). Plants with roots was the most common vector.

Two potential risk species were already on the Observation list (*Ceratocystis fagacearum* and *Phytophthora kernoviae*). However, it is worth looking into whether the fungi *Cryptostroma corticale* should be added to the Observation list, as it could become a serious threat to the environment and economy if introduced to Denmark.

### **Perspectives:**

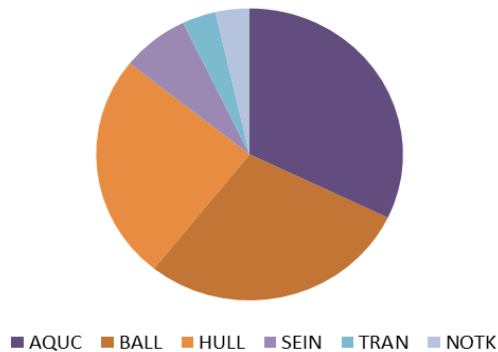
We evaluated 23 fungi: 7 already present in Denmark and 16 potential risk species. Of these, all but one received a relatively high evaluation score. There is a major underrepresentation of fungi in literature and in many databases, and it is generally accepted that less than 10 % of the existing fungi are described (Desprez-Loustau et al. 2007). Only two species of fungi are currently present in NOBANIS. This indicates that the database is not fully up to date. Other countries have published more extensive lists of non-native fungi; Germany (Kreisel 2000, 90 species), Norway (Gederaas et al. 2007, 263 species), Poland (Solarz 2007, 89 species) and France (Desprez-Loustau et al. 2008, 227 species). Although the national lists in NOBANIS are compiled using different definitions and methods and consequently are not directly comparable, there is a vast difference between the numbers of non-native fungi listed in Denmark versus other European

countries. Our consultation with a fungi specialist gave an additional 5 species that were added to the list. In 2014 the National fungi mapping efforts "Danmarks Svampeatlas" (<http://www.svampeatlas.dk/>) are finished and, more light will be shed on this particular group of species.

## Macroalgae

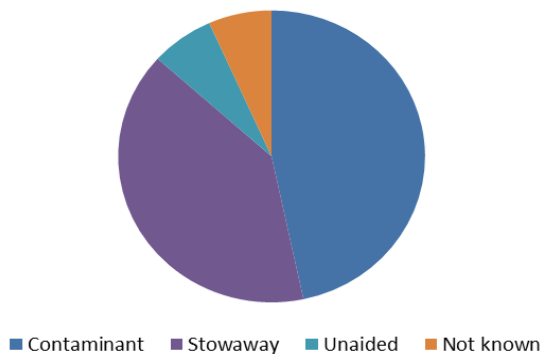
There are 15 non-native macroalgae present in Denmark. Seven of these are already on either the Black list (*Gracilaria vermiculophylla* and *Sargassum muticum*) or on the Observation list (*Bonnemaisonia hamifera*, *Codium fragile*, *Colomenia peregrine*, *Dasya baillouviana* and *Heterosiphonia japonica*). All macroalgae were unintentionally introduced primarily via the pathways Ballast water and sediments and Hull fouling (Fig. 13). The majority of macroalgae entered as Contaminants or Stowaways (Fig.14).

### Pathway of Introduction



**Figure 13.** Pathway of Introduction for non-native macroalgae in Denmark (n=15). ‘Aquaculture’ was the most common POI, but ‘Ballast water and sediments’ together with ‘Hull fouling’ made up more than half of all introductions. AQUC = Aquaculture, BALL = Ballast water and sediments, HULL = Hull fouling, SEIN = Secondary introduction, TRAN = Transport and NOTK = Not known.

### Mode of Entry



**Figure 14.** Mode of Entry for non-native macroalgae in Denmark (n=15). The most common MOE was as a Contaminant.

No vectors were uncovered, except for *Gracilaria Vermiculophylla* that got introduced to Denmark through Transport with ships. Together with *Sargassum muticum* both species are on the Black lists and were also confirmed here as threats to the environment and economy.

## Phytoplankton

Seven non-native phytoplanktons are present in Denmark. Two of these phytoplanktons are considered either invasive (*Karenia mikimotoi*) or potentially invasive (*Chattonella verruculosa*), but no phytoplankton are on the Black or Observation lists.

All phytoplankton were introduced unintentionally. The Pathway of Introduction for all phytoplankton was Ballast water and sediments, but Secondary introduction and Aquaculture were also common pathways. All registered Modes of Entry were Stowaways, but three phytoplanktons (*Karenia mikimotoi*, *Chattonella verruculosa* and *Prorocentrum minimum*) entered Denmark Unaided as well. *Karenia mikimotoi* entered as a Contaminant.

No vectors were described in the literature or by specialists.

Interestingly, only one phytoplankton received high scores for impacts on environment and should perhaps be placed on the Black or Observation list.

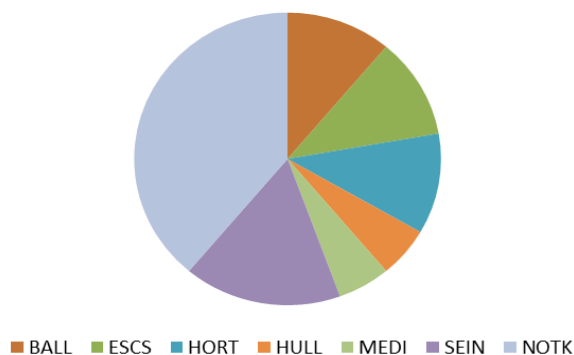
## Annelida

There are 16 non-native annelids present in Denmark. None of these are on the Black list or the Observation list. The majority (62 %) of annelids were unintentionally introduced. Most Pathways of Introduction for annelids was Not known, but a substantial proportion had been introduced via Secondary introduction, Ballast water and sediments, Horticulture and Escape (Fig. 15). In accordance with the pathways most annelids entered the country through the MOE 'Not known' (Fig. 16).

No vectors were described.

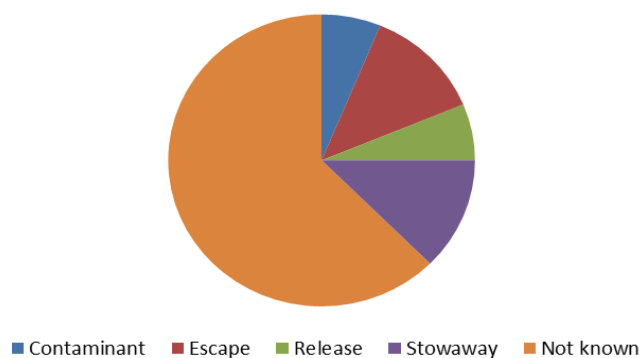
One annelid *Marenzelleria wireni* was identified as a severe threat to the environment, and it is therefore suggested to place *M. wireni* on the Black list or Observation list, so the development can be closely monitored. Ballast water or ship hulls are considered to be the pathway for *M. wireni* (Nehring 2001).

### Pathway of Introduction



**Figure 15.** Pathways of Introduction for non-native annelids in Denmark (n=16). Pathway of Introduction was mostly 'Not known'. BALL = Ballast water and sediments, ESCS = Escapes, HORT = Horticulture, HULL = Hull fouling, MEDI = Medicinal, SEIN = Secondary introduction and NOTK = Not known.

### Mode of Entry



**Figure 16.** Mode of Entry for non-native annelids in Denmark (n=16). Mode of Entry was mostly 'Not known'.

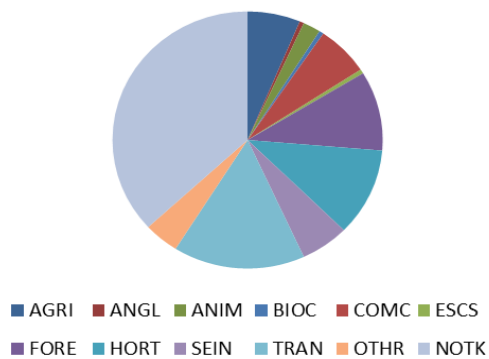
## Arthropoda

**Denmark:** There are 463 non-native arthropods in Denmark, of these 171 have been reviewed here.

**Terrestrial:** In total 155 terrestrial arthropods were assessed. Two of these were already on the Black list (*Cameraria ohridella* and *Harmonia axyridis*) and four were registered on the Observation list (*Anoplophora chinensis*, *Anoplophora glabripennis*, *Lasius neglectus* and *Phyllonorycter robiniella*). Most (93 %) of the arthropods were unintentionally introduced. This seems valid, since on a European level 86 % of alien arthropods are reported to have been unintentionally introduced (Rabitsch 2010).

Pathway of Introduction was mostly Not known (Fig. 17). However, arthropods seem to be able to enter the country via an array of different pathways, with Transport and Horticulture being slightly more common. Horticulture is also recognized as an important pathway according to studies made using the DAISIE database (Rabitsch 2010).

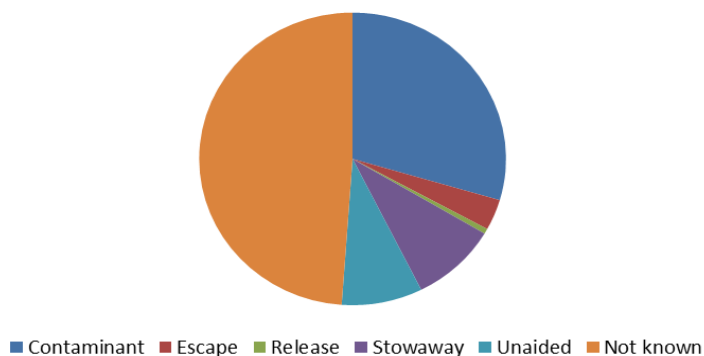
### Pathway of Introduction



**Figure 17.** Pathway of Introduction for non-native terrestrial arthropods in Denmark (n=155). Pathway of introduction was mostly 'Not known'. AGRI = Agriculture, ANGL = Angling/Sport, ANIM = Animal husbandry, BIOC = Biological control, COMC = Commodity Contaminant, ESCS = Escapes, FORE = Forestry, HORT = Horticulture, SEIN = Secondary introduction, TRAN = Transport, OTHR = Other and NOTK = Not known.

Figure 18 shows that MOE was Not known for more than half of the species, whereas Contaminant was the most frequent MOE in accordance with research from other studies (Hulme et al. 2008, Rabitsch 2010, Roy et al. 2011).

## Mode of Entry



**Figure 18.** Mode of Entry for non-native terrestrial arthropodes in Denmark (n=155). Mode of Entry was mostly 'Not known'.

Not surprisingly terrestrial arthropods also make use of a diverse array of vectors.

- Transport: packaging material, ship, car, train, truck, aircraft, peoples baggage
- Forestry: bark and wood chips, plants with roots, timber, seeds
- Horticulture: plants with roots, cut flowers and branches, cuttings, other
- Agriculture: stored products, seeds, grain, birdseeds, fruits and vegetables, plants with roots

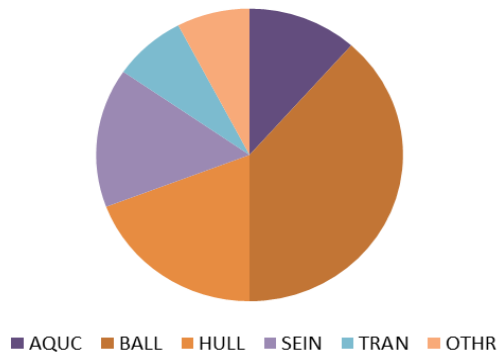
Only one species (*Varroa destructor*) was identified as a threat to the environment, economy and health. This is especially interesting, since it has not previously figured on any Danish Black or Observation lists. *Varroa destructor* entered Denmark as a contaminant on imported queen- and drone bees, and our assessment advocates for a placement on the Observation list, so the development can be closely monitored.

None of the species on the Black and Observation list were found to pose a risk according to our analysis (Black list and Observation lists are provided in Appendices 1 and 2).

**Aquatic:** In total 15 non-native aquatic arthropods were assessed. Three were on the Black list (*Astacus leptodactylus*, *Eriocheir sinensis* and *Pacifastacus leniusculus*) and *Callinectes sapidus* was on the Observation list.

It seems that there generally is more information available on the aquatic arthropods. In this way, and highly contrary to their terrestrial counterparts, pathways were identified for all species. The most common pathway was Ballast water and sediments (Fig.19). However, Aquaculture, Hull fouling and Secondary introduction were also frequently identified and together these three pathways constitute more than half of the pathways identified (Fig.19).

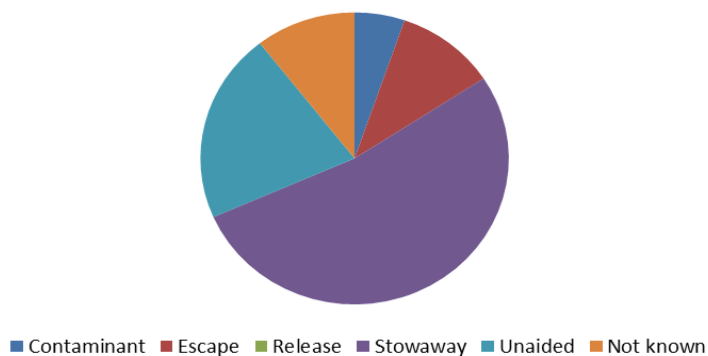
## Pathway of Introduction



**Figure 19.** Pathway of Introduction for non-native aquatic arthropods in Denmark (n=15). Most introductions happened via ‘Ballast water and sediments’. AQUC = Aquaculture, BALL = Ballast water and sediments, HULL = Hull fouling, SEIN = Secondary introduction, TRAN = Transport and OTHR = Other.

The majority of aquatic arthropods were unintentionally introduced. The most common MOE was as Stowaway, but Contaminants and Escapes were also frequent (Fig. 20).

## Mode of Entry



**Figure 20.** Mode of Entry for aquatic arthropods introduced to Denmark (n=15). ‘Stowaway’ was the most common MOE.

Vectors were only identified for one species (*Telmatogeton japonicus*).

- Transport: ship

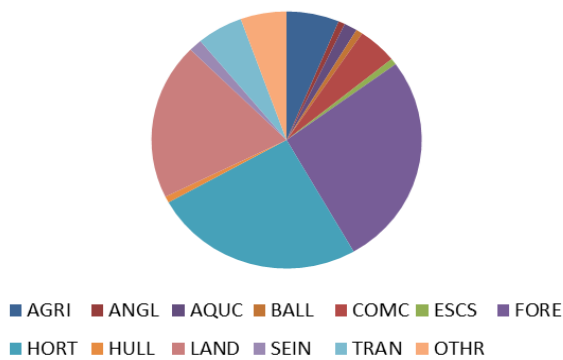
None of the species on the Black and Observation list were found to pose a risk according to our analysis (Black list and Observation lists are provided in Appendices 1 and 2). Furthermore no new species were identified for either list, since no aquatic arthropods already recorded in Denmark received high scores.

**Not recorded in Denmark:**

**Terrestrial:** There are currently 1590 terrestrial arthropods identified as alien to Europe (Roy et al. 2011). In total 43 potential risk species were included in this analysis, since these were deemed relevant if introduced to Denmark. The information on which the scores are based therefore stems from other countries. All have been introduced unintentionally as Contaminants, but five species (*Dendrolimus sibiricus*, *Dendrolimus superans*, *Corythucha ciliate*, *Diabrotica virgifera* and *Lymantria Mathura*) had additional MOE as Stowaways and Unaided.

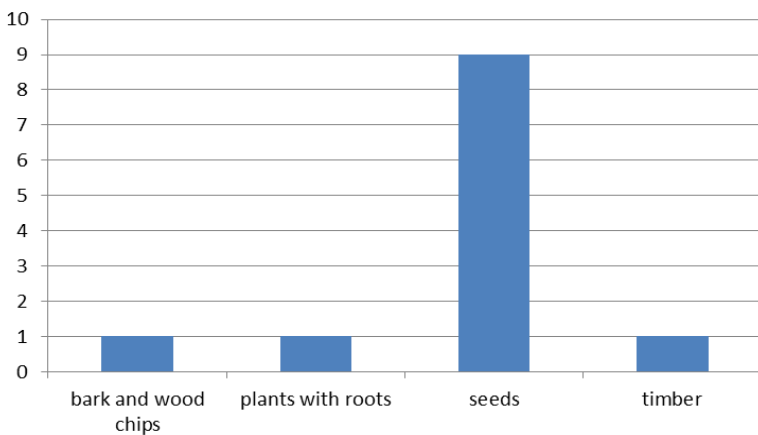
The main POI were Forestry, Horticulture and Landscaping (Fig. 21).

**Pathway of Introduction**



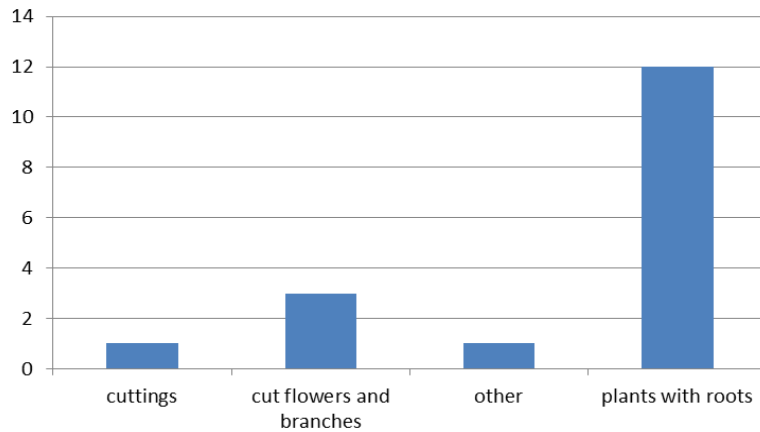
**Figure 21.** Pathway of Introduction for species not recorded in Denmark (n=43). The main pathways were Forestry, Horticulture and Landscaping. AGRI = Agriculture, ANGL = Angling/Sport, AQUC = Aquaculture, BALL = Ballast water and sediments, COMC = Commodity Contaminant, ESCS = Escapes, FORE = Forestry, HORT = Horticulture, LAND = Landscaping, SEIN = Secondary introduction, TRAN = Transport and OTHR = Other.

Vectors were identified for all species. Vectors for the most common POI are illustrated with figures 22-24. The vectors identified for the remaining pathways are listed below. All vectors except ‘Seeds’ were represented in Forestry (Fig. 22), indicating that Forestry is an especially important pathway to monitor.

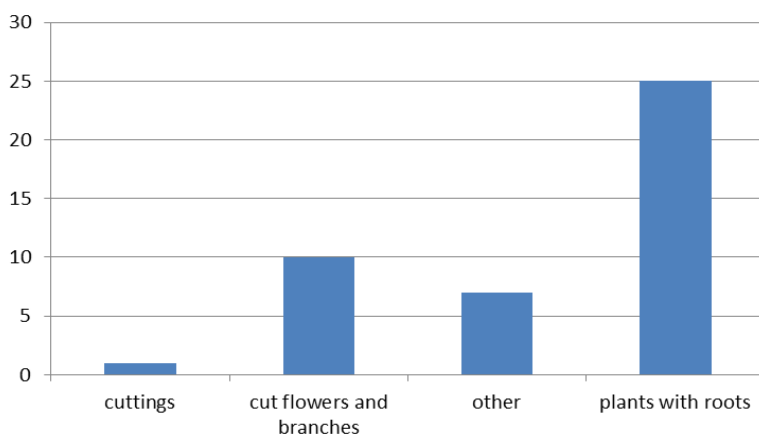


**Figure 22.** Vectors of arthropods introduced to Denmark by the pathway Forestry (n=34). ‘Seeds’ was the most common vector in Forestry.

For Horticulture 'Plants with roots' along with 'Cut flowers and branches' were the most common vectors (Fig.23). 'Plants with roots' and 'Cut flowers and branches' were also the most common vectors for Landscaping (Fig.24).



**Figure 23.** Vectors for arthropods introduced to Denmark by the pathway Horticulture (n=32). 'Plants with roots' was the most common vector in Horticulture.



**Figure 24.** Vectors for arthropods introduced to Denmark by the pathway Landscaping (n=43). 'Plants with roots' was the most common vector in Landscaping.

The vectors were

- Agriculture: plants with roots, fruits and vegetables, other
- Transport: packaging material, car, peoples baggage, aircraft, truck, train, ship, other
- Landscaping: plants with roots, cuttings, other

Three of the potential risk species (*Pissodes strobe*, *Dendrolimus sibiricus* and *Dendrolimus superans*) were identified as a threat to the environment, economy or health. Placing these on the Observation list, in order to closely monitor their further development, is therefore advisable. The beetle *Agrilus planipennis* was

also found to pose a threat to the environment and economy according to this assessment, and this species is already on the Danish Observation list.

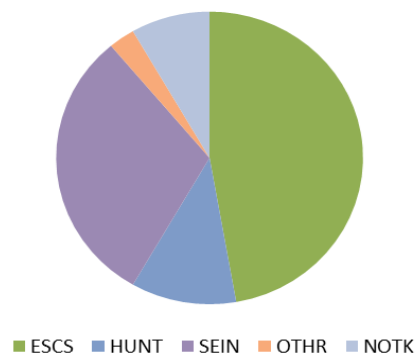
Aquatic: Three aquatic arthropods (*Paralithodes camtschaticus*, *Cercopagis pengoi* and *Homarus americanus*) have not been recorded in Denmark, but are placed on the Danish Observation list. The analysis is based on information on mode of entry and pathway of introduction from other countries. Only *Cercopagis pengoi* has been introduced unintentionally, whereas the other two species have been introduced both intentionally and unintentionally. The three species have entered other countries as Releases, Stowaways, Contaminants, Escapes but also Unaided. There was no general trend in the POI for these species. Four pathways (Ballast water & sediments, Hull fouling, Transport and Angling/sport) have been identified for *Cercopagis pengoi*. The remaining two aquatic arthropods each have two pathways of introduction, and both have been introduced through Aquaculture. Only one vector was identified; *Cercopagis pengoi* has been known to be introduced on fishing material.

Two species (*Paralithodes camtschaticus* and *Cercopagis pengoi*) were identified as a threat to the environment, economy or health, and these are already on the Observation list. The last aquatic arthropod on the Observation list, *Homarus americanus*, should however not be considered a threat according to this assessment.

## Aves

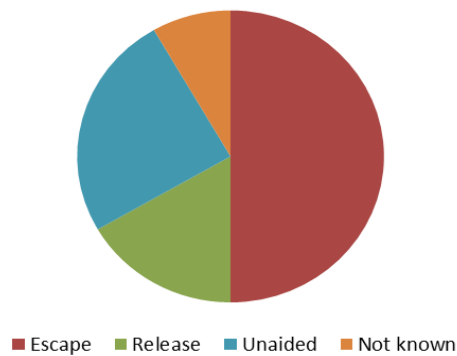
There are 26 non-native birds present in Denmark. Nine of these are already on either the Black list (*Alopochen aegyptiaca*, *Branta Canadensis* and *Oxyura jamaicensis*) or the Observation list (*Aix galericulata*, *Anser cygnoides*, *Anser indicus*, *Columba livia*, *Cygnus atratus* and *Psittacula krameri*). All non-native birds were intentionally introduced and 1/3 of these had also been introduced unintentionally. Almost half of POI were Escapes and more than a quarter Secondary introductions (Fig.25). In accordance with this pattern half the MOE were Escapes, relating to the pathway Escape and a quarter Unaided, relating to the Secondary introduction (Fig.26).

### Pathway of Introduction



**Figure 25.** Pathway of Introduction for non-native birds in Denmark (n=26). Most common POI was 'Escapes'. ESCS = Escapes, HUNT = Hunting, SEIN = Secondary introduction, OTHR = Other and NOTK = Not known.

### Mode of Entry



**Figure 26.** Mode of Entry for non-native birds in Denmark (n=26). Most common MOE was 'Escape'.

Vectors relating to the pathway Escape were identified.

- Escape: Zoo, pets and other (private collections)

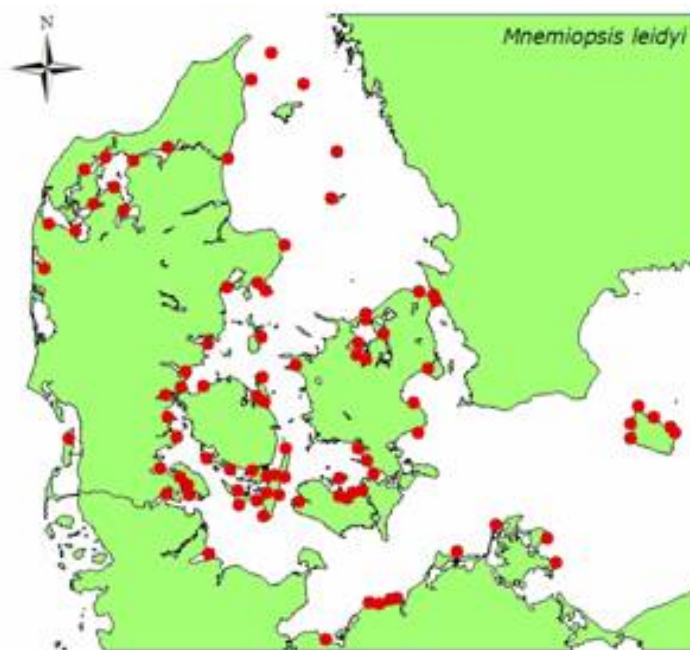
Interestingly none of the birds from the Black- or Observation list were identified as a risk to the environment, economy or health.

## Ctenophora

Only one comb jelly *Mnemiopsis leidyi* is considered non-native in Denmark. The comb jelly is already Black listed and specialists provide different theories for its introduction to Denmark. The most prevailing is, that it was introduced via ballast water to the Netherlands and then spread to Scandinavia either unaided or via ballast water (Faasse and Bayha 2006). Since 2007 it has been recorded from most Danish sea waters (Tendal et al. 2007)(Fig.27).

The Black listed *M. leidyi* poses a threat to the environment and economy according to this assessment, and efforts to limit this species spread as well as new introductions, should therefore be implemented.

Recently another comb jelly - *Beroe ovata* - which is a natural enemy of *M. leidyi* has been recorded from Danish sea waters. This may influence the situation and status of *M. leidyi*.



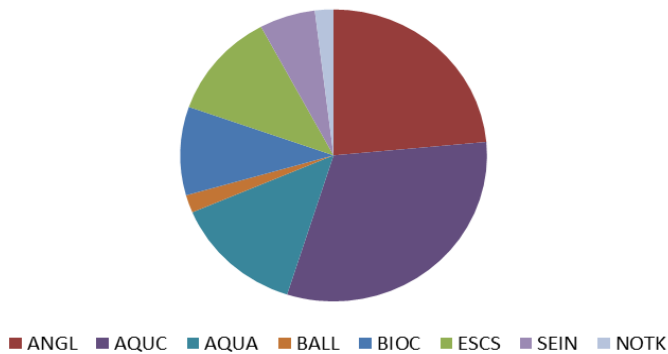
**Figure 27** Records of *Mnemiopsis leidyi* up until 2007.

(From <http://www.huriisgaard.biology.sdu.dk/Dræbergopler/dræber-gople.htm>).

## Pisces

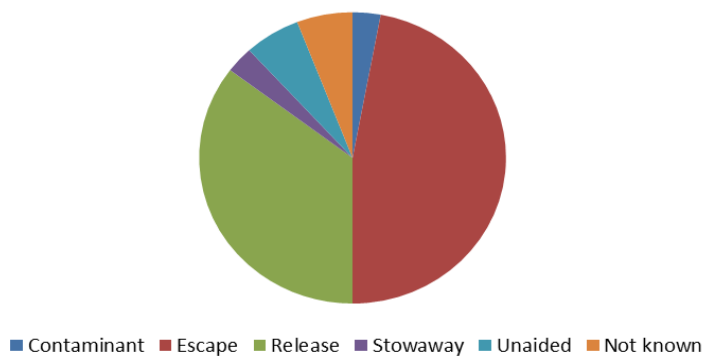
There are 25 non-native fish present in Denmark. Three of these are regarded invasive and are already on the Black list (*Carassius auratus*, *Lepomis gibbosus* and *Pseudorasbora parva*) and two are on the Observation list (*Cyprinus carpio* and *Neogobius melanostomus*). All fish except *Neogobius melanostomus* were introduced intentionally. There were many POI for fish, with the two major pathways being Aquaculture and Angling/sport (Fig.28). The most common MOE was Escapes, but Releases were also common (Fig.29). It was not possible to determine vectors for any of the fish species.

### Pathway of Introduction



**Figure 28.** Pathway of Introduction for non-native fish in Denmark (n=25). Most common pathway was 'Aquaculture'. ANGL = Angling/Sport, AQUC = Aquaculture, AQUA = Aquaria, BALL = Ballast water and sediments, BIOC = Biological control, ESCS = Escapes, SEIN = Secondary introduction and NOTK = Not known.

### Mode of Entry



**Figure 29.** Mode of Entry for non-native fish in Denmark (n=25). Most common MOE was 'Escape'.

Interestingly only *Neogobius melanostomus*, which is already on the Observation list was identified as a threat to the environment in this assessment. The remaining fish that were on the Black or Observation lists were not found to pose serious threats to the environment, economy or health.

## Platyhelminthes

Four non-native flatworms are present in Denmark. Two of these flatworms are considered invasive and are already on the Black list (*Pseudodactylogyrus anguillae* and *Pseudodactylogyrus bini*).

All flatworms were introduced unintentionally. Flatworms were introduced to Denmark through the pathways Aquaculture as well as Ballast water and sediments. The two Black listed species were contaminants in connection with import of elvers (glasål) for commercial eel production.

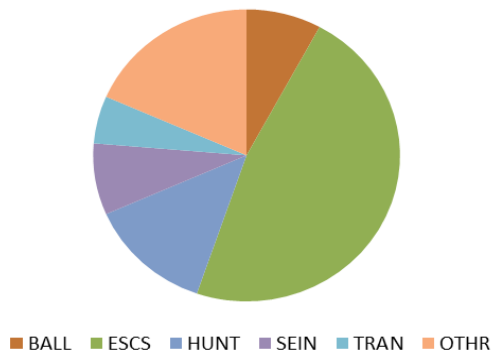
Remarkably, none of the flatworms were identified as a threat to the environment, economy or health according to the assessment method.

## Mammalia

The mammalia group consists of 25 species. Of these, 24 are present in Denmark, while the *Sciurus carolinenses* is not found in Denmark, but is considered a potential risk species due to the problems it causes in other countries.

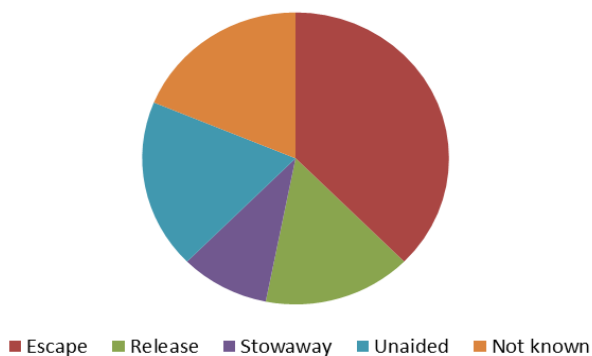
**Denmark:** Seven mammals were already on either the Black list (*Mustela vison*, *Mysocastor coypus*, *Nyctereutes procyonoides*, *Ondatra zibethicus*, *Procyon lotor* and *Rattus norvegicus*) or the Observation list (*Sciurus carolinensis*). The majority (71 %) of mammals were intentionally introduced to Denmark. Escapes were the most frequent POI, with Hunting and Other being fairly frequent as well (Fig.30). There were many different MOE, with the largest part being Escapes in accordance with the most frequent pathway registered (Fig.31).

### Pathway of Introduction



**Figure 30.** Pathway of Introduction for non-native mammals in Denmark (n=24). Most common POI was 'Escapes'. BALL = Ballast water and sediments, ESCS = Escapes, HUNT = Hunting, SEIN = Secondary introduction, TRAN = Transport and OTHR = Other.

### Mode of Entry



**Figure 31.** Mode of Entry for non-native mammals in Denmark (n=24). Most common MOE was 'Escape'.

Vectors were only available for the pathway Escapes.

- Escapes: pets, breeding farms, farms

Four of the Black listed mammals (*Myocastor coypus*, *Nyctereutes procyonoides*, *Ondatra zibethicus* and *Procyon lotor*) were interestingly not considered a threat to the environment, economy or health. The two remaining Black listed mammals (*Rattus norvegicus* and *Mustela vison*) were confirmed as potential risks. A management plan with the aim to regulate populations within certain areas has already been implemented in Denmark for *Myocastor vison* (American Mink) (Forvaltningsplan for mink (*Neovison vison*)).

**Not recorded in Denmark:** *Sciurus carolinensis* is already on the Observation list and our assessment confirms that it would be a problem species if introduced to Denmark. In other countries it is often introduced as a pet and escapes into the wild. However, it has also been intentionally released for ornamental purposes (Vilà et al. 2008). In Italy the introduction of *S. carolinensis* has led to the progressive disappearance of the red squirrel *S. vulgaris* (Bertolino et al. 2000), as has been the case in Great Britain (Gurnell and Wauters in Mitchel-Jones et al. 1999).

## Mollusca

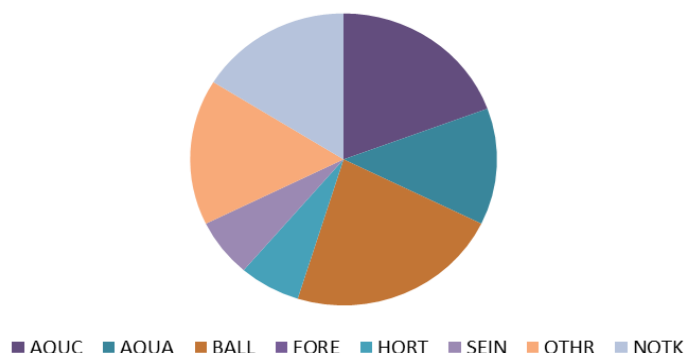
**Denmark:** There are 27 non-native molluscs present in Denmark.

**Terrestrial:** Ten of the non-native molluscs are terrestrial and a single species, *Arion lusitanicus* is already on the Black list. The majority of terrestrial molluscs have been unintentionally introduced, but there are also a few cases of intentional introductions, as well as intentional and unintentional introductions. Mode of Entry was identified for four terrestrial molluscs. Most entered the country as Releases, but there was a single incident of entry as a Stowaway. The MOE for the remaining species was Not known. The POI were Other or Horticulture for half of the species. No vectors were identified.

Surprisingly, the Black listed *Arion lusitanicus* was not found to pose any threat to the environment, economy or health.

**Aquatic:** 17 of the non-native molluscs are aquatic and five of these are already on either the Black list (*Crassostrea gigas*, *Dreissena polymorpha*, *Ensis americanus* and *Teredo navalis*) or the Observation list (*Crepidula fornicata*). The vast majority (82 %) was unintentionally introduced. The most common POI were Ballast water and sediments, Aquaculture and Aquaria (Fig.32). A few examples of Secondary introduction, Other and Hull fouling were also identified. The most common MOE for aquatic molluscs, were as a Stowaway or Contaminant, but there were also some incidents of Release, Unaided and Not known (Fig. 33). No vectors were identified.

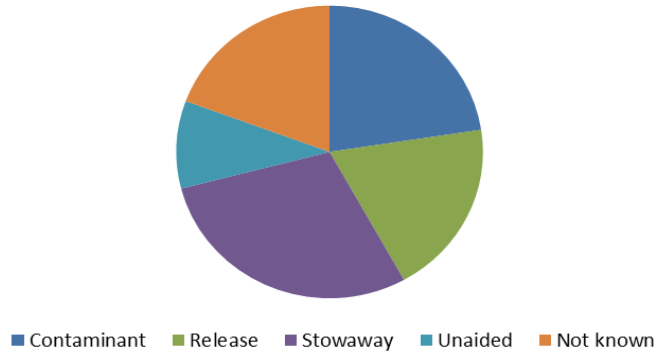
### Pathway of Introduction



**Figure 32.** Pathway of Introduction for non-native molluscs in Denmark (n=17). Most common pathway was 'Ballast water and sediments'. AQUC = Aquaculture, AQUA = Aquaria, BALL = Ballast water and sediments, FORE = Forestry, HORT = Horticulture, SEIN = Secondary introduction, OTHR = Other and NOTK = Not known.

Only two of the Black listed species (*Dreissena polymorpha* and *Teredo navalis*) were identified as a threat to the environment, economy or health. The remaining species on the Black and Observation lists did not meet the requirements based on the available information and should perhaps be re-classified or completely removed from their respective lists. See all non-native mollusc on the Black and Observation lists in Appendices 1 and 2.

### Mode of Entry

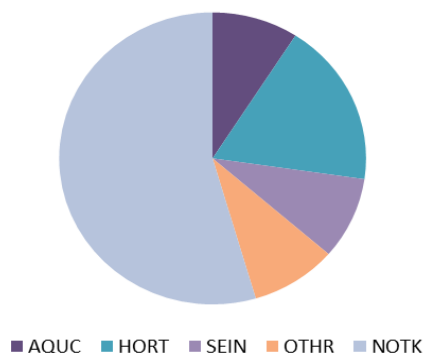


**Figure 33.** Mode of Entry for non-native molluscs in Denmark (n=17). Most common MOE was ' Stowaway'.

## Nematoda

**Denmark:** There are ten non-native nematodes present in Denmark. All have been unintentionally introduced. Pathway of Introduction was mostly Not Known, however it was identified for four species, as either Aquaculture, Horticulture Other or Secondary introduction (Fig.34). 70 % of MOE was Not known and the rest were Contaminants.

### Pathway of Introduction



**Figure 34.** Pathway of introduction for non-native nematodes in Denmark (n=10). AQUC = Aquaculture, HORT = Horticulture, SEIN = Secondary introduction, OTHR = Other and NOTK = Not known.

Vectors were identified for *Radopholus similis*.

- Horticulture: plants with roots

The nematode *Anguillicola crassus* is considered invasive and is already on the Black list. However, our assessment did not identify any of the nematodes as a threat to the environment, economy or health.

**Not recorded in Denmark:** *Bursaphelenchus xylophilus* was added to the literature review, as a potential risk species if introduced to Denmark (EPPO A2 List: Appendix 3, table 16). In other countries it has been unintentionally introduced as a Contaminant via pathways as Forestry or Agriculture.

Several vectors were identified for *Bursaphelenchus xylophilus*:

- Forestry: timber, sawn wood, bark and wood chips, wood packaging material, other
- Agriculture: plants with roots

## Reptilia and amphibia

**Denmark:** There are seven non-native reptiles and amphibians in Denmark. Two of these are considered potentially invasive and are already on the Observation list (*Lithobates catesbeiana* and *Rana balcanica*).

All reptiles and amphibians were introduced intentionally but one, *Emys orbicularis*, was also introduced unintentionally. The most common POI was Escapes of pets, but amphibians and reptiles were also introduced through Aquaria, Secondary introduction and Not known pathways. All MOE were Escapes, but there were also two cases of Unaided and Not known. No other vectors, besides the vector 'pets' from the pathway Escapes, were identified.

Interestingly, none of the amphibians already on the Observation list were identified as a threat to the environment, economy or health according to the assessment.

## 7. Analysis of pathways

Based on the evaluation a cross cutting analysis of the POI was conducted. The analysis includes the 2079 species covered by the survey. Of these 1988 species have been reported in Denmark and there are; 62 on the Black list, 85 on the Eppo list, and 47 on the Observation list. All analyses were conducted using SAS Enterprise. The abbreviations given in Table 2 are used in the subsequent analyses.

**Table 2.** Abbreviations for Pathway of Introduction used in the analyses.

Abbreviation	POI
AGRI	Agriculture
ANGL	Angling/sport
ANIM	Animal husbandry
AQUC	Aquaculture
AQUA	Aquaria
BALL	Ballast water & sediments
BIOC	Biological control
COMC	Commodity contaminants
ESCS	Escapes
FORE	Forestry
HORT	Horticulture
HULL	Hull fouling
HUNT	Hunting
LAND	Landscaping
MEDI	Medicinal
REIN	Reintroduction
SEIN	Secondary introduction
TRAN	Transport
OTHR	Other
NOTK	Not known

Generally the POI reflect the differences of habitats exploited by the organisms and dispersal abilities facilitated by man for the species groups. Many angiosperms have been introduced via the pathways Agriculture and Horticulture. Escapes is a very common POI for birds and mammals. Other frequent pathways are Forestry, Landscaping, Transport and Aquaculture (Table 3). It is important to remember that one species may have several pathways (Table 4), whereby the number of POI exceeds the number of species. The same goes for the vectors (Table 5). It is generally accepted that many of the most successfully dispersing species have multiple vectors and means of dispersal (Hodkinson and Thomson 1997). As a result it makes it rather challenging to eradicate or regulate such species with an effective management plan.

**Table 3.** POI as identified by species groups. 'Total' summaries the numbers of POI, 'Sum' is the total numbers of species with each species group. Table 2 shows abbreviations used for POI. Schaded cells indicate frequent POI for each species group.

POI/species groups	Angiosperma	Annelida	Arthropoda	Aves	Bryophyta	Cnidaria	Coniferae	Ctenophora	Pteridophyta	Platyhelminthes	Fungi	Macroalgae	Mammalia	Mollusca	Nematoda	Other chordates	Pisces	Phytoplankton	Reptilia & amphibia	Total
AGRI	332		20								2				1					355
ANGL	1		2														12			15
ANIM			4																	4
AQUC			5			1			2	1	9		7	1	1	16	1			44
AQUA	16								2					4			7		2	31
BALL	18	2	11			3		1		1		8	3	8			1	5		61
BIOC			1														5			6
COMC	3		18																	21
ESCS		2	2	17									19				6		7	53
FORE	6		53		1		42				17				1					120
HORT	733	2	53				31		6		14			2	2					843
HULL		1	6			2						7		1		2				19
HUNT				4									5							9
LAND	44		25				7				14									90
MEDI	71	1																		72
REIN																				0
SEIN	1	3	17	11	1			1			1	2	3	3	1		3	2	1	50
TRAN	24		39		2						1	1	2							69
OTHR	12		17		1								7	5	1			1		44
NOTK	542	7	72	3						1		1		5	6		1	1		639
sum	1803	18	345	35	5	6	80	2	8	4	50	28	39	35	13	3	51	10	10	2545

**Table 4.** Frequency and percentage of species with one to seven pathways. Most species have one or two POI. No species had six pathways, which is why number of pathways jump from five to seven in the first coloumn.

Number of POI	Frequency	Percent
One	1722	83
Two	270	13
Three	68	3
Four	13	1
Five	4	0
Seven	1	0
Total	2078	100

**Table 5.** Frequency and percentage of species with zero – eight number of vectors. Most species had no registered vector, and about 10 % had one or two vectors.

Number of Vectors	Frequency	Percent
Zero	1794	86
One	175	8
Two	48	2
Three	24	1
Four	13	1
Five	7	0.3
Six	10	0.5
Seven	6	0.3
Eight	1	0.1

The Type of Introduction was classified as either intentional (IN) or unintentional (UN) and in some cases both types have been identified in the sources (UNIN). In total approximately half of the species have been introduced unintentionally, but more interestingly this also tells us that the rest have been more or less intentionally introduced (Table 6). For the pathway Agriculture the majority were introduced unintentionally whereas for pathway Horticulture a dominant part is introduced intentionally, obviously reflecting the differences in the utilization of species. Approximately half of the 50 species which are classified as noxious in Germany were introduced unintentionally, but all of these are confined to agriculture and arable fields (Kowarik 2003). Almost all problems due to invasive plants in other areas than agriculture result from intentional introductions. The vast majority of invasive plants have been introduced on purpose for their ornamental qualities in Horticulture.

**Table 6.** Pathway of Introduction and Type of Introduction in numbers and percent. First part of the table to the left gives numbers of POI. Second part of the table to the right shows the percentage of each TOI for each POI. For POI abbreviations see table 2. 0 = Not Known, IN = Intentional, UN = Unintentional, UNIN = Intentional & Unintentional. 0-10 = no color, 11-25 = green, 26-50 = yellow, >50 = red.

POI abbreviation	Blank	IN	UN	UNIN	SUM				
	Number					Blank	IN	UN	UNIN
AGRI	5	62	237	51	355	1	17	67	14
ANGL		12	3		15	0	80	20	0
ANIM		2	2		4	0	50	50	0
AQUC		20	21	3	44	0	45	48	7
AQUA		21	5	5	31	0	68	16	16
BALL		1	56	4	61	0	2	92	7
BIOC		5	1		6	0	83	17	0
COMC			20	1	21	0	0	95	5
ESCS		37		16	53	0	70	0	30
FORE		46	74		120	0	38	62	0
HORT	39	433	153	218	843	5	51	18	26
HULL			19		19	0	0	100	0
HUNT		6		3	9	0	67	0	33
LAND	3	38	41	8	90	3	42	46	9
MEDI	4	41	7	20	72	6	57	10	28
REIN					0				
SEIN	2	6	28	14	50	4	12	56	28
TRAN			63	6	69	0	0	91	9
OTHR		5	29	10	44	0	11	66	23
NOTK	16	51	412	160	639	3	8	64	25
SUM	69	786	1171	519	2545	3	31	46	20

The six Modes of Entry are given in table 7 relatively to the different pathways. Escape is the most frequent MOE, especially for the POI Horticulture, while Contaminant is most frequent MOE for the POI Agriculture.

**Table 7.** Distribution of Pathway of Introduction and Mode of Entry. Sum is the total for each row or column. Shaded cells indicate frequent Mode of Entry for each Pathway.

POI/MOE	Contaminant	Escape	Release	Stowaway	Unaided	Not known	Sum
Agriculture	124	72	5	3	4	147	355
Angling/Sport		3	9	1	1	1	15
Animal husbandry	1	3					4
Aquaculture	11	7	13	5	7	1	44
Aquaria	3	20	4	1	2	1	31
Ballast water and sediments	3	4		34	10	10	61
Biocontrol		1	4		1		6
Commodity contaminant	10	1		7	3		21
Escapes		31	3		12	7	53
Forestry	60	2	20	5	6	27	120
Horticulture	68	522	28	10	7	208	843
Hull fouling	5			11	3		19
Hunting			6		3		9
Landscaping	35	19	19	5	2	10	90
Medicinal	2	42	2	1		25	72
Reintroduction							0
Secondary introduction	2		2	2	40	4	50
Transport	10	2		22	11	24	69
Other	9	2	5	10	17	1	44
Not known	5	3				631	639
<b>Sum</b>	348	734	120	117	129	1097	2545

Vectors were identified for some POI and gave additional information (Table 8).

**Table 8.** The twenty eight vectors used in this study.

Vector
Aircraft
Agricultural machinery
Peoples baggage
Bark and wood chips
Birdseeds
Breeding farms
Car
Cuttings
Cut flowers and branches
Erosion control
Farms
Fishing material
Fruits and vegetables
Grain
Other
Packaging material (excl. wood)
Pets
Plants with roots
Research
Sawn wood
Seeds
Ship
Stored products
Timber
Train
Truck
Wood packaging material
Zoo

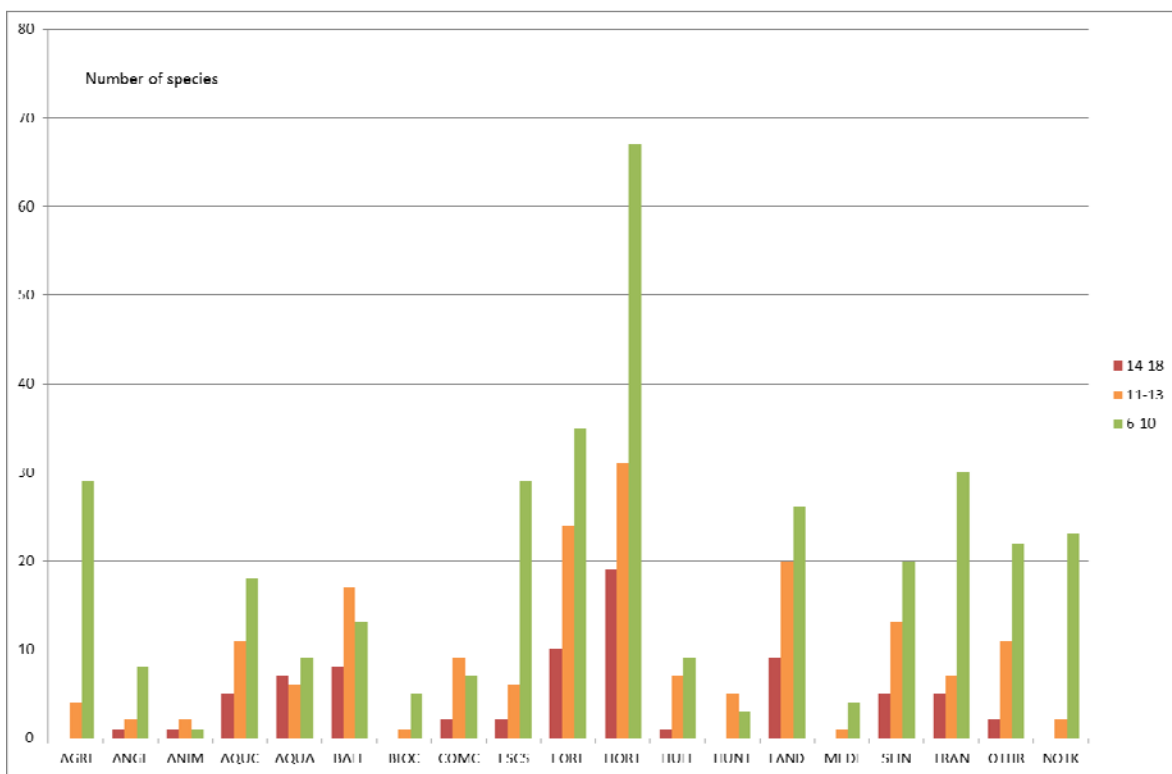
The most frequent vectors identified were plants with roots, seeds, and other (Table 9).

**Table 9.** The frequency of each vector within a particular Pathway of Introduction. Only POI with at least one identified vector are shown here. ‘Sum’ is the total number of times a vector has been identified, ‘Total’ is the total number of vectors within each POI. Shaded cells indicate frequent known vectors for each POI.

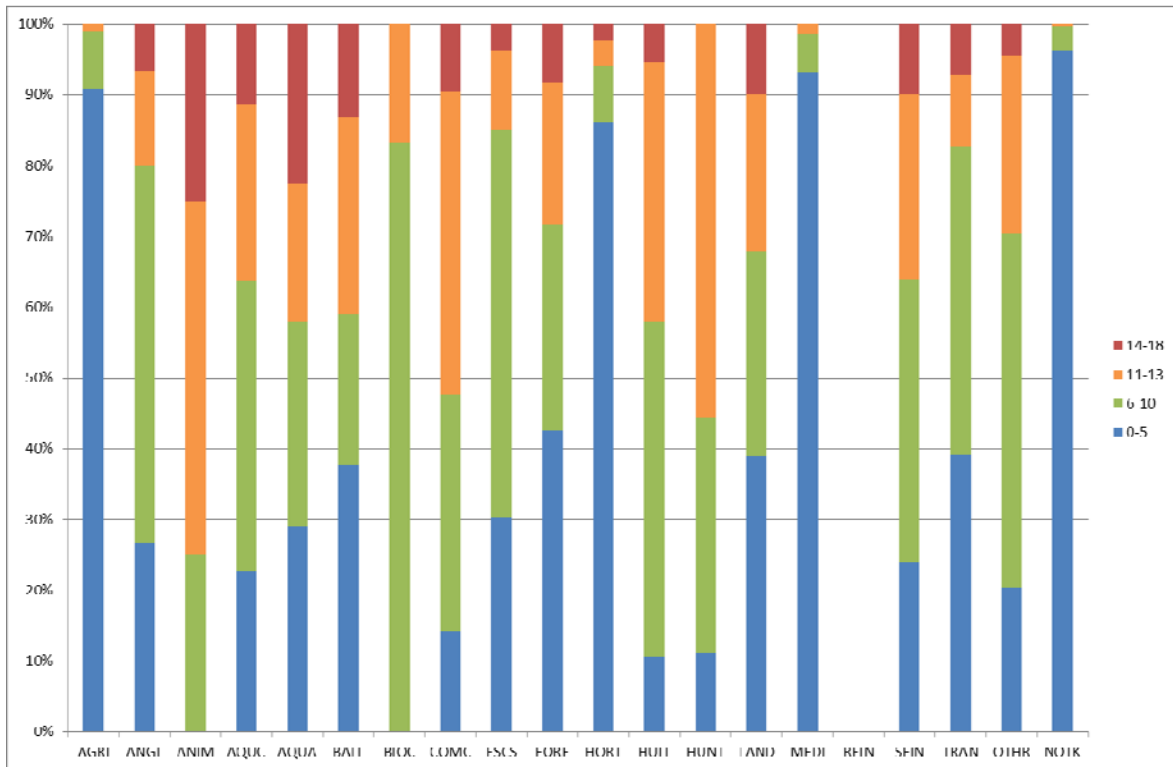
Vector / POI	Agriculture	Angling/Sport	Escapes	Forestry	Horticulture	Landscaping	Medicinal	Transport	Other	Sum
Plants with roots	15			45	66	45				171
Seeds	109			14	27	7	4			161
Other	6		3	24	20	16		5	3	77
Timber				37						37
Cut flowers and branches	1				20	13				34
Sawn wood				34						34
Wood packaging material				33						33
Bark and wood chips				25						25
Pets			12							12
Birdseeds	10									10
Ship								10		10
Car								9		9
Fruits and vegetables	8									8
Grain	7									7
Train								6		6
Breeding farms			5							5
Cuttings					3	2				5
Erosion control						4				4
Peoples baggage								4		4
Stored products	4									4
Farms			3							3
Fishing material		3								3
Agricultural machinery	1							1		2
Aircraft								2		2
Zoo			1							1
Truck							5		5	
<b>Total</b>	161	3	24	212	136	87	4	45	3	675

Figure 35 shows the distributions of scores relative to POI. Species with scores less than 5 are excluded from the figure, leaving focus on the potentially most invasive species. Horticulture is the pathway that contains most species with high scores. Forestry and Landscaping also contain a considerable part of the species with the highest scores. However, these are also some of the most common pathways (Table 7). Interestingly Agriculture, the second most common pathway, contained a relatively low proportion of species with high scores. This is very clear from figure 36, which gives the percentage per POI and contains species with scores less than 5. More than 90 % of the species introduced via Agriculture receive a low score (0-5).

The diagram, Figure 36 shows - for each pathway of introduction - which impact score group the species using this partway fall into. For example more that 50% of the species using 'Animal husbandry', 'Hunting' and 'Commodity contaminants' as pathway scores in the two highest ranking impact categories. However, referring to table 3, page 49 shows that only 4 species (all arthropods) have been identified using this pathway whereas it is 9 species (birds and mammals) using 'Hunting' and 21 species (mainly arthropods) using 'Commodity contaminants'.



**Figure 35.** Number of species by POI and total score. Blue indicate species with a total score between 6-10, red indicates species with a total score between 11-13 and green indicate a total score of 14-18. POI abbreviations are shown in table 2.



**Figure 36.** Percentage of species (y-axis) by POI (x-axis) and total score (colors scale). POI abbreviations are shown in table 2.

In conclusion the pathway analysis shows that 'Horticulture' and 'Agriculture' are by far the common pathways for exotic species to Denmark. In Denmark 1.198 species have been introduced by these two pathways alone whereas third most common pathway 'Forestry' have been led to introduction of 120 species and fourth comes 'Landscaping' – which could be called "Horticulture outside the garden fence" – with 90 species introduced. Fortunately not all introduced species develop into invasive species. If the evaluation of negative impacts on biodiversity, economy and human health are distributed on pathways 'Horticulture' is by far the most significant pathway of introduction closely followed by 'Forestry' and 'Landscaping'. When 'Agriculture' is so much more insignificant as pathway for species with high impact, it is because the organisms unintendedly introduced through 'Agriculture' are most often plant seeds. They probably rarely spread outside the growing system, they are checked by the management regime inside, and outside they are not identified as of significant importance. For 'Horticulture' this is different. There are many examples where plantspecies is introduced as ornamentals for gardens and since have established outside and become invasive: *Heracleum mantegazzianum*, *Rosa rugosa*, *Fallopia japonica*, *Prunus serotina*, *Pinus mugo* ect.

If authorities want to take action on the situation where a few highly competitive organisms are reducing diversity globally at an increasing speed this type of analysis of significance of pathways of introduction and present and potential impacts on biodiversity, economy and human health could be a tool in focusing countermeasures.

## Analysis of impact

The severity of an introduced species is often considered to be a combination of the probability of dispersion abilities and the magnitude of adverse impacts. Table 10 show the distribution of species according to their HARMONIA score (excluding dispersion potential) and Dispersion potential.

The assesment method provides a method for allocating species within different hazard categories (Black and Observation list) based on scientific research and with minimal use of subjective opinions. The Belgium Harmonia system divides the total ISEIA score into three categories; A (black list) 11-12 points, B (watch list) 9-10 points and C with 4-8 points. Table 11 shows how many species are divided into each of these proposed hazard categories. It is clear that the majority of species included in this study are found outside the A-C categories. This supports the general position that most introduced species in fact do not pose a risk to the environment, economy or society (Baagøe and Weidema 2001). A number of introduced species are however not only able to establish populations in new locations, but are also able to reproduce and spread quickly, often out-competing native plant and animal species for food water and space (Baagøe and Weidema 2001).

These problematic species should be placed on the Observation and Black list, and they can be identified in table 10. According to our assessment and the Belgian risk categories only 31 species should be on the Danish Black list while 71 species should be on the Observation list. It is worth noting that a number of species have a medium to high dispersion potential, and are blank in one or all of the remaining HARMONIA categories. It is quite possible that more problematic species are not identified due to lack of information on the species ability to colonize high conservation value habitats, impact native species and alter ecosystem functions. The frequency of scores for each HARMONIA category are given in Appendix 7.

In table 11 the scores for impact on economy and public health is incorporated ('Total sum of impact'). When including the categories public health and economy, the number of problem species increases. An additional 10 species impact human interests and these are evident from table 11. The specific species can be found in the list in Appendix 6.

**Table 10.** Distribution of species according to their 'HARMONIA' score and 'Dispersion potential' score (n=2079). Consistent with the ISEIA score species are allocated to different risk categories( Black list, Watch/Observation list, C list). ISEIA score 11-12 = Black list, ISEIA score 9-10 = Watch/Observation list, ISEIA score 4-8 = C.

<b>HARMONIA</b>	<b>9</b>		<b>1</b>	<b>2</b>	<b>17</b>
	<b>8</b>		<b>1</b>	<b>4</b>	<b>12</b>
	<b>7</b>		<b>2</b>	<b>18</b>	<b>29</b>
	<b>6</b>		<b>4</b>	<b>12</b>	<b>18</b>
	<b>5</b>	<b>1</b>	<b>13</b>	<b>16</b>	<b>28</b>
	<b>4</b>		<b>11</b>	<b>18</b>	<b>27</b>
	<b>3</b>	<b>2</b>	<b>34</b>	<b>19</b>	<b>31</b>
	<b>2</b>	<b>28</b>	<b>13</b>	<b>8</b>	<b>12</b>
	<b>1</b>	<b>62</b>	<b>5</b>	<b>23</b>	<b>13</b>
	<b>Blank</b>	<b>1444</b>	<b>80</b>	<b>18</b>	<b>52</b>
		<b>Blank</b>	<b>1</b>	<b>2</b>	<b>3</b>
	<b>Dispersion potential</b>				

**Table 11.** The distribution of species by 'Total sum of impacts' and 'Dispersion potential' (n=2079). The 'Total sum of impacts' are the sum of scores from 'Adverse impact on native species', 'Alteration of ecosystem functions',

‘Economical effect’ and ‘Public health effects’. Blank was used when no information could be retrieved. Species receiving 14 points or more in total sum of impact are shaded in gray.

<b>Total sum of impact</b>	<b>15</b>				<b>2</b>
	<b>14</b>				
	<b>13</b>		<b>1</b>		<b>5</b>
	<b>12</b>			<b>4</b>	<b>14</b>
	<b>11</b>			<b>5</b>	<b>13</b>
	<b>10</b>		<b>2</b>	<b>11</b>	<b>20</b>
	<b>9</b>		<b>6</b>	<b>15</b>	<b>21</b>
	<b>8</b>		<b>4</b>	<b>17</b>	<b>21</b>
	<b>7</b>	<b>1</b>	<b>11</b>	<b>16</b>	<b>28</b>
	<b>6</b>	<b>1</b>	<b>12</b>	<b>15</b>	<b>27</b>
	<b>5</b>	<b>3</b>	<b>24</b>	<b>15</b>	<b>9</b>
	<b>4</b>	<b>8</b>	<b>2</b>	<b>11</b>	<b>8</b>
	<b>3</b>	<b>35</b>	<b>9</b>	<b>6</b>	<b>7</b>
	<b>2</b>	<b>157</b>	<b>13</b>	<b>6</b>	<b>19</b>
	<b>1</b>	<b>107</b>	<b>8</b>	<b>3</b>	<b>16</b>
	<b>Blank</b>	<b>1225</b>	<b>72</b>	<b>14</b>	<b>29</b>
	<b>Blank</b>	<b>1</b>	<b>2</b>	<b>3</b>	
	<b>Dispersion potential</b>				

## High risk species

The species inflicting the most adverse impacts are listed in Appendix 6, matching the high risk species and scores, here with a selection of the approx. 100 species with the highest scores shown by taxonomic group following same order as in this report.

It is somewhat reassuring that 63 % of the species on the Black list and almost 45 % of species from the Observation list are represented on our list of high risk species. At the same time the differences calls for our attention. The reasons for this could be manifold, so it may prove fruitful, when circumstances allow it, to have the scores in this report refereed by a broader audience of specialists. It is also interesting if we reverse the picture and look at species on the Black list that are have not been given high scores in this project. Twenty such species exists and are listed in table 12 below.

**Table 12.** Twenty species from the Black list (Appendix 1) that is not among the species with high scores in the current project. Danish common names are given within brackets.

<i>Pastinaca sativa</i> (Pastinak)	<i>Lycium barbarum</i> (Almindelig buketorn)
<i>Ambrosia artemisiifolia</i> (Bynke ambrosie)	<i>Cameraria ohridella</i> (Kastanieminermøl)
<i>Conyza canadensis</i> (Canadisk bakkestjerne)	<i>Branta canadensis</i> (Canadagås)
<i>Telekia speciosa</i> (Stor tusindstråle)	<i>Lepomis gibbosus</i> (Solaborre)
<i>Impatiens glandulifera</i> (Kæmpe balsamin)	<i>Carassius auratus</i> (Sølvkarusse)
<i>Impatiens parviflora</i> (Småblomstret balsamin)	<i>Pseudorasbora parva</i> (Båndgrundling)
<i>Crassula helmsii</i> (New Zealandsk korsarve)	<i>Myocastor coypus</i> (Sumpbæver)
<i>Lupinus polyphyllus</i> (Mangebladet lupin)	<i>Ondatra zibethicus</i> (Bisamrotte)
<i>Anguillicola crassus</i> (Ålens svømmeblære nematod)	<i>Amelanchier spicata</i> (Aks-bærmispel)
<i>Lamiastrum galeobdolon ssp. Argentatum</i> (Have-guldnælde)	<i>Pseudodactylogyrus anguillae</i> (Monogene gællesnylter)

Again there are probably multiple reasons why these twenty species were not given a high score in our assessment (see Constraints and recommendations). Most obviously they will not have received a very high score if no published literature exists on their impacts on environment etc. One also has to keep in mind that the Danish Nature Agency's Black list is not developed from objective criteria, but as a result of collaboration between various scientists, authorities and the Nature Agency itself (Naturstyrelsen 2014). Our assessment is transparent step-by-step and as such provides a sound basis for future discussions of the discrepancies between the lists. Neither DAISIE nor GISP rank the species in their databases. Here a ranking system was needed since this study encompasses economic impacts and the list is intended to inform on choices for prioritizing countermeasures. It is not practicable to comment on all species with high scores on the list, but some examples are drawn out here for the sake of argument. The differences for species on DAISIE's '100 of The Worst' (Vilà et al. 2008) or GISP's '100 of the World's Worst Invasive Alien Species' (Lowe et al. 2000) do to some extent reflect the differences in geographic scale (National – European – World wide). For instance the species *Heracleum mantegazzianum* is on the DAISIE list, but not on the GISP list. This plant is an iconic invasive weed in many European countries, and although it is invasive in parts of North Eastern USA, it is not a very significant problem in the rest of the world. Another species with a high score is the brown rat *Rattus norvegicus* or *Rattus rattus*, which is also found on both international lists (in no particular order), reflecting that this species has been spread all over the world (Lowe et al. 2000).

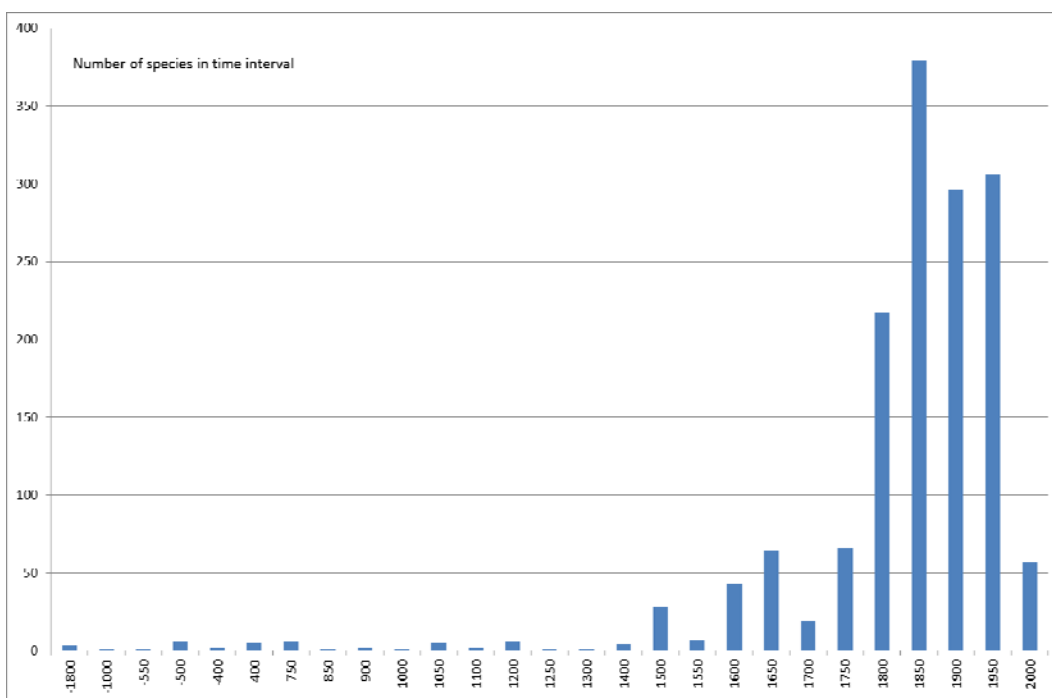
Some uncertainty regarding the scoring is unavoidable and it is inherent in the method that literature becomes sparse the more complex the assessment has to be. So while access to information on 'Dispersion potential' was relatively abundant, information regarding 'Alteration of ecosystem functions' was sparser. In Appendix 7 information on the frequency each level of the scale (incl. blank) is shown for each of the six indices.

As a part of a report on 'Economics and Environment 2014' The Danish Economic Council in February 2014 published calculations and considerations on the society expenses in relation to management and damage by invasive species (<http://www.dors.dk/graphics/Synkron->

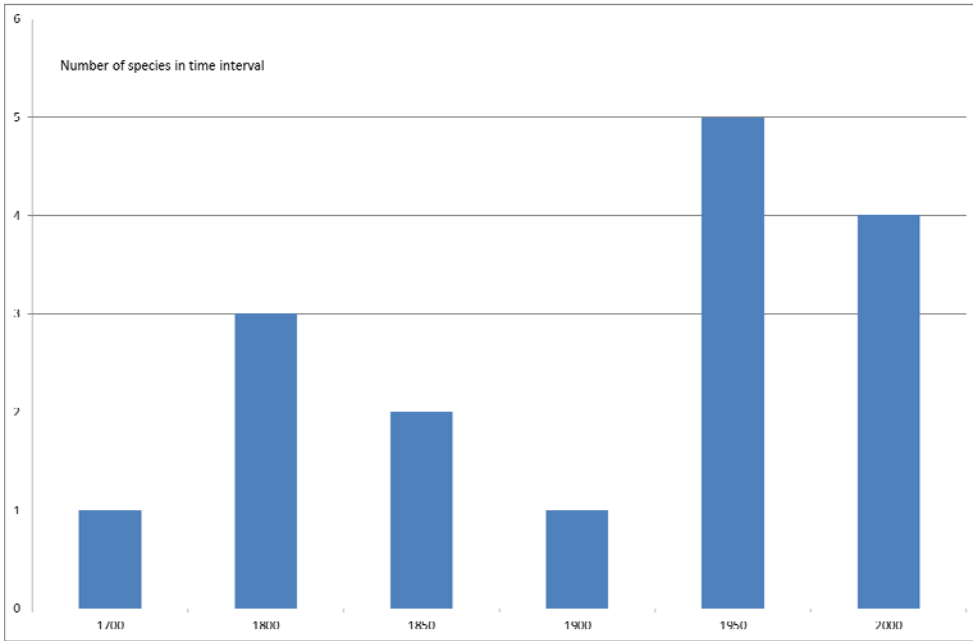
Library/Publikationer/Rapporter/Miljo\_2014/Disk/Hele\_pub.pdf). This further highlights the value of ranking introduced and invasive species.

## Analysis of development over time

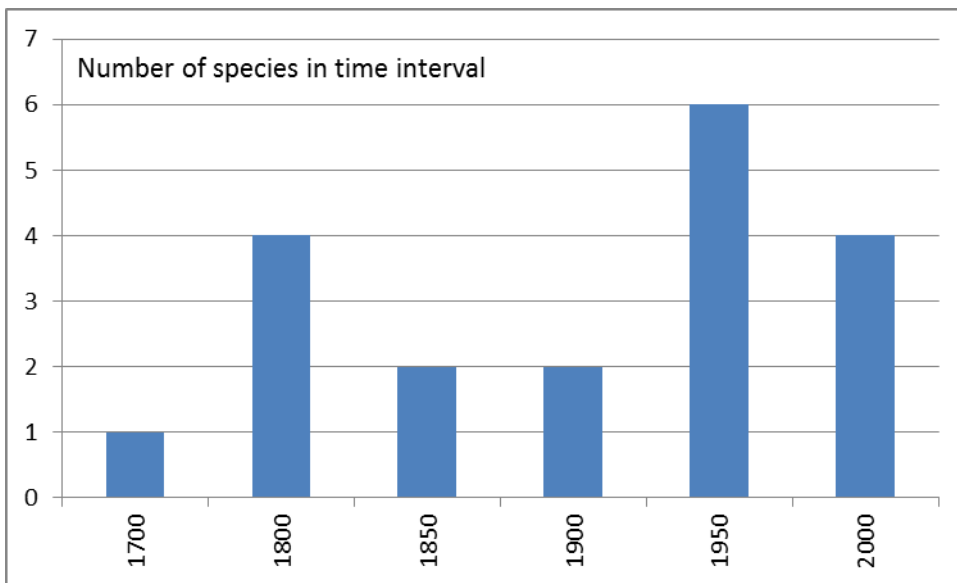
The time of introduction is known for a relative large part of the introduced species and it is therefore possible to view development over time. Figure 37 shows an increasing trend in number of species in the last 200 years. When looking at species with high scores in terms of both original HARMONIA indicators (Fig. 38) and full index including economic and health impact (Fig. 39), an increasing trend in number of species with severe negative impacts can be identified. Considering that the period since 2000 covers merely 13 years, this is quite alarming.



**Figure 37.** Number of species introduced from 1800 BC till year 2000 in 50 years timeintervals. Data stems from the category 'Year of introduction' in our NOBANIS dataset.



**Figure 38.** Number of species with a HARMONIA score  $\geq 11$  in time interval of 50 years.



**Figure 39.** Number of species with total score  $\geq 14$  in time interval of 50 years.

## 8. Constraints and recommendations

The following is a discussion of some of the most immediate constraints faced.

### NOBANIS

First of all the concept of 'invasive species' is disputed and the discussion of which species to consider 'native' and which to label as 'introduced' are no less complicated. The project group has dealt with this, when consulting both literature and specialists, where terms are used differently. Specialists have expressed concern and sometimes surprise when presented with some of the species from NOBANIS. It was necessary to emphasize repeatedly that non-native species from NOBANIS were 'merely species registered, at some point in time, as having a foreign natural distribution'. A cut-off date, as the 1500AD used in the DAISIE database, would restrict its contents and perhaps criticism. It would also be interesting to see if a cut-off date would affect the analysis of POI. A good example of this is the *Poa annua* (Enårig rapgræs). It occurs in the NOBANIS database as introduced, but probably it could have arrived by itself as well or have been introduced naturally by roe deer.

Another aspect that is important to keep in mind is that very little is known about the POI for most species. Therefore the need for scientifically validated data cannot be stressed enough, as many literature sources are considerably old, and specialists' best estimates are still affected by, a sometimes large, degree of uncertainty. It was suggested by some specialists, to build a 'level of certainty' estimate into NOBANIS. In this way, mere guesses could be separated from scientifically documented knowledge.

Lately aspects of genetic pollution have been widely discussed, and if we deem e.g. *Sarothamnus scoparius* (Italiensk gyvel) nonnative based on genetic dissimilarities in the current population (Rosenmeier et al. 2013), then one could claim that even beech and oak are genetically nonnatives too. Furthermore species might locally be genetically non-native, as with parts of the Red Deer population. However, it is not evident in NOBANIS that only a part of the population is non-native and that the evaluations concern these only. Some specialists suggested removing and adding species from NOBANIS – e.g. *Sander lucioperca* (Sandart) and *Silurus glanis* (Europæisk malle). This brings us to another concern and a definite constraint for the study: the fact that NOBANIS is not up to date. The literature review and the specialists made it clear that many introduced species are not registered in the database. Specialists were asked to point out grossly missing species, but this proved too big a task for many within the timeframe. Establishing a protocol for systematic update of species lists would probably be valuable.

Finally some categories like 'Pathway of Introduction' are being evaluated from a mix of historic, recent and projected (for species not yet present) information. The origin and quality of information is not immediately apparent, unless details and references are followed up upon.

### The assessments

It proved difficult to make categories and their definitions fit all types of organisms. For instance two categories 'spread potential' and 'colonization of high conservation value habitats' were problematic for marine species. For those, it simply makes little sense to differentiate between the categories, especially when dealing with species that are planktonic most of their lives.

Concerning scoring the effects on ecosystem functions, if (as here) spectacular worst case scenarios influence the evaluation score, then some species have probably been scored too high. Whereas the 'worst capabilities' of the species are relevant to know, it does not necessarily reflect the most common outcome. In addition low impacts tend to be reported less, making evaluations even more biased towards well-documented high impact species. In addition some species groups are probably also less studied than others.

Species were assessed for their known or possible economical impacts. However, one should try to steer clear of circular reasoning with previous expenses legitimizing for instance further eradication efforts. Again setting a cut-off date would ensure the expenses in some way reflect the current situations. Scoring for health effects were assessed for known effects.

Another aspect concerns species that are only registered once or twice in Denmark. They will often receive a low score, as effects are not yet seen or documented. In this way, the *potential* the species have for affecting for instance native species or economy is not reflected properly. To illustrate the point, this was the case for some species known to cause huge problems in other countries. Finally there are many species that could have a substantial economic effect on cultivated plants that are not included in this study. Since the majority of cultivated plants were excluded (only species with trees as host plants have been included), it is likely that there will be a bias in the pathways of introduction. A more thorough assessment of all species of importance in Denmark beyond biodiversity concerns should also take these species into account.

**Subspecies and varieties.** When it comes to plants and shrubs used as ornamentals in horticulture the numbers of varieties is huge and increasing. Some interviewed specialists suggested that subspecies and varieties should be ignored since "they probably all have same impact". However this is not always the case. E.g. for *Buddleja davidii* – which is an acknowledged highly invasive plant in some other European countries – US plant breeders have developed sterile non-invasive varieties called 'Miss Ruby' and 'Blue Chip'. Nevertheless finding written documentation for the subspecies effects were almost always impossible, and in general most subspecies will probably have same impacts.

**Biased evaluation system.** Using HARMONIA index gives contributions on four issues each with a contribution between 1 and 3 and a maximum of 12 points. Economic impacts and human health impacts each may add 1 to 3 resulting in a total score up to 18 points. Thus, this evaluation system favours ecological impacts over economic and human health impacts.

**Time frame and specialist involvement.** Given the limited time frame for this project, it has been possible to consult only one specialist for each taxon. This is a major limiting factor in what may be deduced from the final output. Knowledge on pathways and records of exotic species is indisputable, but when it comes to evaluation of probability of establishment, spread and impact, there could be huge variations in evaluation outcome. Looking at the final Top 100 list of invasive species the position of some of the species are surprising if you compare with DAISIE or Global Invasive Species Database. For example the two *Anoplophora* species *A. glabripennis* and *A. chinensis* achieve a position as number 88 and 89 on this list. This is in contrast to many efforts that plant health authorities take in keeping these two species out of their respective countries or eradicating them when introduced. When you look at scores on the TOP 100

list and how they influence the final position, you realize how a single or two changes in evaluation will alter ranking on the list.

**Recommendations.** It should be taken into account that the impact evaluations are preliminary and build upon judgement, for each species by one specialist given short time notice only. Consulting additional specialists within same taxonomic groups and merging the results to achieve a common evaluation could improve the estimates.

Fish specialist Henrik Carl suggests removing two species *Sander lucioperca* and *Silurus glanis* from NOBANIS. He points out that both are native species and therefore they can never become invasive.

Entomology specialist Jan Pedersen suggests removing *Dermestes lardarius* from NOBANIS, as it is a native species, which were merely rare in ancient times.

Plant specialist Hans Henrik Bruun suggests removing *Cytisus scoparius* and *Digitalis purpurea*, as he considers both to be native species. He also suggests to remove subspecies in general, as they have the same impacts as the main species e.g. *Symphoricarpos albus* var. *laevigatus*, *Fallopia japonica* ssp. *japonica*, *Cornus alba* ssp. *alba* and *Glandularia laciniata*.

Athropod specialist Hans Peter Ravn suggest removing *Oryctes nasicornis*.

Finally for *Artemia tonosa* no information could be retrieved in literature search, so perhaps a spelling error is to blame?

#### **Following species have been deleted**

*Gymnodinium mikimotoi*. Phytoplankton specialist Niels Daugbjerg noted that *Gymnodinium mikimotoi* is merely synonymous of *Karenia mikimotoi*.

*Physa heterostropha* and *Physella acuta*. Mollusc specialist Jakob Thyrring noted that *Physa heterostropha* is synonymous of *Physella acuta*. In addition the latter were registered twice.

## 9. Conclusion

The main outcome of this project was the analysis of introduction pathways along with an updated database with added columns for introduction pathways and effects on the environment and society. An analysis of the identified Pathways of Introduction, Mode of Entry and vectors was performed for each species group. The most common pathways, modes and vectors were identified for each species group. An analysis of Pathways of Introduction was performed across all species groups.

As the overall conclusion the pathway analysis shows that 'Horticulture' and 'Agriculture' are by far the common pathways for exotic species to Denmark, followed by 'Forestry' and 'Landscaping'. Fortunately not all introduced species develop into invasive species. If the evaluation of negative impacts on biodiversity, economy and human health are distributed on pathways 'Horticulture' is by far the most significant pathway of introduction closely followed by 'Forestry' and 'Landscaping'. There are many examples where plantspecies is introduced as ornamentals for gardens and since have established outside and become invasive.

If authorities want to take action on the situation where a few highly competitive organisms are reducing diversity globally at an increasing speed this type of analysis of significance of pathways of introduction and present and potential impacts on biodiversity, economy and human health could be a tool in focusing countermeasures.

## 10. Acknowledgements

We are grateful to the various organizations and individuals who have provided information, comments and suggestions. In particular we would like to thank the advisory group: Fabienne Grousset, Ebbe Nordbo, Hans Erik Svart and Helene Nyegaard Hvid.

Many specialist contributions were made and we would like to thank following:

Assistant Curator Jan Pedersen<sup>1</sup> (Arthropoda), Assistant Curator Ole Karsholt<sup>1</sup> (Arthropoda), Associate professor emeritus Ole Secher Tendal<sup>1</sup> (Other chordates), Senior Advisor Iben Margrethe Thomsen<sup>2</sup> (Fungi), Associate professor emeritus Marianne Køie<sup>3</sup>, Tommy Asferg<sup>4</sup> (Mammalia), Senior Advisor Hans Meltofte<sup>5</sup> (Aves), Associate professor Jes Søre Pedersen<sup>6</sup> (Arthropoda), Associate professor Gert Steen Mogensen<sup>7</sup> (Bryophyta), Professor Erik Dahl Kjær<sup>2</sup> (Coniferae), Guest Researcher Kathe R. Jensen<sup>1</sup> (Ctenophora), Project employee Henrik Carl<sup>1</sup> (Pisces), Associate professor emeritus Jørgen Lützen<sup>8</sup> (Cnidaria), Senior Scientist Steen Lykke Nielsen<sup>9</sup> (Nematoda), Associate professor Niels Daugbjerg<sup>10</sup> (Phytoplankton), Associate professor Per Kryger<sup>11</sup> (Arthropoda), Ph.d. stud. Jakob Thyrring<sup>12</sup> (Mollusca), Zoologist Morten Vissing<sup>13</sup> (Aquatic angiosperma), Member of administrative staff Peter Wind<sup>14</sup> (Angiosperma), Biologist Peer Ravn<sup>15</sup> (Reptilia & Amphibia) and Associate professor Hans Henrik Bruun (Angiosperma)<sup>6</sup>.

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## Appendices

### Appendix 1. Danish Nature Agency's Black list

**Table 13.** Danish Nature Agency's Black list with scores from this assessment study. Table show Group, Species name, the six assessment categories (Dispersion potential, Colonisation of high conservation value habitats, Adverse impacts on native species, Alteration of ecosystem functions, Economical effect and Public health effects), Total score and Registered in Denmark (Empty = Not registered in Denmark, DK = Registered in Denmark).

Group	Species	Dispersion potential	Colonisation of high conservation value habitats	Adverse impacts on native species	Alteration of ecosystem functions	Economical effect	Public health effects	Total	Registered in Denmark
Angiosperma	<i>Heracleum mantegazzianum</i>	3	3	3	3	3	3	18	DK
Angiosperma	<i>Pastinaca sativa</i>	3	1	1	1	1	1	8	DK
Angiosperma	<i>Ambrosia artemisiifolia</i>	2	1	1	1	3	3	11	DK
Angiosperma	<i>Conyza canadensis</i>	3	1	1	1	2	2	10	DK
Angiosperma	<i>Petasites hybridus</i>	2	2	2	2	2	1	11	DK
Angiosperma	<i>Petasites japonicus</i>	2	3	2	2	2	2	13	DK
Angiosperma	<i>Solidago canadensis</i>	3	3	3	2	2	2	15	DK
Angiosperma	<i>Solidago gigantea</i>	3	3	3	3	1	1	14	DK
Angiosperma	<i>Telekia speciosa</i>	1	1	1	1	1	1	6	DK
Angiosperma	<i>Impatiens glandulifera</i>	3	1	2	2	2	1	11	DK
Angiosperma	<i>Impatiens parviflora</i>	3	1	2	2	1	1	10	DK
Angiosperma	<i>Crassula helmsii</i>	1	2	2	1	1	1	8	DK
Angiosperma	<i>Lupinus polyphyllus</i>	2	1	2	2	1	1	9	DK
Angiosperma	<i>Elodea canadensis</i>	3	3	3	3	1	1	14	DK

Group	Species	Dispersion potential	Colonisation of high conservation value habitats	Adverse impacts on native species	Alteration of ecosystem functions	Economical effect	Public health effects	Total	Registered in Denmark
Angiosperma	<i>Elodea nuttallii</i>	3	3	3	3	3	1	16	DK
Angiosperma	<i>Lamiastrum galeobdolon ssp. argentatum</i>	1	1	2	1	1	1	7	DK
Angiosperma	<i>Spartina anglica</i>	2	3	2	2	1	1	11	DK
Angiosperma	<i>Fallopia japonica</i>	2	2	3	3	3	1	14	DK
Angiosperma	<i>Fallopia sachalinensis</i>	2	2	3	1	1	1	10	DK
Angiosperma	<i>Fallopia x bohemica</i>	2	2	3	3	1	1	12	DK
Angiosperma	<i>Amelanchier spicata</i>	3	2	1	1	1	1	9	DK
Angiosperma	<i>Prunus serotina</i>	3	3	3	2	2	2	15	DK
Angiosperma	<i>Rosa rugosa</i>	3	3	3	3	2	1	15	DK
Angiosperma	<i>Rosa rugosa var. kamtchatica</i>	1	2	3	3	1	1	11	DK
Angiosperma	<i>Lycium barbarum</i>	1	2	1	1	1	2	8	DK
Arthropoda	<i>Astacus leptodactylus</i>	3	2	2	1	2	0	10	DK
Arthropoda	<i>Pacifastacus leniusculus</i>	2	3	3	1	2	1	12	DK
Arthropoda	<i>Harmonia axyridis</i>	3	1	3	2	2	1	12	DK
Arthropoda	<i>Cameraria ohridella</i>	3	1	1	1	2	1	9	DK
Arthropoda	<i>Eriocheir sinensis</i>	3	3	2	2	2	1	13	DK
Aves	<i>Alopochen aegyptiaca</i>	3	2	2	1	1	1	10	DK
Aves	<i>Branta canadensis</i>	3	2	2	1	2	1	11	DK
Aves	<i>Oxyura jamaicensis</i>	3	3	3	1	1	1	12	DK
Bryophyta	<i>Campylopus introflexus</i>	3	2	2	2	1	1	11	DK

Group	Species	Dispersion potential	Colonisation of high conservation value habitats	Adverse impacts on native species	Alteration of ecosystem functions	Economical effect	Public health effects	Total	Registered in Denmark
Ctenophora	<i>Mnemiopsis leidyi</i>	3	3	3	3	2	1	15	DK
Coniferae	<i>Pinus contorta</i>	2	3	2	2	1	1	11	DK
Coniferae	<i>Pinus contorta ssp. contorta var. contorta</i>	2	3	2	2	2	1	12	DK
Coniferae	<i>Pinus contorta ssp. contorta var. latifolia</i>	2	3	2	2	1	1	11	DK
Coniferae	<i>Pinus contorta ssp. murrayana</i>	2	3	2	2	2	1	12	DK
Coniferae	<i>Pinus mugo</i>	2	3	3	3	1	1	13	DK
Coniferae	<i>Pinus mugo ssp. mugo</i>	2	3	2	2	3	1	13	DK
Coniferae	<i>Pinus mugo ssp. mugo x rotundata</i>	2	3	2	2	3	1	13	DK
Pisces	<i>Lepomis gibbosus</i>	2	2	2	1	1	1	9	DK
Pisces	<i>Carassius auratus</i>	3	2	1	2	1	1	10	DK
Pisces	<i>Pseudorasbora parva</i>	2	2	3	1	2	1	11	DK
Platyhelminthes	<i>Pseudodactylogyrus anguillae</i>	1	1	3	1	3	1	10	DK
Fungi	<i>Ophiostoma novo-ulmi</i>	3	3	3	3	3	1	16	DK
Fungi	<i>Aphanomyces astaci</i>	2	2	3	2	2	1	12	DK
Macroalgae	<i>Gracilaria vermiculophylla</i>	3	3	3	3	2	1	15	DK
Macroalgae	<i>Sargassum muticum</i>	3	3	3	3	2	0	14	DK
Mammalia	<i>Nyctereutes procyonoides</i>	3	3	2	2	1	2	13	DK
Mammalia	<i>Ondatra zibethicus</i>	2	3	1	2	2	1	11	DK

Group	Species	Dispersion potential	Colonisation of high conservation value habitats	Adverse impacts on native species	Alteration of ecosystem functions	Economical effect	Public health effects	Total	Registered in Denmark
Mammalia	<i>Rattus norvegicus</i>	3	3	3	3	3	3	18	DK
Mammalia	<i>Mustela vison</i>	3	3	3	3	1	1	14	DK
Mammalia	<i>Myocastor coypus</i>	1	3	2	2	1	1	10	DK
Mammalia	<i>Procyon lotor</i>	3	3	2	2	1	1	12	DK
Mollusca	<i>Arion lusitanicus</i>	2	2	3	2	2	1	12	DK
Mollusca	<i>Dreissena polymorpha</i>	3	3	2	3	3	0	14	DK
Mollusca	<i>Crassostrea gigas</i>	3	3	3	3	1	1	14	DK
Mollusca	<i>Ensis americanus</i>	3	3	2	2	2	1	13	DK
Mollusca	<i>Teredo navalis</i>	3	3	2	2	3	1	14	DK
Nematoda	<i>Anguillicola crassus</i>	1	1	3	1	3	1	10	DK

## Appendix 2. Danish Nature Agency's Observation list

**Table 14.** Danish Nature Agency's Observation List with scores from this assessment study. Table show Group, Species name, the six assessment categories (Dispersion potential, Colonisation of high conservation value habitats, Adverse impacts on native species, Alteration of ecosystem functions, Economical effect and Public health effects), Total score and Registered in Denmark (Empty = Not registered in Denmark, DK = Registered in Denmark).

Group	Species	Dispersion potential	Colonisation of high conservation	Adverse impacts on native species	Alteration of ecosystem	Economical effect	Public health effects	Total	Registered in Denmark
Angiosperma	Aegopodium podagraria	0	0	0	0	0	0	0	DK
Angiosperma	Lysichiton americanus	2	2	3	2	1	1	11	DK
Angiosperma	Berberis thunbergii	1	2	2	2	1	1	9	DK
Angiosperma	Buddleja davidii	3	1	3	2	3	1	13	DK
Angiosperma	Symphoricarpos albus	3	2	2	1	1	2	11	DK
Angiosperma	Cornus alba	2	2	2	2	1	1	10	DK
Angiosperma	Cornus alba ssp. alba	0	2	0	0	0	1	3	DK
Angiosperma	Cornus alba ssp. stolonifera	0	2	0	0	0	1	3	DK
Angiosperma	Robinia pseudoacacia	3	2	2	3	1	2	13	DK
Angiosperma	Epilobium ciliatum	2	1	2	1	2	1	9	DK
Angiosperma	Claytonia perfoliata	1	1	1	1	2	1	7	DK
Angiosperma	Amelanchier lamarckii	3	2	1	1	1	1	9	DK
Angiosperma	Spiraea douglasii	1	2	1	1	1	1	7	DK
Angiosperma	Spiraea salicifolia	1	2	1	1	1	1	7	DK
Angiosperma	Digitalis purpurea	0	0	0	0	0	3	3	DK
Arthropoda	Agrilus planipennis	3	3	3	3	3	1	16	
Arthropoda	Anoplophora chinensis	3	3	1	1	3	1	12	DK
Arthropoda	Anoplophora glabripennis	3	3	1	1	3	1	12	DK
Arthropoda	Cercopagis pengoi	3	3	2	3	2	1	14	
Arthropoda	Lasius neglectus	2	2	3	2	1	1	11	DK

Group	Species	Dispersion potential	Colonisation of high conservation	Adverse impacts on native species	Alteration of ecosystem	Economical effect	Public health effects	Total	Registered in Denmark
Arthropoda	Phyllonorycter robinella	2	2	2	2	1	1	10	DK
Arthropoda	Paralithodes camtschaticus	3	3	3	3	2	1	15	
Arthropoda	Homarus americanus	1	1	2	2	2	1	9	
Arthropoda	Callinectes sapidus	3	3	2	2	1	1	12	DK
Arthropoda	Corythucha ciliata	3	2	1	1	0	1	8	
Aves	Aix galericulata	3	1	1	1	1	1	8	DK
Aves	Anser cygnoides	3	1	1	1	1	1	8	DK
Aves	Anser indicus	3	1	1	1	2	1	9	DK
Aves	Cygnus atratus	3	2	1	1	1	1	9	DK
Aves	Columba livia	3	1	1	1	2	2	10	DK
Aves	Psittacula krameri	3	1	1	1	2	1	9	DK
Bryophyta	Orthodontium lineare	3	2	2	1	1	1	10	DK
Pisces	Cyprinus carpio	1	2	1	2	1	1	8	DK
Pisces	Neogobius melanostomus	3	3	3	2	2	1	14	DK
Fungi	Ceratocystis fagacearum	3	3	3	3	3	1	16	
Fungi	Microsphaera alphitoides	3	3	2	2	2	1	13	DK
Fungi	Phytophthora kernoviae	2	3	2	3	3	1	14	
Macroalgae	Bonnemaisonia hamifera	3	3	2	1	1	1	11	DK
Macroalgae	Codium fragile	3	3	2	2	1	1	12	DK
Macroalgae	Colpomenia peregrina	3	3	2	1	1	1	11	DK
Macroalgae	Dasya baillouviana	3	3	2	1	1	1	11	DK
Macroalgae	Heterosiphonia japonica	3	3	2	1	1	1	11	DK
Mammalia	Sciurus carolinensis	2	3	3	3	2	1	14	
Mollusca	Crepidula fornicata	3	3	2	2	1	1	12	DK
Mollusca	Rapana venosa	1	1	2	2	1	1	8	
Reptilia & amphibia	Lithobates catesbeiana	1	2	2	1	1	1	8	DK
Reptilia & amphibia	Rana balcanica	1	1	1	1	1	1	6	DK

### Appendix 3. Reviewed EPPO species (List A1 and A2)

**Table 15.** EPPO A1 List: Insects and mites, nematodes and fungi recommended for regulation. First column (Species) shows the considered species, second column (Comment) offers various comments on hosts, pathways etc. and third column (Add?) shows whether the species were added to the EPPO list of species assessed in this report. DK = Denmark. Obs. List = Observation list. Host plants were extracted from PQR (EPPO, 2013).

Species	Comment	Add?
<b>Insects and mites</b>		
1. <i>Acleris gloverana</i>	<i>Tsuga heterophylla</i> as main host; <i>Abies</i> , <i>Picea</i> , <i>Pseudotsuga menziensis</i> as minor hosts.  Extensive defoliation leading to loss of wood production and limited top-killing and mortality.  Potential pathways: plants for planting (except seeds and tissue cultures) and cut branches of <i>Abies</i> and <i>Picea</i> from North America.	Yes
2. <i>Acleris variana</i>	<i>Abies balsamea</i> as main host; <i>Abies</i> , <i>Picea</i> , <i>Picea glauca</i> as minor hosts.  Potential pathways: plants for planting (except seeds and tissue cultures) and cut branches of <i>Abies</i> and <i>Picea</i> from North America.  Defoliation, recurrent attacks in several years may lead to mortality.	Yes
3. <i>Agrilus anxius</i>	<i>Betula</i> widely present in DK, natural environment and landscaping.  Potential pathways: infested plants or wood products, including dunnage, crates, pallets, wood chips, lumber and firewood, wood packaging material and wood chips.	Yes
4. <i>Aleurocanthus woglumi</i>	Several Citrus spp. as main hosts; several woody plants grown in DK as minor hosts ( <i>Pyrus communis</i> , <i>Rosa</i> , <i>Vitis vinifera</i> ).	No
5. <i>Anastrepha fraterculus</i>	<i>Mangifera indica</i> and <i>Psidium guajavae</i> as major hosts; several fruit trees grown in DK as minor hosts ( <i>Malus domestica</i> , <i>Prunus domestica</i> ).	No
6. <i>Anastrepha ludens</i>	No host important for DK ( <i>Mangifera indica</i> and several Citrus spp. are major hosts; other tropical and sub tropical trees as minor hosts).	No
7. <i>Anastrepha obliqua</i>	No host important for DK ( <i>Mangifera indica</i> = major host; other tropical sub tropical trees as minor hosts).	No
8. <i>Anastrepha suspensa</i>	No host important for DK ( <i>Psidium guajava</i> = major host; minor host = <i>Annona</i> , <i>Eugenia smithii</i> , <i>Syzygium</i> , <i>Terminalia catappa</i> , "fruit trees" (but with tropical/subtropical distribution).	No
9. <i>Anoplophora glabripennis</i>	On the Danish Nature Agency's Observation list.	Yes, Obs. list
10. <i>Anthonomus bisignifer</i>	<i>Fragaria x ananassa</i> main host and <i>Fragaria</i> as minor host, <i>Rubus</i> (incidental); <i>Rosa</i> (wild/weed).	No

Species	Comment	Add?
11. <i>Anthonomus eugenii</i>	<i>Capsicum annuum</i> and <i>frutescens</i> as main host, <i>Solanum melongena</i> as minor host, <i>Capsicum</i> , <i>Solanum</i> (wild/weed).	No
12. <i>Anthonomus grandis</i>	<i>A. grandis grandis</i> in PQR: <i>Gossypium</i> as major host. <i>Hibiscus syriacus</i> as incidental host. <i>A. grandis thurberiae</i> : no host indicated.	No
13. <i>Anthonomus signatus</i>	<i>Fragaria x ananassa</i> as main host, <i>Fragaria</i> , <i>Rosa</i> , <i>Rubus</i> . <i>Vaccinium</i> as minor host, <i>Rubus caesius</i> (incidental).	No
14. <i>Arrhenodes minutus</i> (as a putative vector of <i>Ceratocystis fagacearum</i> )	No host indicated. Mentioned as a vector by EU, but no foundation to consider it as a vector according to EPPO DS.	No
15. <i>Bactericera cockerelli</i> (as a vector of <i>Liberibacter solanacearum</i> )	<i>Solanum lycopersicon</i> and <i>tuberosum</i> are main hosts, <i>Capsicum annuum</i> and <i>Solanum melongena</i> as minor hosts.	No
16. <i>Bactrocera cucumis</i>	<i>Cucumis melo</i> & <i>sativus</i> , <i>Cucurbita pepo</i> as major host. <i>Carica papaya</i> & <i>Solanum lycopersicon</i> as minor host, <i>Cucurbitaceae</i> (wild/weed).	No
17. <i>Bactrocera cucurbitae</i>	<i>Cucumis melo</i> & <i>sativus</i> , <i>Cucurbita pepo</i> , <i>Momordica charantia</i> as major host. <i>Citrullus</i> , <i>Cucumis</i> , <i>Cucurbita</i> . <i>Curcubitaceae</i> , <i>Fabaceae</i> , <i>Mangifera indica</i> , <i>Solanum lycopersicon</i> are minor hosts.	No
18. <i>Bactrocera dorsalis</i> <i>B. carambolae</i> <i>B. caryae</i> <i>B. kandiensis</i> <i>B. occipitalis</i> <i>B. papayae</i> <i>B. philippinensis</i> <i>B. pyrifoliae</i>	Several hosts cultivated in DK in minor hosts (e.g. <i>Malus domestica</i> , <i>Pyrus communis</i> , <i>Solanum lycopersicon</i> ).	No
19. <i>Bactrocera invadens</i>	Several hosts cultivated in DK, but minor hosts (e.g. <i>Solanum lycopersicon</i> , <i>S. melongena</i> ). Most hosts are tropical/sub tropical.	No
20. <i>Bactrocera minax</i>	Hosts are <i>Citrus</i> and <i>Fortunella</i> .	No

Species	Comment	Add?
21. <i>Bactrocera tryoni</i>	Main hosts are three Citrus species, but other fruit trees among minor hosts, including <i>Malus domestica</i> and <i>Pyrus</i> .	No
22. <i>Bactrocera tsuneonis</i>	Hosts are Citrus and <i>Fortunella</i> .	No
23. <i>Bactrocera zonata</i>	<i>Mangifera indica</i> , <i>Prunus persica</i> , <i>Psidium guava</i> are major hosts. <i>Annona squamosa</i> , Citrus, <i>Ficus carica</i> , <i>Prunus</i> , <i>Prunus armeniaca</i> are minor hosts.	No
24. <i>Blitopertha orientalis</i>	<i>Ananas comosus</i> , <i>Saccharum officinarum</i> and <i>Zea mays</i> are main hosts. Poaceae are minor host, with general category of herbaceous plants and vegetable plants.  Larvae feed on roots. Could cause considerable losses to horticulture, especially to grass.	No
25. <i>Carneocephala fulgida</i> (as vector of <i>Xylella fastidiosa</i> )	<i>Vitis vinifera</i> is main host. <i>Cynodon dactylon</i> , <i>Echinochloa crus-galli</i> and Poaceae are minor hosts.	No
26. <i>Ceratitis rosa</i>	Main hosts are <i>Citrus reticulata</i> and <i>sinensis</i> , but other fruit trees among minor hosts, including <i>Malus domestica</i> and <i>Pyrus communis</i> .	No
27. <i>Choristoneura conflictana</i>	<i>Populus tremuloides</i> is main host. <i>Populus</i> are minor host and <i>Alnus</i> , <i>Betula papyrifera</i> , <i>Salix</i> incidental hosts.  May present a certain risk to plantations of aspen and other <i>Populus</i> spp. in Europe, but is probably less significant than <i>Choristoneura</i> spp. on conifers.	No
28. <i>Choristoneura fumiferana</i>	<i>Abies balsamea</i> , <i>Abies lasiocarpa</i> var. <i>lasiocarpa</i> , <i>Picea engelmannii</i> , <i>Picea glauca</i> , <i>Picea rubens</i> and <i>Pseudotsuga menziesii</i> are major hosts. <i>Abies</i> , <i>Larix</i> , <i>Picea</i> , <i>Picea mariana</i> , <i>Pinus</i> , <i>Tsuga</i> are minor hosts; <i>Juniperus</i> (unclassified).  Attacks a rather large number of conifers which are present in Europe and can lead to tree mortality. Presents a serious risk to European forests and plantations.  Potential pathways: plants or cut foliage of hosts, carrying first-instar hibernating larva.	Yes
29. <i>Choristoneura occidentalis</i>	<i>Pseudotsuga menziesii</i> is a major host. <i>Abies</i> , <i>Abies concolor</i> , <i>Abies grandis</i> , <i>Abies lasiocarpa</i> var. <i>lasiocarpa</i> , <i>Larix</i> , <i>Larix occidentalis</i> , <i>Picea</i> , <i>Picea engelmannii</i> , <i>Picea glauca</i> and <i>Picea pungens</i> minor hosts.  Potential pathways: plants and cut foliage of conifers, host plants as first-instar hibernating larvae.	Yes

Species	Comment	Add?
30. <i>Choristoneura rosaceana</i>	<i>Malus domestica</i> is major host. Acer, Betula, <i>Corylus avellana</i> , <i>Pistacia vera</i> , Platanus, Populus, <i>Prunus persica</i> , <i>Pyrus communis</i> , <i>Rubus idaeus</i> , Salix, Ulmus, <i>Vaccinium</i> and deciduous woody plants are minor hosts. Rather important pest in orchards, especially in apples, but is not considered a problem in forests.	No
31. <i>Conotrachelus nenuphar</i>	<i>Hemerocallis lilioasphodelus</i> , <i>Prunus domestica</i> and <i>Prunus persica</i> are major hosts. <i>Amelanchier arborea</i> , <i>Amelanchier canadensis</i> , <i>Crataegus</i> , <i>Cydonia oblonga</i> , <i>Hemerocallis</i> , <i>Malus</i> , <i>Malus domestica</i> , <i>Prunus</i> , <i>Prunus avium</i> , <i>Prunus cerasus</i> , <i>Prunus salicina</i> , <i>Prunus serotina</i> , <i>Pyrus</i> , <i>Pyrus communis</i> , <i>Vaccinium</i> , <i>Vaccinium corymbosum</i> and <i>Vaccinium stamineum</i> are minor hosts. <i>Ribes</i> are an incidental host. <i>Prunus alleghaniensis</i> , <i>Prunus americana</i> , <i>Prunus maritima</i> , <i>Prunus mexicana</i> , <i>Prunus nigra</i> , <i>Prunus pensylvanica</i> , <i>Prunus pumila</i> , <i>Prunus virginiana</i> and <i>Sorbus aucuparia</i> (wild/weed). Demonstrated its adaptability to new hosts. Potential pathways: Soil associated to plants of <i>Prunus</i> , <i>Pyrus</i> and <i>Malus</i> with roots.	Yes
32. <i>Cydia packardii</i>	<i>Prunus avium</i> is the major host. <i>Malus</i> , <i>Malus domestica</i> , <i>Prunus</i> , <i>Prunus domestica</i> , <i>Pyrus</i> , <i>Pyrus communis</i> , <i>Vaccinium</i> , <i>Vaccinium macrocarpon</i> , <i>Cydonia oblonga</i> , <i>Prunus persica</i> , <i>Pyracantha</i> , <i>Rosa</i> , <i>Crataegus</i> and <i>Prunus virginiana</i> are minor hosts. Relatively small risk, targeted by measures against <i>Rhagoletis</i> spp.	No
33. <i>Cydia prunivora</i>	<i>Malus domestica</i> , <i>Prunus avium</i> and <i>Prunus domestica</i> are major hosts. <i>Cydonia oblonga</i> , <i>Malus</i> , <i>Prunus</i> , <i>Prunus persica</i> , <i>Pyrus</i> and <i>Rosa</i> are minor hosts. <i>Photinia</i> , <i>Quercus</i> and <i>Ulmus</i> are incidental hosts. <i>Crataegus</i> , <i>Crataegus holmesiana</i> (wild, weed). Potential pathways: plants accompanied with flowers or fruit, soil associated with host plants.	Yes
34. <i>Dendroctonus adjunctus</i>	<i>Pinus ponderosa</i> is the major host. <i>Pinus</i> and <i>Pinus montezumae</i> are minor hosts. <i>Pinus ayacahuite</i> , <i>Pinus hartwegii</i> , <i>Pinus leiophylla</i> , <i>Pinus maximinoi</i> , <i>Pinus pseudostrobus</i> and <i>Pinus rudis</i> are incidental hosts. Secondary species, small risk for the EPPO region, relevant for areas which lack indigenous bark beetles and protect themselves from species already present elsewhere in Europe.	No
35. <i>Dendroctonus brevicornis</i>	<i>Pinus ponderosa</i> is the major host. <i>Pinus</i> and <i>Pinus coulteri</i> are minor hosts. Risk assessed as relatively moderate, because only <i>P. ponderosa</i> is concerned, and because damage in North America has mainly been associated with drought conditions.	No

Species	Comment	Add?
36. <i>Dendroctonus frontalis</i>	Pinus taeda is the major host. <i>Picea engelmannii</i> , Pinus, <i>Pinus canariensis</i> , <i>Pinus maximinoi</i> and <i>Pinus oocarpa</i> are minor hosts. Risk relatively moderate because of the geographical range of <i>D. frontalis</i> in North America, and particularly the range in which it causes damage, is essentially southern (its range extends into tropical Central America) and the Pinus species concerned in North America are not grown in the EPPO region (except <i>P. ponderosa</i> ).	No
37. <i>Dendroctonus ponderosae</i>	<i>Pinus contorta</i> and <i>Pinus ponderosa</i> are major hosts. Pinus, <i>Pinus flexilis</i> and <i>Pinus monticola</i> are minor hosts. <i>Picea engelmannii</i> is incidental host. Highest risk of all the North American <i>Dendroctonus</i> spp. Present in areas with climatic conditions similar to Western Europe.	Yes
38. <i>Dendroctonus pseudotsugae</i>	<i>Pseudotsuga menziesii</i> is the major host. <i>Pseudotsuga macrocarpa</i> is the minor host. <i>Larix occidentalis</i> and <i>Tsuga heterophylla</i> are incidental hosts. Risk assessed as relatively moderate, because only one host species is concerned and because it attacks weakened or fallen and only occasionally healthy trees.	No
39. <i>Dendroctonus rufipennis</i>	<i>Picea mariana</i> and <i>Picea sitchensis</i> are major hosts. <i>Picea</i> , <i>Picea abies</i> , <i>Picea engelmannii</i> , <i>Picea pungens</i> and <i>Picea rubens</i> are minor hosts. Mostly attacks weakened or windthrown trees and outbreaks are mostly linked to predisposing factors. Not among the most aggressive members of its genus in North America.	No
40. <i>Diabrotica barberi</i>	<i>Zea mays</i> is the major host.	No
41. <i>Diabrotica speciosa</i>	<i>Phaseolus vulgaris</i> , <i>Solanum tuberosum</i> , <i>Triticum aestivum</i> and <i>Zea mays</i> are major hosts. <i>Arachis hypogaea</i> , <i>Brassica napus</i> , <i>Brassica oleracea</i> var. <i>capitata</i> f. <i>alba</i> , Citrus, <i>Cucurbita maxima</i> , <i>Cucurbita pepo</i> , <i>Glycine max</i> , <i>Ipomoea batatas</i> , <i>Malus domestica</i> , <i>Prunus</i> , <i>Solanum lycopersicum</i> are all minor hosts.	No
42. <i>Diabrotica undecimpunctata</i>	<i>Cucumis sativus</i> , <i>Zea mays</i> is the major hosts. Poaceae is an incidental host.	No
43. <i>Diaphorina citri</i> (as vector of <i>Liberobacter</i> spp.)	Major hosts are Citrus and other Rutaceae. Only <i>Ficus carica</i> is a minor host.	No

Species	Comment	Add?
44. <i>Draeculacephala minerva</i> (as vector of <i>Xylella fastidiosa</i> )	<i>Vitis vinifera</i> is the minor host. <i>Cynodon dactylon</i> , <i>Echinochloa crus-galli</i> and Poaceae (wild/weed). Mostly associated with grapevine and important as vector only.	No
45. <i>Dryocoetes confusus</i>	<i>Abies lasiocarpa</i> var. <i>lasiocarpa</i> is the major host. <i>Abies</i> , <i>Abies amabilis</i> , <i>Abies concolor</i> and <i>Picea engelmannii</i> are minor hosts. Risk assessed as relatively small, since <i>D. confusus</i> is fairly specific to <i>A. lasiocarpa</i> , a species which is not grown in the EPPO region.	No
46. <i>Epitrix subcrinita</i>	<i>Solanum tuberosum</i> .	No
47. <i>Epitrix tuberis</i>	<i>Solanum tuberosum</i> is the major host. <i>Nicotiana tabacum</i> , Solanaceae, <i>Solanum lycopersicum</i> and other plants are the minor hosts. <i>Beta vulgaris</i> , <i>Brassica oleracea</i> , <i>Cucumis sativus</i> , <i>Lactuca sativa</i> , <i>Phaseolus vulgaris</i> are incidental hosts.	No
48. <i>Gnathotrichus sulcatus</i>	<i>Abies concolor</i> , <i>Abies magnifica</i> , <i>Abies religiosa</i> , Pinaceae, <i>Pinus leiophylla</i> , <i>Pinus ponderosa</i> , <i>Pinus pseudostrobus</i> , <i>Pseudotsuga menziesii</i> , <i>Tsuga heterophylla</i> are minor hosts. Does not attack living trees, only a pest of cut wood. Rather restricted distribution within North America. Its importance is much less than that of the holarctic <i>T. lineatum</i> . So there is no basis to consider that it presents a significant risk to the EPPO Region.	No
49. <i>Gonipterus gibberus</i>	Major hosts are eucalyptus.	No
50. <i>Graphocephala atropunctata</i> (as vector of <i>Xylella fastidiosa</i> )	<i>Vitis vinifera</i> is the major host. Poaceae (wild/weed). Mostly associated to grapevine and important as vector only.	No
51. <i>Helicoverpa zea</i>	<i>Capsicum annuum</i> , <i>Gossypium hirsutum</i> , <i>Phaseolus vulgaris</i> , <i>Solanum lycopersicum</i> , <i>Solanum melongena</i> , <i>Sorghum vulgare</i> and <i>Zea mays</i> are major hosts. <i>Abelmoschus esculentus</i> , Brassica, <i>Cajanus cajan</i> , <i>Cicer arietinum</i> , <i>Cucurbitaceae</i> , Fabaceae, <i>Fragaria x ananassa</i> , <i>Helianthus annuus</i> , <i>Lactuca sativa</i> , Malvaceae, <i>Nicotiana tabacum</i> , <i>Phaseolus</i> , <i>Pisum sativum</i> , Poaceae, Solanaceae, <i>Trifolium</i> , <i>Vicia faba</i> and vegetable plants are all minor hosts.	No

Species	Comment	Add?
52. <i>Heteronychus arator</i>	<i>Lolium perenne</i> , <i>Solanum tuberosum</i> and <i>Zea mays</i> are major hosts. <i>Cucurbita</i> , <i>Daucus carota subsp. sativus</i> , <i>Fragaria x ananassa</i> , <i>Lactuca sativa</i> , <i>Pisum sativum</i> , <i>Rheum rhabarbarum</i> , <i>Solanum lycopersicum</i> , <i>Vitis vinifera</i> and other plants are minor hosts. <i>Begonia</i> , <i>Calendula</i> , <i>Petunia</i> , <i>Phlox</i> and <i>Poaceae</i> are incidental hosts.	No
53. <i>Homalodisca coagulata</i> (vector of <i>Xylella fastidiosa</i> )	Major hosts are <i>Citrus sinensis</i> , <i>Macadamia ternifolia</i> and <i>Persea americana</i> , among minor hosts, there is <i>Fraxinus</i> , several <i>Prunus</i> , <i>Medicago sativa</i> etc.  Represents a very serious threat essentially to grapevine and citrus crops, but also to other host plants, such as deciduous forest and amenity trees and oleander.  Present in Southern USA, Mexico, introduced to Tahiti.	No
54. <i>Ips calligraphus</i>	<i>Pinus ponderosa</i> and strobilus are major hosts and <i>Pinus</i> is the minor host.  Risk assessed as relatively moderate, because the geographical range of this species in North America, and particularly the range in which it causes damage, is essentially southern and the <i>Pinus</i> species concerned in North America are not grown in the EPPO region.	No
55. <i>Ips confusus</i> & <i>I. paraconfusus</i>	<i>Pinus</i> , <i>Pinus edulis</i> and <i>Pinus monophylla</i> are minor hosts.  <i>Ips confusus</i> : risk practically negligible, since this species is a secondary pest of pinyon pines only, in a specific montane environment in southwestern USA.  <i>I. paraconfusus</i> : primary attacks on <i>Pinus</i> spp. and moderately high risk for the EPPO region, since its geographical range of this species in North America (California and southern Oregon) covers climatic conditions which are similar to those of southern Europe and because the main <i>Pinus</i> species concerned in North America is <i>P. ponderosa</i> , which has been widely planted in the EPPO region.	No
56. <i>Ips grandicollis</i>	<i>Pinus radiata</i> (major), <i>Pinus</i> (minor).  Relatively moderate because the geographical range of this species in North America, and particularly the range in which it causes damage, is essentially southern (its subspecies extend to the Caribbean).  Introduced into Australia and there damages the European species <i>P. pinaster</i> and also <i>P. radiata</i> .	No
57. <i>Ips lecontei</i>	<i>Pinus ponderosa</i> is the major host. <i>Pinus</i> and <i>Pinus pseudostrobus</i> are the minor hosts.  Limited in geographical distribution to the extreme southwest of USA and is not currently reported as of any importance.	No

Species	Comment	Add?
58. <i>Ips pini</i>	<p><i>Pinus</i>, <i>Pinus banksiana</i>, <i>Pinus contorta</i>, <i>Pinus jeffreyi</i> and <i>Pinus strobus</i> are minor hosts.</p> <p>Risk assessed as fairly high, because geographical range in North America (Northern and Western), because some of the <i>Pinus</i> species concerned in North America (<i>P. ponderosa</i>, <i>P. contorta</i>) have been widely planted in the EPPO region, and because pest considered to have a relatively wide and non-specific host range in North America, extending even to <i>Picea</i>.</p> <p>Potential pathways: plants, barks, wood with bark.</p>	Yes
59. <i>Ips plastographus</i>	<p><i>Pinus</i> and <i>Pinus radiata</i> are minor hosts. <i>Picea sitchensis</i>, <i>Pinus contorta</i>, <i>Pinus muricata</i> and <i>Pinus ponderosa</i> are incidental hosts.</p> <p>Geographical distribution (Western North America) covers climatic conditions like those in Southern Europe. One subspecies reported to be always a secondary pest, and the other only rarely a primary pest.</p>	No
60. <i>Keiferia lycopersicella</i>	<p><i>Solanum lycopersicon</i> is the major host. <i>Nicotiana tabacum</i>, <i>Solanum melongena</i> and <i>Solanum tuberosum</i> are the minor hosts.</p>	No
61. <i>Leucinodes orbonalis</i>	<p><i>Solanum melongena</i> is the major host. <i>Capsicum annum</i>, <i>Solanum aculeatissimum</i>, <i>Solanum lycopersicum</i>, <i>Solanum myriacanthum</i>, <i>Solanum rudepannum</i> and <i>Solanum tuberosum</i> are the minor hosts. <i>Beta vulgaris</i>, <i>Ipomoea batatas</i>, <i>Mangifera indica</i> and <i>Pisum sativum</i> are incidental hosts. <i>Solanum nigrum</i> (wild/weed).</p>	No
62. <i>Listronotus bonariensis</i>	<p><i>Lolium multiflorum</i>, <i>Lolium perenne</i> and <i>Zea mays</i> are the major hosts. <i>Agrostis tenuis</i>, <i>Anthoxanthum puelii</i>, <i>Festuca pratensis</i>, <i>Festuca rubra</i>, <i>Lolium</i> and <i>Triticum</i> are the minor hosts. <i>Avena sativa</i>, <i>Brassica napus</i>, <i>Dactylis glomerata</i>, <i>Hordeum vulgare</i>, <i>Medicago sativa</i>, <i>Phleum pratense</i>, <i>Poaceae</i> and <i>Trifolium</i> are incidental hosts.</p>	No
63. <i>Malacosoma americanum</i>	<p><i>Malus coronaria</i>, <i>Prunus pensylvanica</i>, <i>Prunus serotina</i> and <i>Prunus virginiana</i> are major hosts. <i>Malus</i>, <i>Malus domestica</i>, <i>Prunus</i>, <i>Prunus domestica</i>, <i>Prunus persica</i> and <i>Rosaceae</i> are minor hosts. <i>Acer rubrum</i>, <i>Acer saccharum</i>, <i>Alnus</i>, <i>Amelanchier</i>, <i>Berberis vulgaris</i>, <i>Betula alleghaniensis</i>, <i>Betula papyrifera</i>, <i>Carya illinoensis</i>, <i>Corylus</i>, <i>Crataegus</i>, <i>Fagus grandifolia</i>, <i>Fraxinus americana</i>, <i>Fraxinus excelsior</i>, <i>Hamamelis</i>, <i>Liquidambar styraciflua</i>, <i>Nyssa sylvatica</i>, <i>Populus balsamifera</i>, <i>Populus grandidentata</i>, <i>Quercus alba</i>, <i>Quercus rubra</i>, <i>Rosa</i>, <i>Salix</i>, <i>Sorbus</i>, <i>Tilia Americana</i> and <i>Ulmus thomasi</i> are all incidental hosts.</p> <p>Nuisance pest of trees in unsprayed orchards, parks, recreational areas and along roadsides. Major outbreaks could lead to unacceptable damage in orchards, deciduous forest and shade trees.</p> <p>Potential pathways: plants for planting, bark.</p>	Yes

Species	Comment	Add?
64. <i>Malacosoma disstria</i>	<p><i>Acer saccharum</i>, <i>Betula papyrifera</i>, <i>Liquidambar styraciflua</i>, <i>Nyssa aquatica</i>, <i>Nyssa sylvatica</i>, <i>Populus tremuloides</i>, <i>Quercus macrocarpa</i> and <i>Quercus nigra</i>, <i>Quercus phellos</i> are major hosts. <i>Abies</i>, <i>Acer</i>, <i>Alnus</i>, <i>Amelanchier</i>, <i>Betula</i>, <i>Cornus</i>, <i>Corylus</i>, <i>Fraxinus</i>, <i>Larix</i>, <i>Malus</i>, <i>Nyssa</i>, <i>Ostrya</i>, <i>Picea</i>, <i>Pinus</i>, <i>Populus</i>, <i>Prunus</i>, <i>Pseudotsuga menziesii</i>, <i>Pyrus</i> and <i>Quercus</i> are minor hosts.</p> <p>Although infested trees normally recover, growth loss may be substantial. Major outbreaks could lead to unacceptable damage in orchards, deciduous forest and shade trees.</p> <p>Potential pathways: plants for planting, bark.</p>	Yes
65. <i>Margarodes prieskaensis</i>	<i>Vitis vinifera</i> is the major host and <i>Vitis</i> the minor host.	No
66. <i>Margarodes vitis</i>	<p><i>Vitis vinifera</i> is the major host. <i>Aleurites fordii</i> and <i>Vitis</i> are the minor hosts. <i>Arachis hypogaea</i>, <i>Corchorus olitorius</i>, <i>Cydonia oblonga</i>, <i>Dahlia</i>, <i>Linum usitatissimum</i>, <i>Petroselinum crispum</i> and <i>Prunus</i> are incidental hosts. <i>Apiaceae</i>, <i>Asteraceae</i>, <i>Casuarinaceae</i>, <i>Convolvulaceae</i>, <i>Euphorbiaceae</i>, <i>Fabaceae</i>, <i>Linaceae</i>, <i>Nyctaginaceae</i>, <i>Poaceae</i>, <i>Polygalaceae</i>, <i>Rosaceae</i>, <i>Tilioideae</i>, <i>Verbenaceae</i>, <i>Vitaceae</i> (wild/weed).</p> <p>Potential pathways: soil, grapevine roots.</p>	Yes
67. <i>Margarodes vredendalensis</i>	<i>Vitis vinifera</i> is the major host and <i>Vitis</i> the minor host.	No
68. <i>Melanotus communis</i>	<p><i>Ipomoea batatas</i>, <i>Saccharum officinarum</i>, <i>Solanum tuberosum</i> and <i>Zea mays</i> are the major hosts. <i>Apium graveolens</i>, <i>Avena sativa</i>, <i>Capsicum</i>, <i>Capsicum annum</i>, <i>Daucus carota</i>, <i>Hordeum vulgare</i>, <i>Sorghum vulgare</i> and <i>Triticum aestivum</i> are the minor hosts.</p>	No
69. <i>Metamasius hemipterus</i>	<p><i>Cocos nucifera</i> as major host; sugarcane and banana as minor hosts. Maize among incidental hosts.</p>	No

Species	Comment	Add?
<p>70. <i>Monochamus</i> spp. (vectors of <i>B. xylophilus</i>)</p> <p><i>M. alternatus</i></p> <p><i>M. carolinensis</i></p> <p><i>M. marmorator</i></p> <p><i>M. mutator</i></p> <p><i>M. nitens</i></p> <p><i>M. notatus</i></p> <p><i>M. obtusus</i></p> <p><i>M. scutellatus</i></p> <p><i>M. titillator</i></p>	<p><i>M. alteratus</i>: Abies, Cedrus, Larix, Picea, Pinus, <i>Pinus densiflora</i>, <i>Pinus thunbergii</i></p> <p><i>M. carolinensis</i>: Pinus</p> <p><i>M. marmorator</i>: Abies, Picea</p> <p><i>M. mutator</i>: Pinus</p> <p><i>M. nitens</i>: Pinus</p> <p><i>M. notatus</i>: <i>Pinus storbus</i></p> <p><i>M. obtusus</i>: Abies, Pinus, <i>Pseudotsuga menziensis</i></p> <p><i>M. scutellatus</i>: Abies, Larix, Picea, Pinus</p> <p><i>M. titillator</i>: Abies, Picea, Pinus</p> <p>Potential pathways: plants of hosts, wood (timber). Less likely on wood chips and wood packaging material (but there may be more recent information than EPPO DS).</p> <p>The threat from <i>Monochamus</i> spp. is that could carry <i>B. xylophilus</i> on entry. [Note: <i>Monochamus sartor</i>, <i>titillator</i> and <i>urussovii</i> are in NOBANIS DK].</p> <p><i>Monochamus</i> spp. (all on the list): The importance of <i>Monochamus</i> spp. is as vector for pinewood nematode <i>Bursaphelenchus xylophilus</i>. It is important to identify potential pathways, and these were listed. However it is not possible to consider potential environmental, economic and health effects for each species, and the corresponding fields where left blank.</p>	Yes, in part
<p>71. <i>Myndus crudus</i> (putative vector of palm lethal yellowing phytoplasma)</p>	<p><i>Cocos nucifera</i> as major host; Poaceae among minor hosts, but no details.</p>	No
<p>72. <i>Naupactus leucoloma</i></p>	<p><i>Solanum tuberosum</i> is the major host. Brassica, <i>Daucus carota</i> subsp. <i>sativus</i>, <i>Fragaria x ananassa</i>, <i>Pisum sativum</i>, Rubus, <i>Trifolium</i>, <i>Vigna unguiculata</i>, Zea mays and other plants are minor hosts. Fabaceae and vegetable plants are incidental hosts.</p>	No
<p>73. <i>Nemorimyza (Amauromyza) maculosa</i></p>	<p><i>Dendranthema x grandiflorum</i>, <i>Gerbera jamesonii</i>, <i>Lactuca sativa</i> and <i>Pericallis x hybrida</i> are major hosts. Asteraceae, Dahlia and <i>Symphotrichum novi-belgii</i> are minorhosts. <i>Argyranthemum frutescens</i>, Chrysanthemum, <i>Dendranthema indicum</i>, <i>Leucanthemum vulgare</i>, <i>Leucanthemum x superbum</i>, <i>Tanacetum parthenium</i>, <i>Tanacetum vulgare</i> (unclassified); <i>Arctium lappa</i> (wild/weed).</p>	No

Species	Comment	Add?
74. <i>Oligonychus perditus</i>	<p><i>Chamaecyparis pisifera</i>, <i>Juniperus chinensis</i> and <i>Platycladus orientalis</i> are major hosts. <i>Chamaecyparis</i>, <i>Cryptomeria japonica</i>, <i>Juniperus</i>, <i>Juniperus formosana</i> and <i>Taxus cuspidata</i> are minor hosts. <i>Juniperus communis</i>, <i>Juniperus sabina</i>, <i>Juniperus virginiana</i>, <i>Juniperus x media</i> (indicator).</p> <p>Pest intercepted on bonsai plants from the Far East. Cause significant damage in Japan, and was very destructive to infected plants intercepted in Europe. Its hosts are of moderate but significant importance to the European nursery trade.</p>	No
75. <i>Orgyia pseudotsugata</i>	<p><i>Abies concolor</i>, <i>Abies grandis</i>, <i>Pseudotsuga menziesii</i> (major), <i>Abies lasiocarpa</i> var. <i>lasiocarpa</i>, <i>Abies magnifica</i>, <i>Larix occidentalis</i>, <i>Picea engelmannii</i> (minor), <i>Picea pungens</i>, <i>Pinus contorta</i>, <i>Pinus flexilis</i>, <i>Pinus jeffreyi</i>, <i>Pinus lambertiana</i>, <i>Pinus ponderosa</i>, <i>Tsuga heterophylla</i> (incidental), <i>Purshia tridentata</i>, <i>Vaccinium</i> (wild/weed) one of the most serious defoliators of North American forests. Repeated infestations may cause top-killing of the trees and tree mortality. Number of pest species of these important timber trees is still relatively low.</p>	Yes
76. <i>Pheletes (Limonius) californicus</i>	<p><i>Avena sativa</i>, <i>Beta vulgaris</i>, <i>Hordeum vulgare</i>, <i>Solanum tuberosum</i> and <i>Triticum aestivum</i> are major hosts. <i>Phaseolus vulgaris</i>, <i>Trifolium pratense</i> and <i>Zea mays</i> are minor hosts.</p>	No
77. <i>Pissodes nemorensis</i>	<p><i>Picea glauca</i>, <i>Picea mariana</i> and <i>Pinus banksiana</i> are major hosts. <i>Picea</i>, <i>Picea abies</i>, <i>Picea pungens</i>, <i>Pinus</i>, <i>Pinus canariensis</i>, <i>Pinus contorta</i>, <i>Pinus echinata</i>, <i>Pinus elliotii</i>, <i>Pinus glabra</i>, <i>Pinus palustris</i>, <i>Pinus pungens</i>, <i>Pinus radiata</i>, <i>Pinus resinosa</i>, <i>Pinus rigida</i>, <i>Pinus serotina</i>, <i>Pinus strobus</i>, <i>Pinus sylvestris</i>, <i>Pinus taeda</i> and <i>Pinus virginiana</i> are minor hosts. <i>Cedrus atlantica</i>, <i>Cedrus deodara</i> and <i>Cedrus libani</i> are incidental hosts.</p> <p>Little importance in natural pine stands, but important for Christmas tree plantations and in nursery. Serious pest especially in conifer nurseries and in Christmas tree plantations. Could have serious economic and ecological consequences.</p> <p>Potential pathways: living plants, including Christmas trees. Also cut branches (as <i>P. terminalis</i>?).</p>	Yes

Species	Comment	Add?
78. <i>Pissodes strobi</i>	<p><i>Picea sitchensis</i> and <i>Pinus strobus</i> are the major hosts. <i>Picea</i>, <i>Picea abies</i>, <i>Picea engelmannii</i>, <i>Picea glauca</i> and <i>Pinus</i> are minor hosts. <i>Picea mariana</i>, <i>Picea omorika</i>, <i>Picea pungens</i>, <i>Picea rubens</i>, <i>Pinus banksiana</i>, <i>Pinus contorta</i>, <i>Pinus pungens</i>, <i>Pinus resinosa</i>, <i>Pinus rigida</i>, <i>Pinus sylvestris</i> and <i>Pseudotsuga menziesii</i> are incidental hosts.</p> <p>Serious pest of the introduced <i>Picea sitchensis</i> and the native <i>P. abies</i>, two very important timber species in Europe, obvious potential to establish in the conditions of Northern Europe which resemble those of Canada. Less potential importance on European <i>Pinus</i> spp., since <i>P. strobus</i> is no longer planted to any significant extent.</p> <p>Potential pathways: living plants, including Christmas trees. Also cut branches (as <i>P. terminalis</i>?).</p>	Yes
79. <i>Pissodes terminalis</i>	<p><i>Pinus contorta</i> is the major host. <i>P. banksiana</i>, <i>muricata</i> and <i>radiata</i> are minor hosts.</p> <p>Risk assessed as moderate for the EPPO region: cited much less frequently in the North American literature than the much more important <i>P. strobi</i>, occurs over a much smaller area, and narrower host range; does not have potential to spread to other species or cause more extensive damage.</p> <p>Potential pathways: plants and cut branches of host species, minor risk from conifer wood.</p>	Yes
80. <i>Premnotrypes latithorax</i>	<i>Solanum tuberosum</i> is the major host and <i>Solanum</i> the minor host.	No
81. <i>Premnotrypes suturicallus</i>	<i>Solanum tuberosum</i> is the major host and <i>Solanum</i> the minor host.	No
82. <i>Premnotrypes vorax</i>	<i>Solanum tuberosum</i> is the major host and <i>Solanum</i> the minor host.	No
83. <i>Pseudopityophthorus minutissimus</i> and <i>P. pruinus</i> (as putative vectors of <i>Ceratocystis fagacearum</i> )	<p><i>Quercus rubra</i> is the major host and <i>Quercus</i> the minor host.</p> <p>Vector with no damage of its own. Thought to play a relatively minor role in dissemination (less than the presumed potential role of the European <i>S. intricatus</i> [present in Denmark]).</p>	No

Species	Comment	Add?
84. <i>Rhagoletis fausta</i>	<i>Prunus avium</i> is the major host. <i>Prunus</i> , <i>Prunus cerasus</i> and <i>Prunus salicina</i> are minor hosts. <i>Prunus pensylvanica</i> (wild/weed) Potential pathways: fruits of hosts.	Yes
85. <i>Rhagoletis indifferens</i>	<i>Prunus avium</i> is the major host and <i>P. salicina</i> the minor host. <i>P. cerasus</i> is incidental host. <i>P. emarginata</i> (wild/weed). Potential pathways: fruit of hosts, soil, packaging used to transport host fruit.	Yes
86. <i>Rhagoletis mendax</i>	<i>Vaccinium corymbosum</i> as main hosts, and other <i>Vaccinium</i> as minor hosts.	No
87. <i>Rhagoletis pomonella</i>	<i>Malus domestica</i> is the major host. <i>Prunus armeniaca</i> , <i>Prunus avium</i> , <i>Prunus cerasus</i> are minor hosts. <i>Malus</i> and <i>Prunus</i> are incidental hosts. <i>Amelanchier</i> , <i>Aronia arbutifolia</i> , <i>Cotoneaster</i> , <i>Crataegus</i> , <i>Prunus americana</i> , <i>Rosa</i> , <i>Rosaceae</i> (wild/weed). Most serious fruit-fly pest in North America. Potential pathways: fruit of hosts, soil, packaging used to transport host fruit.	Yes
88. <i>Rhizoecus hibisci</i>	<i>Cuphea hyssopifolia</i> , <i>Hibiscus rosa-sinensis</i> , <i>Pelargonium x hortorum</i> , <i>Phoenix canariensis</i> and <i>Serissa foetida</i> are major hosts. <i>Calathea</i> , <i>Camellia sinensis</i> , <i>Carex</i> , <i>Celtis</i> , <i>Crinum asiaticum</i> , <i>Cryptanthus</i> , <i>Dieffenbachia</i> , <i>Dieffenbachia maculata</i> , <i>Ficus</i> , <i>Hakonechloa macra</i> , <i>Howea forsteriana</i> , <i>Ligustrum ovalifolium</i> , <i>Nerium oleander</i> , <i>Pelargonium</i> , <i>Phoenix</i> , <i>Punica granatum</i> , <i>Ravenia rivularis</i> , <i>Rhapis</i> , <i>Rhapis excelsa</i> , <i>Rhododendron</i> , <i>Sabal</i> , <i>Sageretia thea</i> , <i>Serissa</i> , <i>Ulmus parvifolia</i> , <i>Zelkova</i> and <i>Zelkova serrata</i> are all minor hosts.	No
89. <i>Rhynchophorus palmarum</i>	Main hosts: palm, sugarcane.	No
90. <i>Saperda candida</i>	<i>Malus</i> (apple, also wild apple), <i>Prunus</i> (cherry, plum, peach), <i>Pyrus</i> (pear), <i>Cydonia</i> (quince), <i>Sorbus</i> (mountain ash, beam-tree, rowan berry), <i>Crataegus</i> (hawthorn), <i>Amelanchier</i> (serviceberry, shadbush), <i>Cotoneaster</i> , <i>Aronia</i> (chokeberry or black mountain ash) (EPPO PRA). Already introduced into Germany. Pathways: plants for planting with roots, wood with bark.	Yes

Species	Comment	Add?
91. <i>Scaphoideus luteolus</i> (vector of Elm phloem necrosis phytoplasma)	<i>Ulmus alata</i> , <i>Americana</i> and <i>rubra</i> are major hosts. <i>Ulmus</i> is the minor host. Significant only as vector of the phytoplasma. Potential pathways: planting material of elm. Analysis of environmental, economic and health effects would not be relevant as <i>Scaphoideus luteolus</i> is important only as a vector of elm phloem necrosis phytoplasma. In addition, the importance of the phytoplasma for European elms is uncertain (EPPO data sheet). For these reasons, <i>Scaphoideus luteolus</i> was not considered further.	No
92. <i>Scirtothrips aurantii</i>	Main hosts are citrus and related ( <i>Vitis vinifera</i> amongst incidental hosts).	No
93. <i>Scirtothrips citri</i>	Main hosts are citrus (although rose, <i>Medicago sativa</i> and <i>Vitis vinifera</i> amongst incidental hosts).	No
94. <i>Spodoptera eridania</i>	<i>Ipomoea batatas</i> and <i>Solanum lycopersicum</i> are the major hosts. <i>Beta vulgaris</i> , Brassicaceae, <i>Capsicum annuum</i> , <i>Dendranthema x grandiflorum</i> , <i>Dianthus caryophyllus</i> , <i>Dioscorea opposita</i> , Fabaceae, <i>Gossypium hirsutum</i> , <i>Manihot esculenta</i> , <i>Nicotiana tabacum</i> , Pelargonium, <i>Phaseolus vulgaris</i> , Poaceae, <i>Solanum melongena</i> , <i>Solanum tuberosum</i> , Zea mays, herbaceous ornamental plants and other plants are all minor hosts. In NOBANIS DK.	No
95. <i>Spodoptera frugiperda</i>	<i>Oryza sativa</i> , <i>Saccharum officinarum</i> , <i>Sorghum vulgare</i> and Zea mays are the major hosts. <i>Allium cepa</i> , <i>Arachis hypogaea</i> , Brassicaceae, <i>Capsicum annuum</i> , Cucurbitaceae, <i>Dendranthema x grandiflorum</i> , <i>Dianthus caryophyllus</i> , <i>Gossypium hirsutum</i> , <i>Ipomoea batatas</i> , <i>Medicago sativa</i> , <i>Nicotiana tabacum</i> , Pelargonium, <i>Phaseolus vulgaris</i> , Poaceae, <i>Solanum lycopersicum</i> , <i>Solanum melongena</i> and vegetable plants are minor hosts.	No
96. <i>Spodoptera litura</i>	<i>Glycine max</i> , <i>Gossypium hirsutum</i> , <i>Nicotiana tabacum</i> and Zea mays are major hosts. <i>Arachis hypogaea</i> , <i>Brassica oleracea</i> , <i>Camellia sinensis</i> , <i>Capsicum annuum</i> , <i>Colocasia esculenta</i> , <i>Corchorus olitorius</i> , Cucurbitaceae, <i>Gossypium barbadense</i> , <i>Ipomoea batatas</i> , <i>Leucaena leucocephala</i> , <i>Linum usitatissimum</i> , <i>Medicago sativa</i> , <i>Morus alba</i> , <i>Oryza sativa</i> , <i>Phaseolus vulgaris</i> , <i>Solanum lycopersicum</i> , <i>Solanum melongena</i> , <i>Solanum tuberosum</i> , <i>Vigna</i> , herbaceous ornamental plants, other plants and vegetable plants are all minor hosts.	No
97. <i>Sternochetus mangiferae</i>	Host (mango).	No

Species	Comment	Add?
98. <i>Thrips palmi</i>	<i>Capsicum annuum</i> , <i>Cucumis melo</i> , <i>Cucumis sativus</i> , <i>Solanum melongena</i> , herbaceous ornamental plants and vegetable plants are major hosts. <i>Benincasa hispida</i> , <i>Citrullus lanatus</i> , <i>Cucurbita pepo</i> , Cucurbitaceae, <i>Cyclamen persicum</i> , <i>Dendranthema x grandiflorum</i> , <i>Ficus</i> , <i>Glycine max</i> , <i>Gossypium hirsutum</i> , <i>Helianthus annuus</i> , <i>Nicotiana tabacum</i> , Orchidaceae, <i>Phaseolus vulgaris</i> , <i>Pisum sativum</i> , <i>Sesamum indicum</i> , Solanaceae, <i>Solanum tuberosum</i> and <i>Vigna unguiculata</i> are minor hosts. <i>Citrus</i> , <i>Mangifera indica</i> are incidental hosts. <i>Capsella bursa-pastoris</i> , <i>Cerastium glomeratum</i> , <i>Vicia sativa</i> (wild/weed). Tropical/sub tropical distribution, and likely to establish only in glasshouses in Denmark.	No
99. <i>Unaspis citri</i>	Host (Citrus and related species).	No
<b>Nematoda</b>		
100. <i>Nacobbus aberrans</i>	<i>Beta vulgaris</i> and <i>Solanum tuberosum</i> are major hosts. <i>Brassica oleracea</i> , Cactaceae, <i>Capsicum annuum</i> , <i>Cucumis sativus</i> , <i>Daucus carota</i> subsp. <i>sativus</i> , <i>Lactuca sativa</i> , <i>Opuntia</i> , <i>Solanum</i> , <i>Solanum lycopersicum</i> and herbaceous plants are minor hosts.	No
101. <i>Radopholus similis</i> attacking citrus (formerly <i>R. citrophilus</i> )	Citrus pest.	No
102. <i>Xiphinema americanum sensu stricto</i>	Vector.	No
103. <i>Xiphinema bricolense</i>	Vector.	No
104. <i>Xiphinema californicum</i>	Vector.	No
<b>Fungi</b>		
105. <i>Alternaria mali</i>	<i>Malus pumila</i> and <i>Malus sylvestris</i> . Not carried in dormant planting material. Causes disease of leaf and fruit.	No
106. <i>Anisogramma anomala</i>	<i>Corylus</i> spp. Causes death of branches. Would have economic impact in plantations, but does not kill trees.	No

Species	Comment	Add?
107. <i>Apiosporina morbosana</i>	<i>Prunus</i> spp. Within a few years of attack, trees lose vigour and become worthless. Causes stunting of trees, death of individual branches. No mortality.	No
108. <i>Atropellis pinicola</i>	<i>Pinus contorta</i> (important branch and trunk canker), <i>P. lambertiana</i> , <i>P. monticola</i> and <i>P. strobus</i> (minor cankers), <i>P. nigra</i> and <i>P. sylvestris</i> (minor twig blights). Bark and wood with bark of <i>Pinus</i> .	Yes
109. <i>Atropellis piniphila</i>	<i>Pinus contorta</i> , also <i>P. albicaulis</i> , <i>P. banksiana</i> , <i>P. jeffreyi</i> , <i>P. monticola</i> , <i>P. ponderosa</i> , <i>P. taeda</i> and <i>P. virginiana</i> . Bark and wood with bark of <i>Pinus</i> .	Yes
110. <i>Ceratocystis fagacearum</i>	<i>Quercus</i> species. <i>C. fagacearum</i> is registered on the Danish Nature Agency's Observation list. Vectors have not been added here.	Yes, Obs. list
111. <i>Chrysomyxa arctostaphyli</i>	<i>Picea</i> . Dead branches and mortality are common. Vectors are plants for planting and cut branches.	Yes
112. <i>Cronartium coleosporioides</i>	<i>Pinus banksiana</i> and <i>contorta</i> . Causes mortality of seedlings. However, telial hosts do not occur in Europe.	No
113. <i>Cronartium comandrae</i>	<i>Pinus</i> . Risk of establishment assessed as practically nil, due to absence of telial hosts.	No
114. <i>Cronartium comptoniae</i>	<i>Pinus contorta</i> , <i>banksiana</i> , <i>rigida</i> . <i>P. sylvestris</i> is susceptible. Causes damage to seedlings (not mortality). Less important than the other <i>Cronartium</i> rusts on the list, but has a telial host in Europe.	No
115. <i>Cronartium fusiforme</i>	<i>Pinus elliotii</i> , <i>P. taeda</i> , occasionally <i>P. rigida</i> and <i>P. serotina</i> . Some artificial hosts (e.g. <i>P. contorta</i> ). Causes serious disease, but no mortality. Presents in South Eastern USA, i.e. different climatic conditions.	No
116. <i>Cronartium himalayense</i>	<i>Pinus roxburghii</i> (rare, ornamental in Europe). Dwarfes plants. Particularly damaging in nurseries and young plantations of <i>P. roxburghii</i> .	No
117. <i>Cronartium quercuum</i>	<i>Pinus densiflora</i> , <i>P. thunbergii</i> , <i>P. kesiya</i> , <i>P. luchuensis</i> , <i>P. takahasii</i> , <i>P. massoniana</i> , <i>P. tabulaeformis</i> , <i>P. banksiana</i> , <i>P. echinata</i> , <i>P. virginiana</i> and <i>P. sylvestris</i> is susceptible. <i>P. nigra</i> possibly at risk. May cause severe stunting and rapid death of seedlings. No European species is telial host. Establishment would depend on susceptibility of <i>Quercus</i> and <i>Castanea</i> species (telial hosts at origin do not occur in Europe).	No

Species	Comment	Add?
118. <i>Davidiella (Mycosphaerella) populorum</i>	<i>Populus nigra</i> and <i>Populus x canadensis</i> are major hosts. <i>Populus</i> , <i>Populus balsamifera</i> , <i>Populus deltoides</i> and <i>Populus trichocarpa</i> are minor hosts.  Causes cankers and may lead to dieback. More damage on young trees/seedlings.  Potential pathways: seedlings, cuttings or cankered bark of older trees, or infected bark on logs or sawn wood.	Yes
119. <i>Endocrona rtium harknessii</i>	<i>Pinus banksiana</i> , <i>Pinus contorta</i> and <i>Pinus ponderosa</i> are major hosts. <i>Pinus</i> , and <i>Pinus sylvestris</i> are minor hosts. <i>Pinus attenuata</i> , <i>Pinus halepensis</i> , <i>Pinus mugo</i> , <i>Pinus muricata</i> , <i>Pinus nigra</i> and <i>Pinus radiata</i> are incidental hosts.  Effects on form, lumber content and growth rates; kills individual trees, although not known to kill whole stands. Galls on the main stem of young trees can lead to the death of the tree.  Potential pathways: plants for planting, bark, wood.	Yes
120. <i>Guignardia citricarpa</i>	Citrus and Rutaceae.	No
121. <i>Gymnosporangium clavipes</i>	Major hosts are <i>Cydonia oblonga</i> . Minor hosts are <i>Malus</i> and <i>Malus domestica</i> . Alternate: <i>Juniperus</i> , <i>Juniperus communis</i> , <i>Juniperus virginiana</i> , Incidental hosts are <i>Amelanchier</i> , <i>Aronia</i> , <i>Chaenomeles</i> , <i>Crataegus</i> , <i>Mespilus</i> and <i>Photinia</i> .	No
122. <i>Gymnosporangium globosum</i>	Major host is <i>Crataegus</i> and minor hosts are <i>Malus</i> and <i>Malus domestica</i> . Alternate: <i>Juniperus</i> , <i>Juniperus virginiana</i> . Incidental hosts are <i>Amelanchier</i> , <i>Pyrus</i> and <i>Sorbus</i> .	No
123. <i>Gymnosporangium juniperi-virginianae</i>	Major host is <i>Malus domestica</i> and minor host <i>Malus</i> . Alternate: <i>Juniperus</i> , <i>Juniperus virginiana</i> .	No
124. <i>Gymnosporangium yamadae</i>	Major hosts are <i>Larix gmelinii</i> and <i>Larix kaempferi</i> . Minor hosts are <i>Larix</i> and <i>Larix decidua</i> .  May causes defoliation, death of shoots and twigs.	No
125. <i>Melampsora farlowii</i>	<i>Tsuga canadensis</i> and <i>T. caroliniana</i> .	No

Species	Comment	Add?
126. <i>Mycosphaerella gibsonii</i>	<i>Pinus densiflora</i> , <i>Pinus pinaster</i> subsp. <i>escarena</i> , <i>Pinus radiata</i> and <i>Pinus thunbergii</i> are major hosts. <i>Pinus caribaea</i> , <i>Pinus halepensis</i> , <i>Pinus merkusii</i> and <i>Pinus sylvestris</i> are minor hosts. <i>Pinus</i> , <i>Pinus canariensis</i> , <i>Pinus luchuensis</i> , <i>Pinus massoniana</i> , <i>Pinus resinosa</i> and <i>Pinus strobus</i> are incidental hosts.  Severe defoliation, may cause death.  Tropical/sub tropical distribution.	No
127. <i>Mycosphaerella laricis-leptolepidis</i>	<i>Larix decidua</i> , <i>L. gmelinii</i> var. <i>japonica</i> , <i>L. gmelinii</i> var. <i>olgensis</i> and <i>L. leptolepis</i> .  Potential pathway: plants for planting and cut branches.	Yes
128. <i>Ophiostoma wagneri</i>	<i>Pinus ponderosa</i> and <i>Pseudotsuga menziesii</i> are major hosts. <i>Pinus</i> , <i>Pinus contorta</i> , <i>Pinus edulis</i> , <i>Pinus jeffreyi</i> , <i>Pinus monophylla</i> are minor hosts.  Causes mortality.  Potential pathways: plants for planting.	Yes
129. <i>Phaeoramularia angolensis</i>	Citrus.	No
130. <i>Phellinus weirii</i>	<i>Pseudotsuga menziesii</i> and <i>Tsuga mertensiana</i> are major hosts. <i>Abies grandis</i> , <i>Abies lasiocarpa</i> var. <i>lasiocarpa</i> , <i>Abies magnifica</i> , <i>Abies mariesii</i> , <i>Abies sachalinensis</i> , <i>Chamaecyparis</i> , <i>Cupressaceae</i> , <i>Larix occidentalis</i> , <i>Picea jezoensis</i> , <i>Picea sitchensis</i> , <i>Pinaceae</i> , <i>Pinus contorta</i> , <i>Pinus monticola</i> , <i>Pinus ponderosa</i> , <i>Tsuga diversifolia</i> and <i>Tsuga heterophylla</i> are minor hosts. <i>Thuja plicata</i> is an incidental host.  Causes serious disease, root decay leading to direct mortality or accelerated wind-throw.  Potential pathways: bark, wood with bark.	Yes
131. <i>Phoma andigena</i>	Potatoes and other tuber-bearing <i>Solanum</i> spp., other <i>Solanaceae</i> (including tomatoes and various weeds).	No
132. <i>Phyllosticta solitaria</i>	<i>Malus domestica</i> is the major host and <i>Malus</i> and <i>Pyrus</i> the minor hosts. <i>Crataegus</i> is the incidental host.	No
133. <i>Phymatotrichopsis omnivora</i>	Cotton, including <i>Gossypium herbaceum</i> , <i>G. hirsutum</i> and <i>G. Barbadense</i> as major hosts. Can also develop on more than 200 species of dicotyledons.  Potential distribution would mainly be in the warmer wetter areas (cotton-growing countries of the Mediterranean basin for EPPO).	No

Species	Comment	Add?
134. <i>Puccinia hemerocallidis</i>	Hemerocallis.	No
135. <i>Puccinia pittieriana</i>	Potatoes and tomatoes, <i>Solanum demissum</i> and other wild Solanaceae. Can cause severe defoliation.	No
136. <i>Septoria lycopersici</i> var. <i>malagutii</i>	<i>Solanum tuberosum</i> and other tuber-bearing Solanum spp.	No
137. <i>Sirococcus clavignenti-juglandacearum</i>	<i>Juglans cinerea</i> . Also: <i>Juglans nigra</i> (black walnut) and <i>Juglans ailantifolia</i> var. <i>Cordiformis</i> . <i>J. regia</i> is artificial host.	No
138. <i>Stegophora ulmea</i>	Many <i>Ulmus</i> spp. Mortality not common, but <i>Ulmus</i> already depleted by other pests in Europe. Potential pathways: plants for planting, cut branches, bonsais.	Yes
139. <i>Thecaphora solani</i>	<i>Solanum tuberosum</i> , various other tuber-bearing Solanum spp., <i>Datura stramonium</i> .	No
140. <i>Tilletia indica</i>	Main host wheat. Also rye.	No

**Table 16.** Reviewed EPPO A2 List: Insects and mites, nematodes and fungi recommended for regulation. First column (Species) shows the considered species, second column (Comment) offers various comments on hosts, pathways etc. and third column (Add?) shows whether the species were added to the EPPO list of species assessed in this report. DK = Denmark. Obs. List = Observation list. Host plants were extracted from PQR (EPPO, 2013).

Species	Comments	Add?
<b>Insects and mites</b>		
1. <i>Aculops fuchsiae</i>	Fuchsia.	No
2. <i>Aeolesthes sarta</i>	<i>Juglans regia</i> , <i>Malus domestica</i> , <i>Platanus orientalis</i> , <i>Platanus x acerifolia</i> , <i>Populus alba</i> , <i>Populus euphratica</i> , <i>Populus x canadensis</i> , <i>Salix acmophylla</i> , <i>Ulmus minor</i> and <i>Ulmus pumila</i> are major hosts. Acer, Betula, Elaeagnus, Fraxinus, Gleditsia, Juglans, Malus, Morus, Platanus, Populus, Prunus, Pyrus, Quercus, Robinia, Salix, Ulmus and woody plants are minor hosts.  Currently occurs in hot dry climatic conditions; endangered area is primarily the Mediterranean region, and some other southern countries of the EPPO region.	No
3. <i>Agrilus planipennis</i>	The species is registered on the Danish Nature Agency's Observation list.	Yes, Obs. List.
4. <i>Aleurocanthus spiniferus</i>	Main hosts are several Citrus spp. <i>Pyrus communis</i> , Rosa and Vitis vinifera are minor hosts.	No
5. <i>Anoplophora chinensis</i>	The species is registered on the Danish Nature Agency's Observation list.	Yes, Obs. List.
6. <i>Bemisia tabaci</i>	<i>Capsicum annuum</i> , <i>Euphorbia pulcherrima</i> , <i>Gerbera jamesonii</i> , <i>Gossypium hirsutum</i> , <i>Ipomoea batatas</i> , <i>Manihot esculenta</i> , <i>Nicotiana tabacum</i> and <i>Solanum lycopersicum</i> are major hosts. Asteraceae, Brassicaceae, Convolvulaceae, <i>Cucumis sativus</i> , <i>Cucurbita pepo</i> , Cucurbitaceae, Euphorbiaceae, Fabaceae, Hibiscus, Lactuca sativa, Malvaceae, Sinningia, Solanaceae, other plants and vegetable plants are minor hosts. <i>Abelmoschus esculentus</i> , <i>Glycine max</i> , <i>Phaseolus vulgaris</i> , <i>Solanum melongena</i> (unclassified). In NOBANIS DK.	No
7. <i>Cacoecimorpha pronubana</i>	<i>Dianthus caryophyllus</i> is the main host. Minor hosts include Rosa and Pelargonium. In NOBANIS DK.	No
8. <i>Cacyreus marshalli</i>	Pelargonium	No

Species	Comments	Add?
9. <i>Carposina sasakii</i>	<i>Malus domestica</i> , <i>Pyrus communis</i> and <i>Pyrus pyrifolia</i> are major hosts. <i>Crataegus</i> , <i>Cydonia oblonga</i> , <i>Prunus armeniaca</i> , <i>Prunus domestica</i> , <i>Prunus persica</i> , <i>Ziziphus jujube</i> and <i>Ziziphus mauritiana</i> are minor hosts. <i>Corchorus</i> (unclassified), <i>Chaenomeles</i> , <i>Malus</i> , <i>Prunus</i> , <i>Pyrus</i> , <i>Ziziphus</i> (unclassified).	No
10. <i>Ceratitidis capitata</i>	<i>Citrus sinensis</i> and <i>reticulata</i> , <i>Prunus persica</i> and <i>Mangifera indica</i> are major hosts. Several <i>Prunus</i> and <i>Pyrus communis</i> are minor hosts.	No
11. <i>Cydia inopinata</i>	<i>Malus domestica</i> is the main host. <i>Cydonia oblonga</i> , <i>Malus</i> and <i>Pyrus</i> are minor hosts. Potential pathway: fruit.	No
12. <i>Dacus ciliatus</i>	<i>Cucumis melo</i> , <i>Cucurbita pepo</i> and <i>Cucumis sativus</i> are main hosts. Other Cucurbitaceae are minor hosts.	No
13. <i>Dendrolimus sibiricus</i>	Major hosts are <i>Abies nephrolepis</i> , <i>Abies sibirica</i> , <i>Larix gmelinii</i> , <i>Larix russica</i> , <i>Picea jezoensis</i> , <i>Picea obovata</i> , <i>Pinus koraiensis</i> and <i>Pinus sibirica</i> . Minor hosts are <i>Abies</i> , <i>Larix</i> , <i>Picea</i> , <i>Pinus</i> and <i>Tsuga</i> . Should be able to attack other species in the Western part of the EPPO region. Potential pathways: wood with bark, bark, plants for planting and cut branches (incl. Christmas trees), as contaminant of other commodities. In NOBANIS DK.	Yes
14. <i>Dendrolimus superans</i>	Major hosts are <i>Larix kamtschatica</i> , <i>Pinus pumila</i> , <i>Minor</i> , <i>Abies</i> , <i>Abies sachalinensis</i> , <i>Larix</i> , <i>Picea</i> , <i>Picea jezoensis</i> , <i>Pinus</i> and <i>Tsuga</i> . Should be able to attack other species in the Western part of the EPPO region. Potential pathways: wood with bark, bark, plants for planting and cut branches (incl. Christmas trees), as contaminant of other commodities.	Yes
15. <i>Diabrotica virgifera</i>	<i>Zea mays</i> .	No
16. <i>Drosophila suzukii</i>	Several fruit crops including <i>Prunus avium</i> and strawberry.	No

Species	Comments	Add?
17. <i>Dryocosmus kuriphilus</i>	Major hosts are <i>Castanea crenata</i> , <i>Castanea dentata</i> , <i>Castanea mollissima</i> and <i>Castanea sativa</i> . Unclassified: <i>Castanea seguinii</i> . Most serious pest of chestnut worldwide. Very likely to be able to establish in many EPPO countries, particularly in the Centre and South where cultivated or wild chestnuts grow. However, it is considered here that <i>Castanea</i> is only occasional in Denmark and not planted over large areas. <i>Dryocosmus kuriphilus</i> was not considered further.	No
18. <i>Epitrix cucumeris</i>	Major host is <i>Solanum tuberosum</i> and minor host Solanaceae and other plants. Incidental hosts are <i>Beta vulgaris</i> , <i>Brassica oleracea</i> , <i>Cucumis sativus</i> , <i>Lactuca sativa</i> and <i>Phaseolus vulgaris</i> .	No
19. <i>Epitrix similaris</i>	Major hosts are <i>Capsicum annuum</i> , <i>Nicotiana tabacum</i> , <i>Solanum lycopersicum</i> , <i>Solanum melongena</i> and <i>Solanum tuberosum</i> . Wild/Weed: <i>Datura stramonium</i> and <i>Solanum nigrum</i> .	No
20. <i>Erschoviella musculana</i>	<i>Juglans regia</i> .	No
21. <i>Eutetranychus orientalis</i>	Citrus and Rutaceae as major and minor hosts. Several fruit crops as incidental hosts, such as <i>Morus</i> spp., <i>Pyrus communis</i> .	No
22. <i>Frankliniella occidentalis</i>	Major hosts are <i>Capsicum annuum</i> , <i>Cucumis sativus</i> , <i>Dendranthema x grandiflorum</i> , <i>Gerbera jamesonii</i> , <i>Medicago sativa</i> , <i>Prunus armeniaca</i> , <i>Prunus domestica</i> , <i>Prunus persica</i> , <i>Rosa</i> large-flowered bush hybrids and <i>Saintpaulia ionantha</i> . Minor hosts are Cucurbitaceae, <i>Dianthus caryophyllus</i> , <i>Fragaria x ananassa</i> , <i>Gladiolus</i> hybrids, <i>Lathyrus odoratus</i> , <i>Nicotiana tabacum</i> , <i>Pisum sativum</i> , <i>Rosa</i> , <i>Sinningia speciosa</i> , <i>Solanum lycopersicum</i> , fruit plants, herbaceous ornamental plants and vegetable plants. Incidental hosts are <i>Allium cepa</i> , <i>Beta vulgaris</i> , <i>Carthamus tinctorius</i> , <i>Citrus paradisi</i> , <i>Daucus carota</i> subsp. <i>sativus</i> , <i>Gossypium hirsutum</i> and <i>Phaseolus vulgaris</i> . In NOBANIS DK.	No
23. <i>Gonipterus scutellatus</i>	Eucalyptus species.	No

Species	Comments	Add?
24. <i>Helicoverpa armigera</i>	Major hosts are <i>Cicer arietinum</i> , <i>Glycine max</i> , <i>Gossypium hirsutum</i> , <i>Linum usitatissimum</i> , <i>Medicago sativa</i> , <i>Nicotiana tabacum</i> , <i>Phaseolus vulgaris</i> , <i>Solanum lycopersicum</i> , <i>Solanum tuberosum</i> , <i>Sorghum vulgare</i> and <i>Zea mays</i> . Minor hosts are <i>Abelmoschus esculentus</i> , <i>Allium</i> , <i>Arachis hypogaea</i> , Brassicaceae, <i>Cajanus cajan</i> , <i>Capsicum annuum</i> , Citrus, Cucurbitaceae, <i>Guizotia abyssinica</i> , <i>Helianthus annuus</i> , <i>Mangifera indica</i> , <i>Phaseolus</i> , <i>Pinus radiata</i> , <i>Prunus</i> , <i>Solanum melongena</i> , herbaceous ornamental plants and vegetable plants. Unclassified: <i>Dendranthema x grandiflorum</i> . In NOBANIS DK.	No
25. <i>Hesperophanes campestris</i>	<i>Malus domestica</i> , <i>Morus alba</i> . <i>Betula</i> , <i>Salix</i> and <i>Sorbus</i> as minor hosts. Potential pathways: wood, wood packaging material. Note on the assessment: Within EPPO, it was originally assessed that this species presented a risk for the Central and Mediterranean part of the EPPO region (EPPO data sheet). However, <i>H. campestris</i> has since been introduced successfully into the USA (it is currently present in several Northern states), and possibly Canada, and has also been introduced into a substantial number of European countries. It may be actively spreading in climatic conditions that are different from originally predicted, and was therefore maintained here.	Yes
26. <i>Ips hauseri</i>	<i>Larix russica</i> , <i>Picea schrenkiana</i> , <i>Pinus nigra subsp. Pallasiana</i> and <i>Pinus sylvestris</i> are major hosts. <i>Larix</i> , <i>Picea</i> and <i>Pinus</i> are minor hosts. Potential pathways: wood commodities with bark, cut branches.	Yes
27. <i>Ips subelongatus</i>	<i>Larix gmelinii</i> and <i>Larix russica</i> are the major hosts. <i>Abies</i> , <i>Larix</i> , <i>Picea</i> , <i>Pinus</i> , <i>Pinus koraiensis</i> , <i>Pinus sibirica</i> and <i>Pinus sylvestris</i> are minor hosts. Potential pathways: wood, contaminating pest on other commodities.	Yes
28. <i>Lepidosaphes ussuriensis</i>	<i>Alnus hirsuta</i> , <i>Betula pendula</i> , <i>Euonymus hamiltoniana var. maackii</i> , <i>Malus baccata</i> , <i>Physocarpus amurensis</i> , <i>Populus maximowiczii</i> , <i>Populus suaveolens</i> , <i>Populus tremula</i> , <i>Syringa reticulata var. mandschurica</i> , <i>Ulmus japonica</i> , <i>Ulmus laciniata</i> and <i>Ulmus pumila</i> are major hosts. <i>Alnus</i> , <i>Betula</i> , <i>Euonymus</i> , <i>Malus</i> , <i>Populus</i> , <i>Ulmus</i> and woody plants are minor hosts. Potential pathways: plants for planting.	Yes

Species	Comments	Add?
29. <i>Leptinotarsa decemlineata</i>	<i>Solanum tuberosum</i> is the major host. <i>Brassica oleracea</i> , <i>Cichorium endivia</i> , <i>Cichorium endivia</i> var. <i>latifolia</i> , <i>Daucus carota</i> subsp. <i>sativus</i> , <i>Lactuca sativa</i> , <i>Petroselinum crispum</i> , <i>Solanum lycopersicum</i> , <i>Solanum melongena</i> and vegetable plants are minor hosts. Solanaceae and <i>Solanum</i> (wild/weed). In NOBANIS DK.	No
30. <i>Liriomyza huidobrensis</i>	<i>Apium graveolens</i> , <i>Capsicum annuum</i> , <i>Cucumis melo</i> , <i>Cucumis sativus</i> , <i>Dendranthema x grandiflorum</i> , <i>Lactuca sativa</i> , <i>Phaseolus vulgaris</i> , <i>Solanum lycopersicum</i> , <i>Verbena</i> hybrids are major hosts. <i>Allium cepa</i> , <i>Allium sativum</i> , <i>Aster</i> , <i>Beta vulgaris</i> , <i>Cannabis sativa</i> , <i>Cucumis</i> , <i>Cucurbita pepo</i> , <i>Dahlia</i> hybrids, <i>Dianthus caryophyllus</i> , <i>Gypsophila paniculata</i> , <i>Lathyrus</i> , <i>Medicago sativa</i> , <i>Pisum sativum</i> , <i>Primula Polyanthus</i> hybrids, <i>Raphanus sativus</i> , <i>Solanum melongena</i> , <i>Solanum tuberosum</i> , <i>Spinacia oleracea</i> , <i>Vicia faba</i> , <i>Zinnia</i> , herbaceous ornamental plants and vegetable plants are minor hosts. <i>Argyranthemum frutescens</i> , <i>Chrysanthemum</i> , <i>Dendranthema indicum</i> , <i>Leucanthemum vulgare</i> , <i>Leucanthemum x superbum</i> , <i>Tanacetum parthenium</i> and <i>Tanacetum vulgare</i> (unclassified), <i>Tropaeolum majus</i> is an incidental host. <i>Amaranthus</i> (wild/weed).	No
31. <i>Liriomyza sativae</i>	<i>Cucurbita pepo</i> , <i>Solanum lycopersicum</i> and <i>Solanum tuberosum</i> are major hosts. <i>Apium graveolens</i> , <i>Capsicum annuum</i> , <i>Cucumis</i> , <i>Cucumis melo</i> , <i>Cucumis sativus</i> , <i>Dahlia</i> hybrids, <i>Dendranthema x grandiflorum</i> , Fabaceae, <i>Lathyrus</i> , <i>Medicago sativa</i> , <i>Phaseolus lunatus</i> , <i>Phaseolus vulgaris</i> , <i>Pisum sativum</i> , <i>Ricinus communis</i> , Solanaceae, <i>Solanum melongena</i> , <i>Sorghum vulgare</i> , <i>Spinacia oleracea</i> , <i>Symphotrichum novi-belgii</i> , <i>Vicia faba</i> , <i>Vigna</i> , herbaceous ornamental plants, vegetable plants are all minor hosts. <i>Tropaeolum majus</i> is an incidental host. <i>Amaranthus</i> (wild/weed).	No

Species	Comments	Add?
32. <i>Liriomyza trifolii</i>	<p><i>Apium graveolens</i> and <i>Dendranthema x grandiflorum</i> are major hosts. <i>Allium cepa</i>, <i>Allium porrum</i>, <i>Allium sativum</i>, <i>Arachis hypogaea</i>, Asteraceae, <i>Beta vulgaris</i>, Brassica, <i>Brassica chinensis</i>, <i>Capsicum annuum</i>, <i>Citrullus lanatus</i>, Cucumis, <i>Cucumis melo</i>, <i>Cucumis sativus</i>, <i>Cucurbita pepo</i>, Dahlia hybrids, <i>Dianthus caryophyllus</i>, <i>Gerbera jamesonii</i>, <i>Gossypium hirsutum</i>, <i>Gypsophila paniculata</i>, <i>Lactuca sativa</i>, Lathyrus, <i>Medicago sativa</i>, <i>Pericallis x hybrida</i>, <i>Phaseolus coccineus</i>, <i>Phaseolus lunatus</i>, <i>Phaseolus vulgaris</i>, <i>Pisum sativum</i>, <i>Solanum lycopersicum</i>, <i>Solanum tuberosum</i>, , <i>Spinacia oleracea</i>, <i>Symphytotrichum novi-belgii</i>, Trifolium, Vigna, Zinnia, herbaceous ornamental plants and vegetable plants are all minor hosts. <i>Argyranthemum frutescens</i>, Chrysanthemum, <i>Dendranthema indicum</i>, <i>Leucanthemum vulgare</i>, <i>Leucanthemum x superbum</i>, <i>Tanacetum parthenium</i> and <i>Tanacetum vulgare</i> (unclassified), <i>Tropaeolum majus</i> is an incidental host. <i>Bidens pilosa</i> (wild/weed). In NOBANIS DK.</p>	No
33. <i>Lopholeucaspis japonica</i>	Citrus as main hosts. Betula, Acer as minor hosts.	No
34. <i>Lymantria mathura</i>	<p><i>Juglans mandshurica</i>, <i>Malus baccata</i> var. <i>mandshurica</i>, <i>Quercus dentata</i>, <i>Quercus mongolica</i> are major hosts. Betula, Castanea, Fagaceae, <i>Juglans</i>, <i>Malus domestica</i>, <i>Quercus</i>, Salix, Tilia and Ulmus are minor hosts.</p> <p>One of the most important defoliators where it occurs.</p> <p>Potential pathways: wood with bark, bark, other articles (packaging, conveyances, containers, etc.) (eggs in crevasses). Can cause serious changes in environment over large areas.</p> <p>Note on the assessment: Allergic reactions are commonly recorded for 'hairy' caterpillars. This includes for example the related species <i>L. dispar</i>, in Europe <i>Thaumtopoea</i> spp., or in this study <i>Dendrolimus</i> spp. No such effects were recorded in the publications compiling information on <i>L. mathura</i>; however, there is still an uncertainty regarding such effects, and the field for health effects was left blank.</p>	Yes
35. <i>Maconellicoccus hirsutus</i>	Annona, <i>Gossypium</i> and Hibiscus are main hosts. Several vegetable crops as minor hosts, e.g. <i>Lactuca sativa</i> and <i>Phaseolus vulgaris</i> , but currently subtropical/tropical distribution.	No

Species	Comments	Add?
36. <i>Malacosoma parallela</i>	<p><i>Malus domestica</i>, <i>Malus sieversii</i>, <i>Prunus bucharica</i>, <i>Prunus dulcis</i>, <i>Quercus infectoria</i>, <i>Quercus macranthera</i>, <i>Quercus robur</i> are major hosts. <i>Berberis integerrima</i>, <i>Chaenomeles japonica</i>, <i>Cotoneaster insignis</i>, <i>Cotoneaster suavis</i>, <i>Crataegus hissarica</i>, <i>Crataegus pontica</i>, <i>Crataegus turkestanica</i>, <i>Cydonia oblonga</i>, <i>Malus</i>, <i>Prunus</i>, <i>Pyrus communis</i>, <i>Rosa</i>, <i>Rosa canina</i>, <i>Rosa corymbifera</i>, <i>Rosa kokanica</i>, <i>Rosa maracandica</i>, <i>Salix</i>, <i>Salix excelsa</i>, <i>Salix tenuijulis</i>, <i>Sorbus</i>, <i>Sorbus turkestanica</i> and woody plants are minor hosts.</p> <p>May cause serious changes in the environment. However, the current distribution of <i>Malacosoma parallela</i> is in Central Asia and Turkey, in areas without climatic similarity with Denmark. The South and East of the EPPO region is considered at risk (EPPO data sheet). This species is not considered further.</p>	No
37. <i>Megaplatus mutatus</i>	<p><i>Populus deltoides</i> and <i>Populus x canadensis</i> are major hosts. <i>Acacia</i>, <i>Acer</i>, <i>Ailanthus</i>, <i>Castanea</i>, <i>Citrus</i>, <i>Corylus</i>, <i>Eucalyptus</i>, <i>Fraxinus</i>, <i>Juglans</i>, <i>Laurus nobilis</i>, <i>Ligustrum</i>, <i>Liquidambar</i>, <i>Magnolia grandiflora</i>, <i>Malus domestica</i>, <i>Melia</i>, <i>Persea americana</i>, <i>Platanus</i>, <i>Populus</i>, <i>Prunus pennsylvanica</i>, <i>Pyrus communis</i>, <i>Quercus</i>, <i>Robinia pseudoacacia</i>, <i>Salix</i>, <i>Tilia</i> and <i>Ulmus</i> are minor hosts.</p> <p>Serious to poplar. However, its current distribution is sub tropical, and the area at risk in the EPPO region is considered to be the Mediterranean, Balkan and Black Sea coasts (EPPO data sheet and PRA). This species is not considered further.</p>	No
38. <i>Numonia pyrivorella</i>	<i>Pyrus communis</i> is the major host and <i>Pyrus</i> is the minor host.	No
39. <i>Opogona sacchari</i>	<i>Dracaena</i> , <i>Musa</i> , <i>Yucca</i> . Several ornamentals and vegetables as minor hosts, such as <i>Capsicum annuum</i> and <i>Solanum melongena</i> . Subtropical/tropical distribution. In NOBANIS DK.	No
40. <i>Paysandisia archon</i>	Areaceae.	No
41. <i>Popillia japonica</i>	<p><i>Fragaria x ananassa</i>, <i>Malus domestica</i>, <i>Prunus domestica</i>, <i>Prunus persica</i>, <i>Rosa</i> large-flowered bush hybrids and <i>Zea mays</i> are major hosts. <i>Acer</i>, <i>Aesculus</i>, <i>Betula</i>, <i>Castanea</i>, <i>Glycine max</i>, <i>Juglans</i>, <i>Malus</i>, <i>Medicago sativa</i>, <i>Platanus</i>, <i>Poaceae</i>, <i>Populus</i>, <i>Prunus</i>, <i>Rosa</i>, <i>Salix</i>, <i>Tilia cordata</i>, <i>Trifolium</i>, <i>Ulmus</i>, <i>Vitis</i> and woody plants are minor hosts and other plants is incidental hosts.</p> <p>Risk of establishment assessed as low in the UK, Ireland or in continental Europe north of about 53°N, because the summers are too cool.</p>	No

Species	Comments	Add?
42. <i>Quadraspidiotus perniciosus</i>	<p><i>Malus domestica</i>, <i>Prunus domestica</i>, <i>Prunus persica</i> and <i>Pyrus communis</i> are major hosts. <i>Actinidia chinensis</i>, <i>Chaenomeles</i>, <i>Cornus sanguinea</i>, <i>Cotoneaster</i>, <i>Crataegus</i>, <i>Cydonia oblonga</i>, <i>Fagus</i>, <i>Juglans</i>, <i>Malus</i>, <i>Mespilus germanica</i>, <i>Prunus</i>, <i>Pyrus</i>, <i>Ribes</i>, <i>Rosa</i>, <i>Rubus</i>, <i>Sorbus</i> and <i>Symphoricarpos rivularis</i> are minor hosts. <i>Acacia</i>, <i>Acacia dealbata</i>, <i>Acacia farnesiana</i>, <i>Acer</i>, <i>Amelanchier</i>, <i>Eriobotrya japonica</i>, <i>Euonymus japonicus</i>, <i>Ligustrum</i>, <i>Lonicera japonica</i>, <i>Maclura pomifera</i>, <i>Populus</i>, <i>Ptelea trifoliata</i>, <i>Pyracantha</i>, <i>Salix</i>, <i>Spiraea salicifolia</i>, <i>Syringa vulgaris</i>, <i>Tilia cordata</i> and <i>Ulmus</i> are incidental hosts. <i>Betula</i> (wild/weed).</p> <p>Absent, pest no longer present in DK. In at more Northern zones, able to exist, but is not likely to cause much damage (reproductive potential and development are much reduced at low temperatures).</p>	No
43. <i>Rhagoletis cingulata</i>	<i>Prunus avium</i> and <i>salicina</i> as major hosts. <i>P. cerasus</i> , <i>serotina</i> , <i>virginiana</i> as minor hosts. Attacks fruit.	No
44. <i>Rhynchophorus ferrugineus</i>	Arecaceae.	No
45. <i>Scirtothrips dorsalis</i>	<i>Camellia sinensis</i> and <i>Capsicum annuum</i> are major hosts. <i>Arachis hypogaea</i> , <i>Citrofortunella microcarpa</i> , <i>Citroncirus</i> , <i>Citrus</i> , <i>Fortunella</i> , <i>Fragaria x ananassa</i> , <i>Hevea brasiliensis</i> , <i>Mangifera indica</i> , <i>Poncirus trifoliata</i> , <i>Ricinus communis</i> , <i>Tamarindus indica</i> , <i>Vitis vinifera</i> and other plants are minor hosts. <i>Glycine max</i> and <i>Passiflora edulis</i> (unclassified), <i>Actinidia chinensis</i> , <i>Allium cepa</i> , <i>Gossypium hirsutum</i> , <i>Hydrangea</i> , <i>Nelumbo</i> and <i>Rosa</i> are incidental hosts. <i>Acacia</i> , <i>Fabaceae</i> , <i>Mimosa</i> (wild/weed).	No
46. <i>Scolytus morawitzi</i>	<i>Larix gmelinii</i> , <i>Larix kamtschatica</i> , <i>Larix russica</i> and <i>Larix x maritima</i> are major hosts, and <i>Larix</i> is the minor host.	Yes
47. <i>Sirex ermak</i>	<i>Larix gmelinii</i> and <i>Larix russica</i> are major hosts. <i>Abies</i> , <i>Larix</i> , <i>Picea</i> , <i>Pinus</i> and <i>Pinus sibirica</i> are minor hosts.	Yes
48. <i>Spodoptera littoralis</i>	<i>Arachis hypogaea</i> , <i>Glycine max</i> , <i>Gossypium hirsutum</i> , <i>Nicotiana tabacum</i> , <i>Solanum lycopersicum</i> and <i>Zea mays</i> are major hosts. <i>Beta vulgaris</i> , <i>Gossypium barbadense</i> , <i>Malus domestica</i> , <i>Medicago sativa</i> , <i>Solanum tuberosum</i> , <i>Trifolium</i> , <i>Vigna</i> , <i>Vitis vinifera</i> , herbaceous ornamental plants, other plants and vegetable plants are minor hosts. <i>Dendranthema x grandiflorum</i> (unclassified). In NOBANIS DK.	No

Species	Comments	Add?
49. <i>Strobilomyia viaria</i>	<i>Larix gmelinii</i> , <i>Larix gmelinii</i> subsp. <i>cajanderi</i> , <i>Larix gmelinii</i> subsp. <i>olgensis</i> , <i>Larix laricina</i> and <i>Larix x lubarskii</i> are major hosts. Attacks cones, and destroys seed. Largely limit the potential of natural regeneration of larch forests in the Far East. Known to be capable of shifting on new hosts congeneric to the original one. Eggs and larvae on immature cones (unlikely to be spread). Pathways: soil of potted larch seedlings (plants for planting with roots and soil).	Yes
50. <i>Tecia solanivora</i>	<i>Solanum tuberosum</i> .	No
51. <i>Tetranychus evansi</i>	<i>Nicotiana tabacum</i> , <i>Solanum lycopersicum</i> , <i>Solanum melongena</i> and <i>Solanum tuberosum</i> are major hosts. <i>Arachis hypogaea</i> , <i>Arachis prostrata</i> , <i>Capsicum annuum</i> , <i>Citrullus lanatus</i> and <i>Phaseolus vulgaris</i> are minor hosts. <i>Convolvulus arvensis</i> , <i>Conyza</i> , <i>Parietaria officinalis</i> , <i>Solanum americanum</i> , <i>Solanum nigrum</i> and <i>Sonchus</i> (wild/weed).	No
52. <i>Tetropium gracilicorne</i>	<i>Abies nephrolepis</i> , <i>Larix gmelinii</i> , <i>Larix russica</i> , <i>Picea jezoensis</i> , <i>Pinus koraiensis</i> , <i>Pinus sibirica</i> and <i>Pinus sylvestris</i> are major hosts. <i>Abies</i> , <i>Larix</i> , <i>Picea</i> and <i>Pinus</i> are minor hosts. Potential pathways: large plants for planting (but usually not traded), wood.	Yes
53. <i>Toxoptera citricida</i>	Citrus and Rutaceae.	No
54. <i>Trioza erytrae</i> (vector of <i>L. asiaticum</i> and <i>L. africanum</i> )	Citrus and Rutaceae.	No
55. <i>Trogoderma granarium</i>	<i>Arachis hypogaea</i> , <i>Glycine max</i> , <i>Oryza sativa</i> and <i>Triticum aestivum</i> are major hosts. <i>Avena sativa</i> , <i>Carya illinoensis</i> , <i>Cicer arietinum</i> , <i>Hordeum vulgare</i> , <i>Juglans regia</i> , <i>Lens culinaris</i> , <i>Pisum sativum</i> , <i>Prunus dulcis</i> , <i>Sorghum vulgare</i> , <i>Vigna unguiculata</i> and <i>Zea mays</i> are minor hosts. <i>Medicago sativa</i> , <i>Phaseolus lunatus</i> and <i>Vitis vinifera</i> are incidental hosts. In NOBANIS DK.	No
56. <i>Tuta absoluta</i>	<i>Solanum lycopersicum</i> is the major host. <i>Phaseolus vulgaris</i> , <i>Solanum melongena</i> , <i>Solanum muricatum</i> and <i>Solanum tuberosum</i> are minor hosts. <i>Datura ferox</i> , <i>Datura stramonium</i> , <i>Lycium chilense</i> , <i>Lycopersicon hirsutum</i> , <i>Lycopersicon pennellii</i> var. <i>puberulum</i> , <i>Nicotiana glauca</i> , <i>Solanum elaeagnifolium</i> , <i>Solanum lyratum</i> and <i>Solanum nigrum</i> (wild/weed). Potentially a serious pest of tomato in the warmer parts of the EPPO region, both in the field and in protected conditions.	No

Species	Comments	Add?
57. <i>Viteus vitifoliae</i>	<i>Vitis vinifera</i> is the major host with <i>Vitis aestivalis</i> , <i>labrusca</i> and <i>Vitis</i> as minor hosts.	No
58. <i>Xylotrechus altaicus</i>	<i>Larix gmelinii</i> and <i>russica</i> , <i>x maritima</i> are major hosts and <i>Larix</i> the minor host.  Very serious forest pest where it occurs, but no native host.	No
59. <i>Xylotrechus namanganensis</i>	<i>Alnus glutinosa</i> , <i>Celtis australis</i> , <i>Elaeagnus angustifolia</i> , <i>Juglans regia</i> , <i>Malus domestica</i> , <i>Morus nigra</i> , <i>Platanus x acerifolia</i> , <i>Populus alba</i> , <i>Populus nigra</i> , <i>Prunus armeniaca</i> , <i>Prunus avium</i> , <i>Prunus dulcis</i> , <i>Salix alba</i> , <i>Ulmus minor</i> , <i>Ulmus pumila</i> are major hosts. <i>Alnus</i> , <i>Betula</i> , <i>Celtis</i> , <i>Crataegus</i> , <i>Elaeagnus</i> , <i>Juglans</i> , <i>Malus</i> , <i>Morus</i> , <i>Platanus</i> , <i>Populus</i> , <i>Prunus</i> , <i>Salix</i> , <i>Ulmus</i> and woody plants are minor hosts.  Occurs in hot dry climatic conditions (most likely to establish in Mediterranean countries of the EPPO region).	No
<b>Nematodes</b>		
60. <i>Aphelenchoides besseyi</i>	Rice as main hosts, <i>Fragaria</i> as minor host, <i>Dendranthema grandiflora</i> among incidental hosts.	No
61. <i>Bursaphelenchus xylophilus</i>	<i>Pinus densiflora</i> and <i>Pinus sylvestris</i> as major hosts. Pinaceae, <i>Pinus</i> , <i>Pinus armandii</i> , <i>Pinus bungeana</i> , <i>Pinus echinata</i> , <i>Pinus elliottii</i> , <i>Pinus koraiensis</i> , <i>Pinus lambertiana</i> , <i>Pinus luchuensis</i> , <i>Pinus massoniana</i> , <i>Pinus nigra</i> , <i>Pinus pinaster subsp. escarena</i> , <i>Pinus pinaster subsp. pinaster</i> , <i>Pinus radiata</i> , <i>Pinus tabulaeformis</i> , <i>Pinus taeda</i> , <i>Pinus thunbergii</i> as minor hosts. <i>Abies balsamea</i> , <i>Cedrus atlantica</i> , <i>Cedrus deodara</i> , <i>Larix decidua</i> , <i>Larix laricina</i> , <i>Picea abies</i> , <i>Picea pungens</i> , <i>Pseudotsuga menziesii</i> , <i>Tsuga canadensis</i> are incidental hosts.  Wood (round wood, sawn wood, wood chips, wood packaging material, sawdust) (EPPO Datasheet is old. Must be new and better sources on potential pathways).  Note on the assessment: effects are rated for <i>B. xylophilus</i> on its own, and use in particular recent assessments for the Northern part of Europe. The spread potential would increase if <i>Monochamus</i> spp. vectors occurred in Denmark or were introduced at the same time.	Yes

Species	Comments	Add?
62. <i>Ditylenchus dipsaci</i>	Major hosts are <i>Allium cepa</i> , <i>Allium sativum</i> , <i>Avena sativa</i> , <i>Beta vulgaris</i> , <i>Fragaria x ananassa</i> , <i>Medicago sativa</i> , <i>Solanum tuberosum</i> and <i>Vicia faba</i> . Minor hosts are <i>Allium porrum</i> , <i>Allium schoenoprasum</i> , <i>Camassia cusickii</i> , <i>Chionodoxa luciliae</i> , <i>Crocus flavus</i> , <i>Galanthus nivalis</i> , <i>Galtonia candicans</i> , <i>Hyacinthus</i> , <i>Hyacinthus orientalis</i> , <i>Hymenocallis x festalis</i> , <i>Muscari botryoides</i> , <i>Narcissus</i> , <i>Nicotiana tabacum</i> , <i>Ornithogalum umbellatum</i> , <i>Phlox drummondii</i> , <i>Phlox paniculata</i> , <i>Pisum sativum</i> , <i>Puschkinia scilloides var. libanotica</i> , <i>Scilla sibirica</i> , <i>Secale cereale</i> , <i>Trifolium pratense</i> , <i>Trifolium repens</i> and <i>Tulipa</i> hybrids.	No
63. <i>Globodera pallida</i>	Major host is <i>Solanum tuberosum</i> . Minor host are <i>Solanum lycopersicum</i> , <i>Solanum melongena</i> and other plants. Wild/weed: <i>Solanum</i> . In NOBANIS DK.	No
64. <i>Globodera rostochiensis</i>	Major host is <i>Solanum tuberosum</i> . Minor host are <i>Solanum lycopersicum</i> , <i>Solanum melongena</i> and other plants. Wild/weed: <i>Solanum</i> . In NOBANIS DK.	No
65. <i>Heterodera glycines</i>	Major host is <i>Glycine max</i> . Minor hosts are <i>Phaseolus angularis</i> , <i>Phaseolus vulgaris</i> and herbaceous plants. Incidental hosts are <i>Lespedeza cuneata</i> , <i>Lupinus albus</i> , <i>Nicotiana tabacum</i> , <i>Penstemon hybrids</i> , <i>Phaseolus aureus</i> and <i>Vicia villosa</i> .  Wild/Weed: Boraginaceae, Brassicaceae, Capparaceae, Caryophyllaceae, <i>Cerastium fontanum subsp. vulgare</i> , Chenopodioideae, Fabaceae, Lamioideae, <i>Lamium amplexicaule</i> , Scrophulariaceae, Solanaceae, <i>Stellaria media</i> , Artificial: <i>Beta vulgaris</i> and <i>Solanum lycopersicum</i> .  Based on distribution in Asia and the Americas and its wide host range, assumed that could survive in the warmer and temperate areas of the EPPO region. However, would only establish itself and become a pest of economic importance where the principal host, soyabeans, are widely cultivated in close rotations or monoculture.	No
66. <i>Meloidogyne chitwoodi</i>	<i>Solanum lycopersicum</i> and <i>Solanum tuberosum</i> are major hosts. <i>Avena sativa</i> , <i>Beta vulgaris</i> , <i>Daucus carota subsp. sativus</i> , <i>Hordeum vulgare</i> , <i>Medicago sativa</i> , <i>Phaseolus vulgaris</i> , <i>Pisum sativum</i> , Poaceae, <i>Scorzonera hispanica</i> , <i>Taraxacum officinale</i> , <i>Triticum aestivum</i> , <i>Zea mays</i> and other plants are minor hosts.	No

Species	Comments	Add?
67. <i>Meloidogyne enterolobii</i>	<i>Capsicum annuum</i> , <i>Citrullus lanatus</i> , <i>Coffea arabica</i> , <i>Glycine max</i> , <i>Ipomoea batatas</i> , <i>Nicotiana tabacum</i> , <i>Psidium guajava</i> , <i>Solanum lycopersicum</i> and <i>Solanum melongena</i> are major hosts. <i>Ajuga</i> , <i>Angelonia</i> sp., <i>Aquilaria malaccensis</i> , <i>Brugmansia</i> , <i>Enterolobium contortisiliquum</i> , <i>Euphorbia punicea</i> , <i>Hibiscus</i> , <i>Maranta arundinacea</i> , <i>Morinda citrifolia</i> , <i>Ocimum basilicum</i> , <i>Paulownia elongata</i> , <i>Syzygium aromaticum</i> , <i>Thunbergia</i> and <i>Tibouchina</i> are minor hosts. <i>Solanum tuberosum</i> is an incidental host. <i>Bidens pilosa</i> (wild/weed).	No
68. <i>Meloidogyne fallax</i>	<i>Asparagus officinalis</i> and other plants are incidental hosts. <i>Daucus carota</i> subsp. <i>sativus</i> , <i>Fragaria x ananassa</i> , <i>Scorzonera hispanica</i> , <i>Solanum lycopersicum</i> and <i>Solanum tuberosum</i> (indicator).	No
69. <i>Radopholus similis</i> (not attacking citrus)	<i>Calathea</i> and <i>Musa</i> as main hosts. Ornamentals as minor hosts (e.g. <i>Anthurium</i> , <i>Strelitzia</i> ). In NOBANIS DK.	No
70. <i>Xiphinema rivesi</i>	Non specific. Agricultural, horticultural and forest soils (EPPO Data sheet).	No
<b>Fungi</b>		
71. <i>Botryosphaeria laricina</i>	<i>Larix</i> and <i>Pseudotsuga menziesii</i> . Important disease in nursery. Trees generally do not die.	No
72. <i>Ceratocystis fimbriata</i> f.sp. <i>platani</i>	<i>Platanus</i> spp., especially <i>P. acerifolia</i> , <i>P. occidentalis</i> , <i>P. orientalis</i> .	No
73. <i>Ciborinia camelliae</i>	<i>Camellia</i> .	No
74. <i>Cronartium kamtschaticum</i>	Not clear if it is a separate species from <i>C. ribicola</i> . Damage not clear.	No
75. <i>Cryphonectria parasitica</i>	Chestnuts ( <i>Castanea</i> spp.), particularly <i>C. dentata</i> ; <i>C. mollissima</i> shows resistance but may also become infected. Incidental hosts are <i>Quercus</i> spp., <i>Castanopsis</i> , <i>Acer</i> , <i>Rhus typhina</i> and <i>Carya ovata</i> . Potential pathways: plant for planting, wood, bark. However, it is considered here that <i>Castanea</i> is only occasional in Denmark and not planted over large areas. <i>Cryphonectria parasitica</i> is not considered further.	No
76. <i>Diaporthe vaccinii</i>	<i>Vaccinium macrocarpon</i> , <i>V. oxycoccos</i> , <i>V. oxycoccos</i> var. <i>intermedium</i> , <i>V. corymbosum</i> and <i>V. ashei</i> . Also <i>V. myrtillus</i> , Originally this species was recorded to only attack cultivated <i>Vaccinium</i> species. However, it has now been found on European wild blueberry ( <i>Vaccinium myrtillus</i> ), which grows in specific habitats in Denmark. <i>D. vaccinii</i> was therefore retained here.	Yes

Species	Comments	Add?
77. <i>Didymella ligulicola</i>	Dendranthema spp. Endives, <i>Dahlia pinnata</i> , globe artichokes, lettuces, <i>Rudbeckia hirta</i> , sunflowers and <i>Zinnia elegans</i> (artificial inoculation).	No
78. <i>Fusarium foetens</i>	Begonia.	No
79. <i>Fusarium oxysporum</i> f.sp. <i>albedinis</i>	Date.	No
80. <i>Gibberella circinata</i>	Pinus spp. May cause extensive dieback and death. Has spread to Mediterranean-type climates. Probably greatest danger to forest nurseries. Damage to plantations or native forests more likely in a warmer and more humid climate than exists anywhere in the EPPO region.	No
81. <i>Glomerella gossypii</i>	<i>Gossypium barbadense</i> and <i>G. hirsutum</i> .	No
82. <i>Gymnosporangium asiaticum</i>	<i>Pyrus pyrifolia</i> (alternate host <i>Juniperus</i> ). Other hosts are incidental (e.g. <i>Crataegus</i> , <i>Chaenomeles</i> , <i>Cydonia oblonga</i> ).	No
83. <i>Melampsora medusae</i>	<i>Populus</i> spp. Secondary aecial hosts are conifers (in Canada, <i>Larix</i> spp., <i>Pseudotsuga</i> spp. and young <i>Pinus</i> spp.). Some races are more aggressive than others. Extensive damage reported in some cases to conifers and <i>Populus</i> spp. in nurseries and plantations as well as in natural forests. Causes defoliation.	No
84. <i>Monilinia fructicola</i>	Major hosts are <i>Prunus avium</i> , <i>Prunus domestica</i> and <i>Prunus persica</i> . Minor hosts are <i>Malus</i> , <i>Malus domestica</i> , <i>Prunus</i> , <i>Prunus armeniaca</i> , <i>Pyrus</i> and <i>Pyrus communis</i> . Incidental hosts are <i>Chaenomeles</i> , <i>Crataegus</i> , <i>Cydonia oblonga</i> , <i>Eriobotrya japonica</i> , <i>Vitis vinifera</i> . Potential pathways: planting material, fruit.	Yes
85. <i>Mycosphaerella dearnessii</i>	Pinus. Potential pathways: plants for planting, seed lots contaminated with needle debris.	Yes
86. <i>Phialophora cinerescens</i>	Carnations and other caryophyllaceae.	No
87. <i>Phoma tracheiphila</i>	Citrus.	No
88. <i>Phytophthora fragariae</i> var. <i>fragariae</i>	Fragaria. Also loganberry ( <i>Rubus</i> hybrid).	No

Species	Comments	Add?
89. <i>Phytophthora fragariae</i> var. <i>rubi</i>	<i>Rubus idaeus</i> . Hybrid berries such as loganberries and tayberries found naturally infected.	No
90. <i>Phytophthora kernoviae</i>	The species is registered on the Danish Nature Agency's Observation list.	Yes, Obs. list.
91. <i>Phytophthora lateralis</i>	<i>Chamaecyparis lawsoniana</i> . Also <i>Taxus brevifolia</i> .	No
92. <i>Phytophthora ramorum</i>	Polyphagous, attacks native plant species, also in the wild. In NOBANIS DK.	Yes
93. <i>Puccinia horiana</i>	Chrysanthemum.	No
94. <i>Stenocarpella macrospora</i>	Maize.	No
95. <i>Stenocarpella maydis</i>	Maize and bamboos.	No
96. <i>Synchytrium endobioticum</i>	Potato. Also wild <i>Solanum</i> at origin.	No
97. <i>Verticillium albo-atrum</i> (hop-infecting strains)	<i>Humulus lupulus</i> .	No
98. <i>Verticillium dahliae</i> (hop-infecting strains)	<i>Humulus lupulus</i> .	No
<b>Plants</b>		
99. <i>Baccharis halimifolia</i>		Yes
100. <i>Crassula helmsii</i>	The species is registered on the Danish Nature Agency's Black list.	Yes, Black list.

Species	Comments	Add?
101. <i>Eichhornia crassipes</i>	The EPPO pest risk analysis for <i>E. crassipes</i> assesses a very low climatic similarity between the current distribution of the plant and the Northern part of the region (optimal growth at 28-30°C (air temp.) and growth stops when water temperatures drop below 10°C). However, this species is already in NOBANIS DK, and was retained here. Ratings relate to the pathways/effects for Denmark, and not to potential ones (it has important effects in other countries, but no indication were found for Denmark).	Yes
102. <i>Heracleum persicum</i>	In Norway, <i>H. persicum</i> has similar impacts as <i>H. mantegazzianum</i> (and is more present than <i>H. mantegazzianum</i> in Northern Norway), but such impacts are not recorded for Denmark. This plant is already in NOBANIS DK, and ratings therefore relate to the pathways/effects for Denmark, and not potential ones.	Yes
103. <i>Heracleum sosnowskyi</i>	It is unclear whether <i>H. sosnowskyi</i> is (still) present in Denmark. Fröberg (2009, Flora Danica) mentions tentatively its presence (2007, København) and Faurholdt and Hinke (2007) that it is present in one locality, but may have disappeared. Neither NOBANIS nor EPPO (PQR, PRA) mention its presence in Denmark. In doubt, the ratings relates to the current situation for Denmark (pathway of introduction unknown, and no documented effects). If potential effects were considered, ratings for environmental and economic effects would probably be close to those for <i>H. mantegazzianum</i> (Black listed).	Yes
104. <i>Hydrocotyle ranunculoides</i>	In NOBANIS DK.	Yes
105. <i>Ludwigia peploides</i> and <i>L. grandiflora</i>		Yes
106. <i>Polygonum perfoliatum</i>		Yes
107. <i>Pueraria lobata</i>		Yes
108. <i>Solanum elaeagnifolium</i>	In the EPPO region, the endangered area is considered to be the Southern EPPO region (EPPO PRA and data sheet). However, this species is already in NOBANIS DK, and was retained here. Ratings relate to the pathways/effects for Denmark, and not to potential ones.	Yes

**Table 17.** Reviewed EPPO list of Invasive Alien Plants. First column (Species) show the considered species, second column (Comment) offers various comments on hosts, pathways etc. and third column (Add?) shows whether the species were added to the EPPO list of species assessed in this report. DK = Denmark. Obs. List = Observation list. Host plants were extracted from PQR (EPPO, 2013).

Species	Comments	Add?
<b>Plants</b>		
1. <i>Acacia dealbata</i>	Native to Australia, this plant was introduced to locations in warm/ Mediterranean type climates (DAISIE). It is likely that potential habitats in Denmark would be very limited (protected conditions or specific sites) as it is reported to tolerate moderate frosts and snow (down to -7 °C), for limited periods. It appears in Danish gardening websites and is available for sale. It was retained here for its pathways, but its effects were not rated as it is not present in climatic conditions that are close to those in Denmark.	Yes
2. <i>Acroptilon repens</i>	This plant is confined to areas with a warm, dry climate, with annual precipitation up to 400 mm, and is considered as a risk for the Mediterranean region and Central Europe (EPPO). However, this species is already in NOBANIS DK, and was retained here. Ratings relate to the pathways/effects for Denmark, and not to potential ones.	Yes
3. <i>Ailanthus altissima</i>	Ratings refer to the pathways/effects for Denmark, and not potential ones. In NOBANIS DK.	Yes
4. <i>Alternanthera philoxeroides</i>	This plant causes problems in waterways in tropical and warm-temperate regions of the world. Its current distribution is in tropical or sub tropical climates, with only occurrences in Europe in Southern France and Italy (Toscana). It was retained here for its pathways. Effects were not rated.	Yes
5. <i>Ambrosia artemisiifolia</i>	The species is registered on the Danish Nature Agency's Black list.	Yes, Black list.
6. <i>Amelanchier spicata</i>	The species is registered on the Danish Nature Agency's Black list.	Yes, Black list.
7. <i>Amorpha fruticosa</i>	This plant occurs in warm climates, and was introduced to a number of Mediterranean-type climates in the EPPO region. It was not considered a priority for analysis for Denmark, nor does it have pathways of specific interest.	No
8. <i>Buddleja davidii</i>	The species is registered on the Danish Nature Agency's Black list.	Yes, Black list.
9. <i>Cabomba caroliniana</i>		Yes

Species	Comments	Add?
10. <i>Cardiospermum grandiflorum</i>	Originates from tropical Africa, Central and South America. Identified as a risk (EPPO prioritization process) only for Mediterranean countries. It is not considered a priority for analysis for Denmark due to its tropical origin.	No
11. <i>Carpobrotus acinaciformis</i>	These plants originate from South Africa and were introduced to Mediterranean countries, and to the the Southern part of UK and Ireland (for <i>C. edulis</i> only) (Delipetrou, 2006 - DAISIE). They are sensitive to frost. In Denmark they would likely be confined to limited conditions, indoors or in gardens. However, they were retained here as it has proved serious in coastal areas in several countries and some potential environmental effects were rated as high for Belgium ( <i>Carpobrotus</i> spp.; Baus et al., 2012).	Yes
12. <i>Carpobrotus edulis</i>	See <i>Carpobrotus acinaciformis</i> .	Yes
13. <i>Cornus sericea</i>	In NOBANIS DK.	Yes
14. <i>Cortaderia selloana</i>		Yes
15. <i>Cyperus esculentus</i>		Yes
16. <i>Delairea odorata</i>	This plant is considered to have the potential to become invasive in the Mediterranean and Atlantic areas of the EPPO region (EPPO). However, this species is already in NOBANIS DK, and was retained here. Ratings relate to the pathways/effects for Denmark, and not to potential ones.	Yes
17. <i>Egeria densa</i>		Yes
18. <i>Elodea nuttallii</i>	The species is registered on the Danish Nature Agency's Black list.	Yes, Black list.
19. <i>Fallopia baldschuanica</i>	Ratings refer to the pathways/effects for Denmark, and not potential ones. In NOBANIS DK.	Yes
20. <i>Fallopia japonica</i>	The species is registered on the Danish Nature Agency's Black list.	Yes, Black list.
21. <i>Fallopia sachalinensis</i>	The species is registered on the Danish Nature Agency's Black list.	Yes, Black list.
22. <i>Fallopia x bohémica</i>	The species is registered on the Danish Nature Agency's Black list.	Yes, Black list.
23. <i>Hakea sericea</i>	This plant is native to Australia and invasive in New Zealand and South Africa. In the EPPO region, it occurs in south of France, Portugal and Spain. However it was retained here, as it is considered as a new emerging invader in Europe.	Yes
24. <i>Helianthus tuberosus</i>	Ratings refer to the pathways/effects for Denmark, and not potential ones. In NOBANIS DK.	Yes
25. <i>Heracleum mantegazzianum</i>	The species is registered on the Danish Nature Agency's Black list.	Yes, Black list.
26. <i>Humulus japonicus</i>	Ratings refer to the pathways/effects for Denmark, and not potential ones. In NOBANIS DK.	Yes

Species	Comments	Add?
27. <i>Hydrilla verticillata</i>		Yes
28. <i>Hygrophila polysperma</i>	The temperature range of this species is 18-30 C, and in Europe it has only been found as casual in thermal waters. It was considered here for its pathways, but potential effects are not rated.	Yes
29. <i>Impatiens glandulifera</i>	The species is registered on the Danish Nature Agency's Black list.	Yes, Black list.
30. <i>Lagarosiphon major</i>		Yes
31. <i>Microstegium vimineum</i>		Yes
32. <i>Myriophyllum aquaticum</i>	This plant is associated with areas with a warm to hot wet summer and a cool to hot winter, but was introduced to Austria, France, Germany, Portugal, United Kingdom, and was retained here.	Yes
33. <i>Myriophyllum heterophyllum</i>		Yes
34. <i>Paspalum distichum</i>	Ratings refer to the pathways/effects for Denmark, and not potential ones. In NOBANIS DK.	Yes
35. <i>Oxalis pes-caprae</i>	Ratings refer to the pathways/effects for Denmark, and not potential ones. In NOBANIS DK.	Yes
36. <i>Pennisetum setaceum</i>	This plant originates from North Africa and has been introduced to dry areas. It is very aggressive in dry habitats, but in wet habitats, it is outcompeted by other grasses. It not considered further.	No
37. <i>Pistia stratiotes</i>	This plant has a tropical origin, with optimal growth temperature of 22-30°C (with extremes at 15°C and 35°C). Conditions in Denmark are probably not appropriate, but it has been introduced to several temperate countries, and was therefore retained here.	Yes
38. <i>Prunus serotina</i>	The species is registered on the Danish Nature Agency's Black list.	Yes, Black list.
39. <i>Senecio inaequidens</i>	Ratings refer to the pathways/effects for Denmark, and not potential ones. In NOBANIS DK.	Yes
40. <i>Salvinia molesta</i>	This plant occurs in tropical, sub tropical or warm temperate areas of the world. Depending on the climate, it can either be a perennial or an annual (in non-tropical regions). It has been introduced to a few Mediterranean locations. It was not considered further.	No
41. <i>Sicyos angulatus</i>		Yes
42. <i>Solidago canadensis</i>	The species is registered on the Danish Nature Agency's Black list.	Yes, Black list.
43. <i>Solidago gigantea</i>	The species is registered on the Danish Nature Agency's Black list.	Yes, Black list.

## Appendix 4. Species added by specialists

**Table 13.** Species added to NOBANIS datasheet by specialists with scores from this assessment study. Table show Group, Species name, the six assessment categories (Dispersion potential, Colonisation of high conservation value habitats, Adverse impacts on native species, Alteration of ecosystem functions, Economical effect and Public health effects), Total and Registered in Denmark (Empty = Not registered in Denmark, DK = Registered in Denmark).

Group	Species	Dispersion potential	Colonisation of high conservation	Adverse impacts on native species	Alteration of ecosystem	Economical effect	Public health effects	Total	Registered in Denmark
Angiosperma	<i>Hydrocotyle ranunculoides</i>	1	3	3	3	2	2	14	
Angiosperma	<i>Cytisus scoparius spp</i>	1	3	2	2	2	1	11	DK
Angiosperma	<i>Cornus sericea</i>	2	2	2	2	1	1	10	
Angiosperma	<i>Baccharis halimifolia</i>	3	2	3	3	2	2	15	
Angiosperma	<i>Egeria densa</i>	3	2	3	3	3	1	15	
Angiosperma	<i>Lagarosiphon major</i>	3	2	3	3	3	1	15	
Angiosperma	<i>Ludwigia grandiflora</i>	3	3	3	2	3	1	15	
Angiosperma	<i>Ludwigia peploides</i>	3	3	3	2	3	1	15	
Angiosperma	<i>Carpobrotus acinaciformis</i>	3	2	2	3	1	1	12	
Angiosperma	<i>Carpobrotus edulis</i>	3	2	2	3	1	1	12	
Angiosperma	<i>Hydrilla verticillata</i>	2	2	3	2	2	1	12	
Angiosperma	<i>Myriophyllum aquaticum</i>	2	2	3	2	2	1	12	
Angiosperma	<i>Myriophyllum heterophyllum</i>	2	2	3	2	2	1	12	
Angiosperma	<i>Cabomba caroliniana</i>	2	2	2	2	2	1	11	
Angiosperma	<i>Microstegium vimineum</i>	2	2	3	2	1	1	11	
Angiosperma	<i>Polygonum perfoliatum</i>	3	2	2	1	2	1	11	
Angiosperma	<i>Cortaderia selloana</i>	3	2	2	1	1	1	10	
Angiosperma	<i>Pistia stratiotes</i>	2	2	2	2	1	1	10	
Angiosperma	<i>Pueraria lobata</i>	2	2	2	1	2	1	10	
Angiosperma	<i>Sicyos angulatus</i>	2	2	2	1	2	1	10	
Angiosperma	<i>Cyperus esculentus</i>	2	1	1	1	3	1	9	
Angiosperma	<i>Hakea sericea</i>	2	2	2	1	1	1	9	
Angiosperma	<i>Heracleum sosnowskyi</i>				1	1	3	5	
Angiosperma	<i>Aegopodium podagraria</i>	3	2	2	2		1	10	
Angiosperma	<i>Alternanthera philoxeroides</i>								
Angiosperma	<i>Hygrophila polysperma</i>								
Angiosperma	<i>Acacia delbata</i>								
Arthropoda	<i>Agrilus planipennis</i>	3	3	3	3	3	1	16	

Group	Species	Dispersion potential	Colonisation of high conservation	Adverse impacts on native species	Alteration of ecosystem	Economical effect	Public health effects	Total	Registered in Denmark
Arthropoda	<i>Paralithodes camtschaticus</i>	3	3	3	3	2	1	15	
Arthropoda	<i>Dendrolimus sibiricus</i>	3	2	2	2	3	3	15	
Arthropoda	<i>Dendrolimus superans</i>	3	2	2	2	3	3	15	
Arthropoda	<i>Cercopagis pengoi</i>	3	2	2	3	2	1	14	
Arthropoda	<i>Pissodes strobi</i>	3	3	2	2	3	1	14	
Arthropoda	<i>Agrilus anxius</i>	3	2	2	2	3	1	13	
Arthropoda	<i>Pissodes nemorensis</i>	3	3	2	2	2	1	13	
Arthropoda	<i>Anoplophora chinensis</i>	3	3	1	1	3	1	12	DK
Arthropoda	<i>Orgyia pseudotsugata</i>	2	2	1	2	3	2	12	
Arthropoda	<i>Tetropium gracilicorne</i>	3	2	2	2	2	1	12	
Arthropoda	<i>Ips hauseri</i>	2	2	2	2	3	1	12	
Arthropoda	<i>Lymantria mathura</i>	3	2	2	3	2		12	
Arthropoda	<i>Lasius neglectus</i>	2	2	3	2	1	1	11	DK
Arthropoda	<i>Ips subelongatus</i>	3	2	2	1	2	1	11	
Arthropoda	<i>Choristoneura fumiferana</i>	3	1	1	1	3	1	10	
Arthropoda	<i>Choristoneura occidentalis</i>	3	1	1	1	3	1	10	
Arthropoda	<i>Cydia prunivora</i>	2	1	2	1	3	1	10	
Arthropoda	<i>Malacosoma disstria</i>	2	1	2	1	3	1	10	
Arthropoda	<i>Pissodes terminalis</i>	3	2	1	1	2	1	10	
Arthropoda	<i>Rhagoletis pomonella</i>	2	2	1	1	3	1	10	
Arthropoda	<i>Saperda candida</i>	2	2	1	1	3	1	10	
Arthropoda	<i>Hesperophanes campestris</i>	3	2	1	1	2	1	10	
Arthropoda	<i>Homarus americanus</i>	1	1	2	2	2	1	9	
Arthropoda	<i>Acleris gloverana</i>	3	1	1	1	2	1	9	
Arthropoda	<i>Acleris variaria</i>	3	1	1	1	2	1	9	
Arthropoda	<i>Conotrachelus nenuphar</i>	2	1	1	1	3	1	9	
Arthropoda	<i>Ips pini</i>	2	1	2	1	2	1	9	
Arthropoda	<i>Rhagoletis fausta</i>	2	2	1	1	2	1	9	
Arthropoda	<i>Rhagoletis indifferens</i>	2	2	1	1	2	1	9	
Arthropoda	<i>Sirex ermak</i>	2	2	1	1	2	1	9	
Arthropoda	<i>Strobilomyia viaria</i>	3	2	1	1	1	1	9	
Arthropoda	<i>Corythucha ciliata</i>	3	2	1	1		1	8	
Arthropoda	<i>Dendroctonus ponderosae</i>	2	1	1	1	2	1	8	
Arthropoda	<i>Malacosoma americanum</i>	2	1	1	1	2	1	8	
Arthropoda	<i>Scolytus morawitzi</i>	1	2	1	1	2	1	8	
Arthropoda	<i>Lepidosaphes ussuriensis</i>	1	2	2	1	1	1	8	

Group	Species	Dispersion potential	Colonisation of high conservation	Adverse impacts on native species	Alteration of ecosystem	Economical effect	Public health effects	Total	Registered in Denmark
Arthropoda	<i>Diabrotica virgifera</i>	2	1	1	1		1	6	
Arthropoda	<i>Margarodes vitis</i>	1	1	1	1	1	1	6	
Arthropoda	<i>Megastigmus pictus</i>	1	1	1	1	1	1	6	DK
Arthropoda	<i>Megastigmus atedius</i>	1	1	1	1	1	1	6	DK
Arthropoda	<i>Megastigmus borriesi</i>	1	1	1	1	1	1	6	DK
Arthropoda	<i>Megastigmus milleri</i>	1	1	1	1	1	1	6	DK
Arthropoda	<i>Megastigmus rafni</i>	1	1	1	1	1	1	6	DK
Arthropoda	<i>Megastigmus suspectus</i>	1	1	1	1	1	1	6	DK
Arthropoda	<i>Megastigmus specularis</i>	1	1	1	1	1	1	6	DK
Arthropoda	<i>Monochamus alternatus</i>								
Arthropoda	<i>Monochamus carolinensis</i>								
Arthropoda	<i>Monochamus marmorator</i>								
Arthropoda	<i>Monochamus mutator</i>								
Arthropoda	<i>Monochamus nitens</i>								
Arthropoda	<i>Monochamus notatus</i>								
Arthropoda	<i>Monochamus obtusus</i>								
Arthropoda	<i>Monochamus scutellatus</i>								
Aves	<i>Myiopsitta monachus</i>	3	1	1	1	2	1	9	DK
Aves	<i>Psittacula krameri</i>	3	1	1	1	2	1	9	DK
Fungi	<i>Ceratocystis fagacearum</i>	3	3	3	3	3	1	16	
Fungi	<i>Chalara fraxinus</i>	3	3	3	3	3	1	16	DK
Fungi	<i>Cryptostroma corticale</i>	3	2	2	2	3	3	15	
Fungi	<i>Phytophthora kernoviae</i>	2	3	2	3	3	1	14	
Fungi	<i>Phytophthora ramorum</i>	2	3	2	3	3	1	14	DK
Fungi	<i>Microsphaera alphitoides</i>	3	3	2	2	2	1	13	DK
Fungi	<i>Cylindrocladium buxicola</i>	3	2	1	2	3	1	12	DK
Fungi	<i>Neonectria neomacrospora</i>	3	2	1	2	3	1	12	DK
Fungi	<i>Atropellis pinicola</i>	3	2	2	1	2	1	11	
Fungi	<i>Endocronartium harknessii</i>	3	2	2	1	2	1	11	
Fungi	<i>Phellinus weirii</i>	2	2	1	2	3	1	11	
Fungi	<i>Mycosphaerella dearnessii</i>	3	2	2	1	2	1	11	
Fungi	<i>Splanchnonema platani</i>	3	1	1	2	3	1	11	
Fungi	<i>Atropellis piniphila</i>	3	2	1	1	2	1	10	
Fungi	<i>Davidiella (Mycosphaerella) populorum</i>	3	2	1	1	2	1	10	
Fungi	<i>Diaporthe vaccinii</i>	1	2	3	1	2	1	10	

Group	Species	Dispersion potential	Colonisation of high conservation	Adverse impacts on native species	Alteration of ecosystem	Economical effect	Public health effects	Total	Registered in Denmark
Fungi	<i>Mycosphaerella laricis-leptolepidis</i>	3	2	1	1	2	1	10	
Fungi	<i>Ophiostoma wagneri</i>	2	2	1	1	3	1	10	
Fungi	<i>Stegophora ulmea</i>	2	2	2	1	2	1	10	
Fungi	<i>Monilinia fructicola</i>	2	2	1	1	3	1	10	
Fungi	<i>Ceratocystis fimbriata f.sp. platani</i>	2	1	1	2	3	1	10	
Macroalgae	<i>Codium fragile</i>	3	3	2	2	1	1	12	DK
Reptilia & amphibia	<i>Chelydra serpentina</i>	1	1	2	1	1	1	7	
Mollusca	<i>Rapana venosa</i>	1	1	2	2	1	1	8	
Nematoda	<i>Bursaphelenchus xylophilus</i>	2	3	2	2	3	1	13	
Mammalia	<i>Sciurus carolinensis</i>	2	3	3	3	2	1	14	

## Appendix 5. Guide to evaluation and a project description for specialists

In Danish

### Guide til arket med ikke-hjemmehørende arter

#### Arket indeholder

Artsnavn (systematisk)

Dansk navn

Introduktionsvej til Danmark

Vurdering af effekter

A. Spredningspotentiale

B. Levestedets bevarings- eller naturværdi

C. Påvirkning af hjemmehørende arter

D. Påvirkning af økosystemfunktioner

E. Økonomiske effekter

F. Helbredseffekter

Referencer

#### Det skal du udfylde i excel-arket

Arket kan være mere eller mindre udfyldt med informationer fra NOBANIS, Naturstyrelsen og litteratursøgninger. Tjek venligst, om du er enig i oplysningerne, der er givet og tilføj, om muligt, der hvor de mangler. For visse arter findes der ikke særlig meget information. Hvis du ikke kan finde en kilde, eller selv kan bruges som kilde, så spring kategorien over.

**Introduktionsvej til Danmark:** Beskriv hvordan arten er blevet indført til landet. F.eks. blev mink importeret som pelsdyr til minkfarme i 1920-30'erne, hvorfra de slap ud i den vilde natur.

**Vurdering af effekter:** Vi benytter en skala fra 1-3. 1 svarer til lav, 2 svarer til middel og 3 svarer til høj.

#### A. Spredningspotentiale

Det potentiale en organisme (individer, frø, spredningslegemer etc.) besidder for at spredes i miljøet på naturlig vis og/eller ved menneskets hjælp.

1 = Arter der ikke spredes grundet lav spredningsevne og lavt reproduktionspotentiale.

2 = Arter der kun ved menneskelig hjælp kan spredes vidt. Naturlig spredning overstiger sjældent 1km/år.

Arten kan dog være lokalt invasiv grundet et stort reproduktions-potentiale.

3 = Arten er meget frugtbar og kan let spredes aktivt eller passivt over store distancer. Spredes let >1 km/år og danner nye populationer.

#### B. Levestedets bevarings- eller naturværdi

Potentialet for at en invasiv art koloniserer habitater af høj bevarings- eller naturværdi. Potentialet baseres på den invasive arts hjemmehabitat og kendte invaderede områder.

1 = Populationer af ikke-hjemmehørende arter, der er begrænset til menneskeskabte eller kulturpåvirkede habitater (lav bevaringsværdi).

2 = Populationer af ikke-hjemmehørende arter, der som regel er begrænset til habitater med lav til middel bevaringsværdi, og kun sjældent koloniserer habitater af høj bevarings- eller naturværdi.

3 = De ikke-hjemmehørende arter koloniserer ofte habitater af høj bevaringsværdi og udgør en potentiel trussel for rødlistede arter.

### **C. Påvirkning af hjemmehørende arter**

Det potentiale en invasiv art har til, at erstatte hjemmehørende arter via mekanismer såsom i) predation/herbivori ii) direkte og indirekte interspecifik konkurrence iii) overførsel af sygdomme til hjemmehørende arter eller iv) genetiske effekter fx hybridisering.

1 = Ud fra invasionshistorien lader det til, at påvirkningen af hjemmehørende arter er ubetydelig.

2 = Det er dokumenteret, at den ikke-hjemmehørende art forårsager lokale ændringer (< 80 %) i populations-størrelsen, -væksten eller -udbredelsen af en eller flere hjemmehørende arter. Dette gælder især for almindelige arter og pionerarter. Effekten kan som oftest reverteres.

3 = Den ikke-hjemmehørende art forårsager ofte alvorlig (>80 %) tilbagegang for populationer af hjemmehørende arter og reducerer den lokale artsdiversitet. På en regional skala er det medvirkende til en nedgang i individantallet af sjældne arter. De danner ofte langtidsholdbare populationer og effekten på de hjemmehørende arter betragtes som svær at revertere.

### **D. Påvirkning af økosystemfunktioner**

Potentialet for en invasiv art til at påvirke hjemmehørende arters økosystemprocesser eller -strukturer på en måde så det har en signifikant effekt på deres overlevelse. F.eks. ændring af næringsstofcyklusser og lysforhold, fysiske ændringer af hydrologien, ændring af naturlig succession eller fødekæder og trofiske niveauer.

1 = Påvirkningen af økosystemprocesser og -strukturer er ubetydelig.

2 = Påvirkningen af økosystemprocesser og -strukturer er moderat, og det er let at genskabe dem.

3 = Påvirkningen af økosystemprocesser og -strukturer er stærk, og vanskelig at genskabe dem.

### **E. Økonomiske effekter**

Negative effekter på produktion af planter og dyr, infrastruktur, tab af eksportmarkeder, pesticider, bekæmpelsesomkostninger, sundhedsomkostninger (andre end nævnt under F.) etc.

1 = Ingen eller få økonomiske effekter.

2 = Bevis for nogen, men dog begrænset effekt.

3 = Bevis for væsentlige effekter.

### **F. Helbredseffekter**

Effekter som opstår ved fx kontakt, bid eller indtagelse/indånding.

1 = Ingen eller kun svage symptomer, der ikke kræver behandling.

2 = Moderate symptomer, der let kan behandles og ikke forårsager permanent skade.

3 = Alvorlige symptomer, hvor behandling er vanskelig eller umulig med permanent skader eller døden til følge. Herunder også højsfrekvente- og kontaktallergier.

### **Referencer:**

Kilder angives med forfatter, år, titel og evt. forlag.

## Appendix 6. Species with high scores

**Table 19.** Species with high scores from this assessment study. The scores in this table are based on evaluations found in literature and a review by external experts. Since limited time only allowed review by a single expert per taxonomic group the list temporary and should be submitted to further revisions. Table show Group, Species name, the six assessment categories (Dispersion potential, Colonisation of high conservation value habitats, Adverse impacts on native species, Alteration of ecosystem functions, Economical effect and Public health effects), Total score. The order of the species is sorted according to species group and alphabetical within these. \* = Species not in Denmark as yet, <sup>BLACK</sup> = On the Black list, <sup>OBS</sup> = On the Observation list.

Group	Species	Danish common name	Dispersion potential	Colonisation of high conservation value habitats	Adverse impacts on native species	Alteration of ecosystem functions	Economical effect	Public health effects	Total score
Angiosperma	<i>Heracleum mantegazzianum</i> <sup>BLACK</sup>	Kæmpe-bjørneklo	3	3	3	3	3	3	18
Angiosperma	<i>Elodea nuttallii</i> <sup>BLACK</sup>	Smalbladet vandpest	3	3	3	3	3	1	16
Angiosperma	<i>Rosa rugosa</i> <sup>BLACK</sup>	Rynket rose	3	3	3	3	2	1	15
Angiosperma	<i>Prunus serotina</i> <sup>BLACK</sup>	Glansbladet hæg	3	3	3	2	2	2	15
Angiosperma	<i>Solidago canadensis</i> <sup>BLACK</sup>	Canadisk gyldenris	3	3	3	2	2	2	15
Angiosperma	<i>Baccharis halimifolia</i> *		3	2	3	3	2	2	15
Angiosperma	<i>Egeria densa</i> *		3	2	3	3	3	1	15
Angiosperma	<i>Lagarosiphon major</i> *		3	2	3	3	3	1	15
Angiosperma	<i>Ludwigia grandiflora</i> *		3	3	3	2	3	1	15
Angiosperma	<i>Ludwigia peploides</i> *		3	3	3	2	3	1	15
Angiosperma	<i>Elodea canadensis</i> <sup>BLACK</sup>	Almindelig vandpest	3	3	3	3	1	1	14
Angiosperma	<i>Solidago gigantea</i> <sup>BLACK</sup>	Sildig gyldenris	3	3	3	3	1	1	14
Angiosperma	<i>Fallopia japonica</i> <sup>BLACK</sup>	Japan-pileurt	2	2	3	3	3	1	14
Angiosperma	<i>Hydrocotyle ranunculoides</i>		1	3	3	3	2	2	14
Angiosperma	<i>Robinia pseudoacacia</i> <sup>OBS</sup>	Robinie	3	2	2	3	1	2	13
Angiosperma	<i>Buddleja davidii</i> <sup>OBS</sup>	Sommerfuglebusk	3	1	3	2	3	1	13
Angiosperma	<i>Heracleum persicum</i>	Hårfrugtet bjørneklo	3	2	3	1	1	3	13
Angiosperma	<i>Petasites</i>	Japansk hestehov	2	3	2	2	2	2	13

Group	Species	Danish common name	Dispersion potential	Colonisation of high conservation value habitats	Adverse impacts on native species	Alteration of ecosystem functions	Economical effect	Public health effects	Total score
	<i>japonicus</i> <sup>BLACK</sup>								
Angiosperma	<i>Ailanthus altissima</i>	Skyrækker	3	1	2	2	2	3	13
Angiosperma	<i>Fallopia x bohemica</i> <sup>BLACK</sup>	Japan- x Kæmpepileurt	2	2	3	3	1	1	12
Angiosperma	<i>Carpobrotus acinaciformis</i> *		3	2	2	3	1	1	12
Angiosperma	<i>Carpobrotus edulis</i> *		3	2	2	3	1	1	12
Angiosperma	<i>Hydrilla verticillata</i> *		2	2	3	2	2	1	12
Angiosperma	<i>Myriophyllum aquaticum</i> *		2	2	3	2	2	1	12
Angiosperma	<i>Myriophyllum heterophyllum</i> *		2	2	3	2	2	1	12
Angiosperma	<i>Lysichiton americanus</i> <sup>OBS</sup>	Gul kæmpekalla	2	2	3	2	1	1	11
Angiosperma	<i>Rosa rugosa</i> var. <i>Kamtchatica</i> <sup>BLACK</sup>	Kamtchatka-rose	1	2	3	3	1	1	11
Angiosperma	<i>Spartina anglica</i> <sup>BLACK</sup>	Engelsk vadegræs	2	3	2	2	1	1	11
Angiosperma	<i>Microstegium vimineum</i> *		2	2	3	2	1	1	11
Annelida	<i>Marenzelleria wireni</i>		3	3	3	3	1	1	14
Arthropoda	<i>Agilus planipennis</i> <sup>OBS</sup>	Asiatisk askepragt-bille	3	3	3	3	3	1	16
Arthropoda	<i>Paralithodes camtschaticus</i> <sup>OBS</sup>	Troldkrabbe	3	3	3	3	2	1	15
Arthropoda	<i>Dendrolimus sibiricus</i>	Sibirisk nåletræ-spinder	3	2	2	2	3	3	15
Arthropoda	<i>Dendrolimus superans</i> *		3	2	2	2	3	3	15
Arthropoda	<i>Cercopagis pengoi</i> <sup>OBS</sup>	Kroghalet rovdafnie	3	3	2	3	2	1	14
Arthropoda	<i>Varroa destructor</i>	Varroamide	3	1	3	3	3	1	14
Arthropoda	<i>Pissodes strobi</i> *		3	3	2	2	3	1	14
Arthropoda	<i>Eriocheir sinensis</i> <sup>BLACK</sup>	Kinesisk uldhåndskrabbe	3	3	2	2	2	1	13
Arthropoda	<i>Rhithropanopeus harrisii</i>	Østamerikansk brakvandskrabbe	3	3	2	2	2	1	13
Arthropoda	<i>Pissodes nemorensis</i> *		3	3	2	2	2	1	13
Arthropoda	<i>Agilus anxius</i> *		3	2	2	2	3	1	13

Group	Species	Danish common name	Dispersion potential	Colonisation of high conservation value habitats	Adverse impacts on native species	Alteration of ecosystem functions	Economical effect	Public health effects	Total score
Arthropoda	<i>Dermestes lardarius</i>	Flæskeklanner	3	2	1	1	3	3	13
Arthropoda	<i>Callinectes sapidus</i> <sup>OBS</sup>	Blå svømmekrabbe	3	3	2	2	1	1	12
Arthropoda	<i>Lymantria mathura</i> *		3	2	2	3	2	-	12
Arthropoda	<i>Harmonia axyridis</i> <sup>BLACK</sup>	Harlekin-Mariehøne	3	1	3	2	2	1	12
Arthropoda	<i>Pacifastacus leniusculus</i> <sup>BLACK</sup>	Signalkrebs	2	3	3	1	2	1	12
Arthropoda	<i>Tetropium gracilicorne</i> *		3	2	2	2	2	1	12
Arthropoda	<i>Anoplophora chinensis</i> <sup>OBS</sup>	Asiatisk citrustræbuk	3	3	1	1	3	1	12
Arthropoda	<i>Anoplophora glabripennis</i> <sup>OBS</sup>	Asiatisk træbuk	3	3	1	1	3	1	12
Arthropoda	<i>Ips hauseri</i> *		2	2	2	2	3	1	12
Arthropoda	<i>Orgyia pseudotsugata</i> *		2	2	1	2	3	2	12
Arthropoda	<i>Anthrenus verbasci</i>	Tæppeklanner	3	1	1	1	3	3	12
Arthropoda	<i>Attagenus smirnovi</i>	Brun pelsklanner	3	1	1	1	3	3	12
Arthropoda	<i>Dermestes haemorrhoidalis</i>	Husklanner	3	1	1	1	3	3	12
Arthropoda	<i>Lasius neglectus</i> <sup>OBS</sup>	Den invasive havemyre	2	2	3	2	1	1	11
Arthropoda	<i>Limulus polyphemus</i>	Dolkhale	3	3	2	1	1	1	11
Arthropoda	<i>Acartia tonsa</i>		3	3	2	1	1	-	10
Aves	<i>Anas platyrhynchos "domestica"</i>	Gråand	3	3	3	2	1	1	13
Aves	<i>Oxyura jamaicensis</i> <sup>BLACK</sup>	Amerikansk skarveand	3	3	3	1	1	1	12
Aves	<i>Phasianus colchicus</i>	Fasan	3	2	3	2	1	1	12
Bryophyta	<i>Campylopus introflexus</i> <sup>BLACK</sup>	Vestlig Bredribbe	3	2	2	2	1	1	11
Cnidaria	<i>Cordylophora caspia</i>	Brakvands-køllepolyp	3	3	2	2	2	1	13
Coniferae	<i>Pinus mugo</i> <sup>BLACK</sup>	Bjerg-fyr	2	3	3	3	1	1	13
Coniferae	<i>Pinus mugo</i> ssp. <i>Mugo</i> <sup>BLACK</sup>	Almindelig bjerg-fyr	2	3	2	2	3	1	13

Group	Species	Danish common name	Dispersion potential	Colonisation of high conservation value habitats	Adverse impacts on native species	Alteration of ecosystem functions	Economical effect	Public health effects	Total score
Coniferae	<i>Pinus mugo</i> ssp. <i>mugo</i> x <i>rotundata</i> <sup>BLACK</sup>	Alpe bjerg-fyr	2	3	2	2	3	1	13
Coniferae	<i>Pinus contorta</i> ssp. <i>contorta</i> var. <i>Contorta</i> <sup>BLACK</sup>	Almindelig klit-fyr	2	3	2	2	2	1	12
Coniferae	<i>Pinus contorta</i> ssp. <i>Murrayana</i> <sup>BLACK</sup>	Lodgepole-fyr	2	3	2	2	2	1	12
Coniferae	<i>Pinus contorta</i> <sup>BLACK</sup>	Klit-fyr	2	3	2	2	1	1	11
Coniferae	<i>Pinus contorta</i> ssp. <i>contorta</i> var. <i>Latifolia</i> <sup>BLACK</sup>	Brednålet fyr	2	3	2	2	1	1	11
Ctenophora	<i>Mnemiopsis leidyi</i> <sup>BLACK</sup>	Amerikansk ribbegople	3	3	3	3	2	1	15
Fungi	<i>Ceratocystis fagacearum</i> <sup>OBS</sup>	Egens visnesyge	3	3	3	3	3	1	16
Fungi	<i>Chalara fraxinus</i>	Asketoptørrer	3	3	3	3	3	1	16
Fungi	<i>Ophiostoma novo-ulmi</i> <sup>BLACK</sup>	Elmesyge	3	3	3	3	3	1	16
Fungi	<i>Cryptostroma corticale</i>	Ahornsodbark	3	2	2	2	3	3	15
Fungi	<i>Phytophthora kernoviae</i> <sup>OBS</sup>	'Cornwall' visneskimmel	2	3	2	3	3	1	14
Fungi	<i>Phytophthora ramorum</i>	Californisk visneskimmel	2	3	2	3	3	1	14
Fungi	<i>Microsphaera alphitoides</i> <sup>OBS</sup>	Egemeldug	3	3	2	2	2	1	13
Fungi	<i>Aphanomyces astaci</i> <sup>BLACK</sup>	Krebsepest	2	2	3	2	2	1	12
Fungi	<i>Cylindrocladium buxicola</i>	Buksbomkvistdød	3	2	1	2	3	1	12
Fungi	<i>Neonectria neomacrospora</i>	Ædelgrankræft	3	2	1	2	3	1	12
Macroalgae	<i>Gracilaria vermiculophylla</i> <sup>BLACK</sup>	Brunlig Gracilariatang	3	3	3	3	2	1	15

Group	Species	Danish common name	Dispersion potential	Colonisation of high conservation value habitats	Adverse impacts on native species	Alteration of ecosystem functions	Economical effect	Public health effects	Total score
Macroalgae	<i>Sargassum muticum</i> <sup>BLACK</sup>	Butblæret Sargassotang	3	3	3	3	2	-	14
Macroalgae	<i>Codium fragile</i> <sup>OBS</sup>	Plysalge	3	3	2	2	1	1	12
Macroalgae	<i>Fucus evanescens</i>	Langfrugtet klørtang	3	3	2	2	1	1	12
Macroalgae	<i>Bonnemaisonia hamifera</i> <sup>OBS</sup>		3	3	2	1	1	1	11
Macroalgae	<i>Colpomenia peregrina</i> <sup>OBS</sup>	Østerstyv	3	3	2	1	1	1	11
Macroalgae	<i>Dasya baillouviana</i> <sup>OBS</sup>	Dusktang	3	3	2	1	1	1	11
Macroalgae	<i>Heterosiphonia japonica</i> <sup>OBS</sup>	Japansk havlyng	3	3	2	1	1	1	11
Mammalia	<i>Rattus norvegicus</i> <sup>BLACK</sup>	Brun rotte	3	3	3	3	3	3	18
Mammalia	<i>Mustela vison</i> <sup>BLACK</sup>	Mink	3	3	3	3	1	1	14
Mammalia	<i>Sciurus carolinensis</i> <sup>OBS</sup>	Grå egern	2	3	3	3	2	1	14
Mammalia	<i>Nyctereutes procyonoides</i> <sup>BLACK</sup>	Mårhund	3	3	2	2	1	2	13
Mammalia	<i>Procyon lotor</i> <sup>BLACK</sup>	Vaskebjørn	3	3	2	2	1	1	12
Mammalia	<i>Cervus nippon</i>	Sikahjort	3	3	2	1	1	1	11
Mollusca	<i>Crassostrea gigas</i> <sup>BLACK</sup>	Stillehavsøsters	3	3	3	3	1	1	14
Mollusca	<i>Dreissena polymorpha</i> <sup>BLACK</sup>	Vandremusling	3	3	2	3	3	-	14
Mollusca	<i>Teredo navalis</i> <sup>BLACK</sup>	Pæleorm	3	3	2	2	3	1	14
Mollusca	<i>Ensis americanus</i> <sup>BLACK</sup>	Amerikansk knivmusling	3	3	2	2	2	1	13
Mollusca	<i>Crepidula fornicata</i> <sup>OBS</sup>	Tøffelsnegl	3	3	2	2	1	1	12
Mollusca	<i>Arion lusitanicus</i> <sup>BLACK</sup>	Iberisk skovsnegl	2	2	3	2	2	1	12
Mollusca	<i>Mya arenaria</i>	Almindelig sandmusling	3	3	2	1	1	1	11
Nematoda	<i>Bursaphelenchus xylophilus</i>	Fyrrevedsnematode	2	3	2	2	3	1	13

Group	Species	Danish common name	Dispersion potential	Colonisation of high conservation value habitats	Adverse impacts on native species	Alteration of ecosystem functions	Economical effect	Public health effects	Total score
Other chordates	<i>Molgula manhattensis</i>	Lådden søpung	3	3	2	2	1	1	12
Other chordates	<i>Styela clava</i>	Østasiatisk søpung	3	3	2	2	1	1	12
Phytoplankton	<i>Karenia mikimotoi</i>		3	3	3	2	2	1	14
Phytoplankton	<i>Chattonella verruculosa</i>		3	3	2	2	2	1	13
Phytoplankton	<i>Pseudochattonella farcimen</i>		3	3	2	2	2	1	13
Phytoplankton	<i>Heterosigma akashiwo</i>		3	3	2	2	2	1	13
Phytoplankton	<i>Prorocentrum minimum</i>		3	3	2	2	2	1	13
Pisces	<i>Neogobius melanostomus</i> <sup>OBS</sup>	Sortmundet kutling	3	3	3	2	2	1	14
Pisces	<i>Oncorhynchus mykiss</i>	Regnbueørred	3	3	3	1	2	1	13
Pisces	<i>Salvelinus fontinalis</i>	Kildeørred	3	3	3	1	2	1	13

## Appendix 7. Additional tables

These tables describe the degree to which it has been possible to find references for the different categories of the overall method. A blank value indicates that literature and information search have not given sufficient information to assess a score.

The categories with most available information is the dispersion potential and the public health effects. The categories with least available information is the Alteration of ecosystem functions, along with Adverse impacts on native species.

In the summary analysis the lack of information has not contributed to the total scores, since blank has counted as '0'.

<b>Dispersion potential</b>	Total
Blank	1537
1	164
2	138
3	239
<b>Total</b>	<b>2078</b>

<b>Colonisation of high conservation value habitats</b>	Total
Blank	1609
1	210
2	164
3	95
<b>Total</b>	<b>2078</b>

<b>Adverse impacts on native species</b>	Total
Blank	1755
1	139
2	123
3	61
<b>Total</b>	<b>2078</b>

<b>Alteration of ecosystem functions</b>	Total
Blank	1767
1	188
2	87
3	36
<b>Total</b>	<b>2078</b>

<b>Economical effect</b>	Total
Blank	1721
1	148
2	146
3	63
<b>Total</b>	<b>2078</b>

<b>Public health effect</b>	Total
Blank	1484
1	367
2	180
3	47
<b>Total</b>	<b>2078</b>

## Appendix 8. Structure of spreadsheet, incl. codelists

All data on species were entered into the NOBANIS excel-spreadsheet following directions from the NOBANIS manual. The structure follows that given in table 20. For a further description of each field consult the NOBANIS manual.

**Table 20.** Structure of NOBANIS spreadsheet. 'Column number' refers to excel spread sheet column (A-AI), 'Heading' is the name of the coloumn, 'Comments and codes' is a description or a definition of the content of each coloumn.

Column number	Heading	Comments and codes
A	<b>List</b>	Empty: The species is not on any lists. BLACK: The species is presently on the Black list. EPPO: The species is presently on the EPPO list. OBS: The species is presently on the Observation list.
B	<b>Report</b>	0: The species has <b>not</b> received an environmental or total point score that according to this assessment method qualifies it as a potential risk species. 1: This species has received an environmental or total point score that according to this assessment method qualifies it as a potential risk species.
C	<b>Review was made by</b>	Specialist: The species was reviewed by specialist. Project group: Litterature for the species was reviewed by the project group. No review: Litterature for the species was not reviewed and the species is not included in any analysis. Proposed erased: The litterature for the species has been reviewed by the project group but specialists suggest removing the species from the list. The species is included in the analysis.
D	<b>Terrestrial/Aquatic</b>	Terrestrial. Aquatic.
E	<b>Country</b>	Empty: Not registered in Denmark. DK: Has been registered in Denmark.
F	<b>Family name</b>	Latin name.
G	<b>Species name</b>	Latin name.
H	<b>Synonym name</b>	Synonymous name(s) for the species.
I	<b>Common name</b>	Danish common name.
J	<b>Group</b>	Angiosperm Annelida Arthropoda Aves Bryophyta Cnidaria Ctenophora Coniferae Pteridophyta Pisces Platyhelminthes Fungi

Column number	Heading	Comments and codes
		Macroalgae Mammalia Mollusca Nematoda Other chordates Phytoplankton Reptilia & amphibia
K	<b>Year of introduction</b>	The year or decade which the species are believed to have been introduced.
L	<b>Year of first report</b>	Numeric year or decade of first report of the species.
M	<b>Natural distribution area</b>	The natural distribution area for the species.
N	<b>Distribution details</b>	Details on distribution.
O	<b>Type of introduction</b>	Whether introduction happened intentionally, unintentionally or both. Blank if it's not known.
P	<b>Mode of Entry</b>	7 Modes of Entry were used: <ul style="list-style-type: none"> <li>• <u>Release</u>: Intentional introduction as a commodity contaminant ie. Biocontrol agents, game animals and plants for erosion control.</li> <li>• <u>Escape</u>: Intentional introduction as a commodity but escapes unintentionally i.e. feral crops and livestock, pets, garden plants and live bait.</li> <li>• <u>Contaminant</u>: Unintentional introduction with a specific commodity i.e. parasites and pests.</li> <li>• <u>Stowaway</u>: Unintentional introduction attached to or within a transport vector i.e. hull fouling or ballast water and sediments.</li> <li>• <u>Corridor</u>: Unintentional introduction via human infrastructures linking previously unconnected regions.</li> <li>• <u>Unaided</u>: Unintentional introduction through natural dispersion.</li> <li>• <u>Not known</u>: The mode was not known.</li> </ul>
Q	<b>Pathway of Introduction</b>	20 different pathways were used with their respective vector(s): <ul style="list-style-type: none"> <li>• <u>Agriculture</u>: cuttings, fruit and vegetables, grain, plants with roots, seeds, stored products (other than grain), birdseeds, other</li> <li>• <u>Angling/Sport</u>: fishing material</li> <li>• <u>Animal husbandry</u></li> <li>• <u>Aquaculture</u></li> <li>• <u>Aquaria</u></li> <li>• <u>Ballast water &amp; sediments</u></li> <li>• <u>Biological control</u></li> <li>• <u>Escapes</u>: Botanical gardens, breeding farms, confinement, farms, pets, research, zoo, other</li> <li>• <u>Forestry</u>: Bark and wood chips, plants with roots, sawn wood (processed), seeds, timber, wood packaging material, other</li> </ul>

Column number	Heading	Comments and codes
		<ul style="list-style-type: none"> <li>• <u>Horticulture</u>: Cut flowers and branches, cuttings, plants with roots, seeds, other</li> <li>• <u>Hull fouling</u></li> <li>• <u>Hunting</u></li> <li>• <u>Landscaping</u>: Cuttings, plants with roots, seeds, other</li> <li>• <u>Medicinal</u>: Cuttings, plants with roots, seeds, other</li> <li>• <u>Reintroduction</u></li> <li>• <u>Secondary introduction</u>: Describe primary in “details column”</li> <li>• <u>Transport</u>: Agricultural machinery, Aircraft, car, truck, train, ship, leisure boat, military, packing material (except wood packaging material), peoples baggage, other</li> <li>• <u>Other</u>: Describe the pathway in “details column”</li> <li>• <u>Commodity contaminants</u>: Presence of a pest or other unwanted organism in a product, or other article being moved for trade or other purpose .</li> <li>• <u>Not Known</u></li> </ul>
R	<b>Details of introduction</b>	Various details of e.g. Pathway of Introduction, history or first record. If no details were found it was also noted.
S –T-U-V	<b>HARMONIA categories</b>	<p>Scores from 1-3, left blank if no information could be retrieved.</p> <ul style="list-style-type: none"> <li>• Dispersion potential.</li> <li>• Colonisation of high conservation value habitats.</li> <li>• Adverse impacts on native species.</li> <li>• Alteration of ecosystem functions.</li> </ul>
W-X	<b>New categories</b>	<p>Scores from 1-3, left blank if no information could be retrieved.</p> <ul style="list-style-type: none"> <li>• Economical effects.</li> <li>• Public health effects.</li> </ul>
Y	<b>Total</b>	Sum of column T till Y.
Z	<b>Donor area</b>	Refers to the locality from which a secondary, reintroduced or transferred introduction came.
AA	<b>Habitat</b>	Refers to the introduced range, not the natural range.
AB	<b>Status</b>	Status of the species, if it has formed self-reproducing populations or not.
AC	<b>Frequency</b>	Refers to commonness of the species, ranging from rare to very common.
AD	<b>Invasiveness</b>	Describe invasiveness of the species.
AE	<b>Impact</b>	Wide range of impacts the species are known to cause.
AF	<b>Comments</b>	Free text field.
AG	<b>References</b>	Refers to NOBANIS’s references along with the new IGN references found on separate worksheet in the Excel spreadsheet.
AH	<b>Last updated</b>	Date of last update.
AI	<b>New</b>	Species that have been added to NOBANIS spreadsheet ( i.e. by specialists or from the EPPO lists).

- Appendix 9. Excel spreadsheet (electronic)
- Appendix 10. Publication references for the database (electronic, in separate files)
- Appendix 11. Web link references for the database (electronic, in separate files)

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