ISEIA, a Belgian non-native species assessment protocol

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Introduction

Belgian land managers and policy makers have to face up to an increasing number of non-native species with contrasted impacts on the environment. To help them in the identification of species of most concern for preventive or mitigation actions, *Harmonia*, an information system on invasive species in Belgium, has recently been developed at the initiative of scientists gathered within the Belgian Forum on Invasive Species (http://ias.biodiversity.be).

Harmonia is based on a standardised assessment protocol (ISEIA) which allows assessing, categorising and listing of non-native species from any taxonomic group according to their invasion stage in Belgium and to their impact on native species and ecosystem functions (Branquart 2007). The ISEIA protocol is one of the first national standardised risk assessment tools developed for non-native species in Europe (Essl et al., submitted).

Here we present the ISEIA protocol, the assessment procedure and the results of the first assessments performed on vascular plant and vertebrate species in Belgium. The way those results may be used to develop regulatory instruments and management guidelines are also briefly discussed.

The ISEIA protocol and the Belgian list system

The ISEIA protocol aims at categorising non-native species on the basis of a standardised methodology designed to minimise the use of subjective opinions and to make the process of assessing and listing invasive species transparent and repeatable.

Contrary to predictive pest risk assessment protocols mainly based on species' intrinsic attributes for evaluating invasion likelihood and potential to cause adverse ecological effects, the ISEIA approach favours the use of invasion histories documented in peer-reviewed publications and in scientific reports from Belgium and neighbouring areas. It is considered that non-native species are likely to cause significant impacts on native species and ecosystems in Belgium if they have already done so in neighbouring countries. The reference area taken into consideration for the assessment includes the European regions with eco-climatic conditions comparable to Belgium, i.e. hardiness zones 7 and 8 characterised by an average annual minimum temperature between –7 and –17°C (Cathey 1990). It covers Denmark, the Netherlands and large parts of Germany, France, Ireland, Switzerland and the United Kingdom (figure 1).
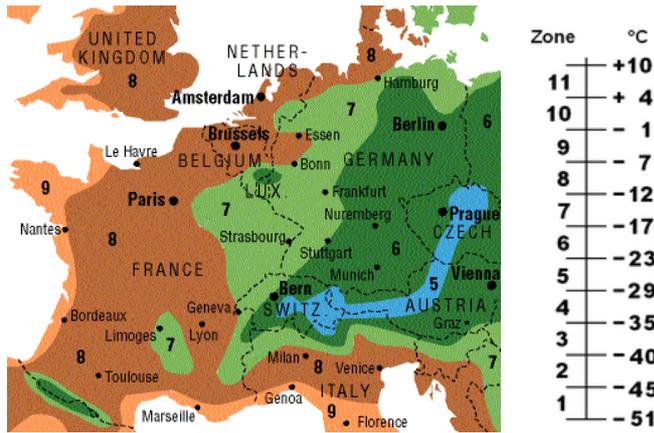
Figure 1 – USDA hardiness zones in western Europe based on the ability of a species to withstand the minimum temperatures of the zone (Cathey 1990). The reference area used in the ISEIA protocol covers hardiness zones 7 and 8.

The Belgian list system is based on three different list categories as proposed in the European strategy on Invasive Alien Species (Genovesi & Shine 2003). Those categories are defined according to the severity of impacts on the environment: no negative impact (white list), negative impact suspected (grey list) and negative impact confirmed (black list). The assignment of a non-native species to one of those categories is assessed by four main criteria matching the last steps of the invasion process, i.e. potential for spread, colonisation of natural habitats and adverse ecological impacts on native species and ecosystems. Consistent with other risk assessment standards, equal weight is assigned to each of the four criteria and a three-point scale is used for criteria scoring: low (or unlikely), medium (or likely) and high. The global ISEIA score is calculated as the sum of risk rating scores of the four criteria (see Branquart 2007 for additional explanation).

Non-native species are allocated to the different categories of the Belgian list system combining information from the ISEIA scoring and data on their invasion stage in the country (figure 2). Detrimental species not yet established in Belgium (A0) or occurring only in a few localities (A1) are to be considered as a high priority for prevention and eradication actions (Genovesi & Shine 2003, Genovesi et al. 2009).
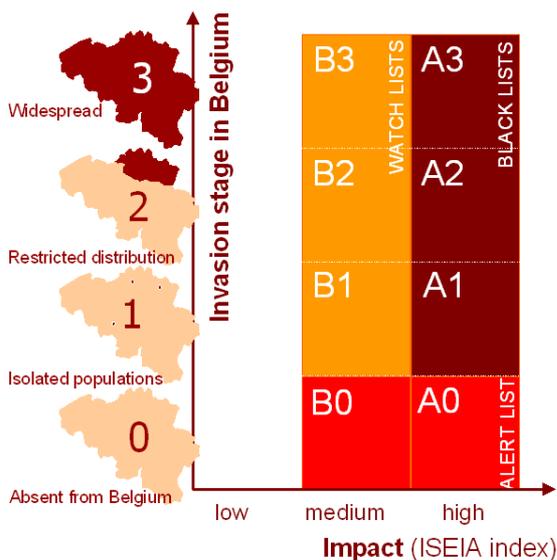

Figure 2 - List system proposed to identify non-native species of most concern for preventive and mitigation actions in Belgium (Branquart 2007).

The assessment procedure

Five different expert working groups were established to deal with vascular plants, fishes, amphibians, birds and mammals, each of them including three to six scientists from different research institutes and universities in Belgium. In a first step, the environmental impact of each species is assessed independently by the different experts, sometimes leading to diverging results. At last, these results are discussed during a working group meeting in order to make sure that experts share a common understanding of criteria and definitions and to search for a robust consensus for each species.

The ISEIA protocol has been improved several times based on those discussions. It has proven to be flexible enough to be used to assess the environmental impact of non-native species from very different taxonomic groups. The major difficulty encountered during the assessment process was that environmental impacts of non-native species in the reference area are often poorly documented in the literature. This is typically the case for most species included in the watch list (e.g. *Acer rufinerve, Alopochen aegyptiacus, Ameiurus* spp*., Cyperus eragrostis, Lepomis gibbosus* and *Tamias sibiricus*).

Up to now, assessments were focused on species considered as detrimental in at least one country of the reference area (e.g. according to Pascal et al. 2003, Muller 2004, Weber et al. 2005, Wittenberg et al. 2006, Copp et al. 2008).

Results and trends

Nearly 400 non-native species of vascular plants and vertebrates can be considered as currently established in Belgium. So far, 57 non-native vascular plant (neophytes) and 32 vertebrate species have been evaluated by Belgian experts using the ISEIA protocol, comprising 72 species considered as naturalised in Belgium. Thirty-nine out of these 72 species were assessed as organisms with a strong detrimental impact on native biodiversity (black list species, A1-A3), for which preventive and mitigation actions are strongly recommended (see the list in appendix). Most of the remaining species were recorded on the watch list (B1-B3), which means either that their impact on native biodiversity is moderate or that their impact is still unclear due to a deficiency in scientific studies.

Compared to vascular plant species, a higher proportion of the vertebrate species has been shown to be detrimental to native species and ecosystem functions. Invasive neophytes typically affect biodiversity by growing in very dense populations in semi-natural habitats, outcompeting native plant species and modifying the vegetation structure. Invasive vertebrate species rather adversely impact biodiversity through a wide range of interspecific interactions (competition, predation, disease transmission and hybridisation) that may act separately or synergistically (*Harmonia* database 2009).

Besides the evaluation of 72 non-native species naturalised in Belgium, 17 taxa established in neighbouring countries but not (yet) in Belgium were assessed and included in the alert list (A0-B0) (see appendix). All of them are likely to become established in the coming years if no preventive action is undertaken.
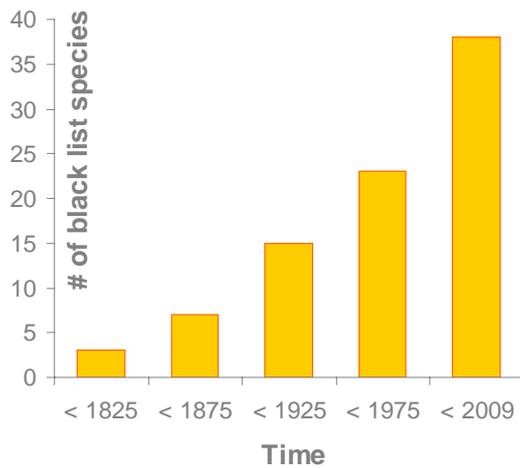
Figure 3A – Number of black list species established in the wild in Belgium at different periods of time. Data: Harmonia database 2009.
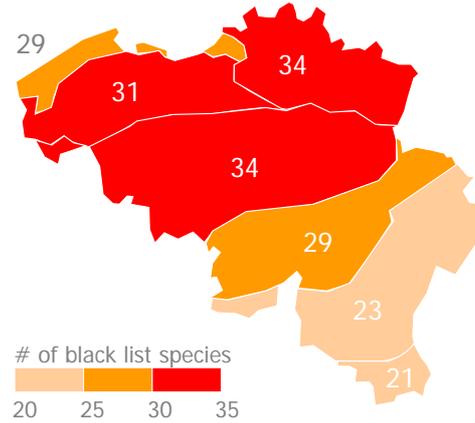
Figure 3B – Number of black list species within the main biogeographic regions of Belgium Data: Harmonia database 2009.

When examining the change in number of invasive species for 200 years (*Harmonia* database 2009), we can see that there is an increasing number of established black-list species in Belgium causing major ecological damages and growing management costs (figure 3A). Those species tend to concentrate in areas where human density and activities are at the highest (figure 3B) and where habitats incur frequent alteration, eutrophication and pollution, and therefore may be prone to invasion. Many of those black-list species thrive along river banks and in freshwater environments.

From science to management

Eighteen non-native species out of the group of organisms responsible for high environmental impacts are either not yet established in Belgium (A0) or only known from a limited number of localities (A1) (see appendix). Prevention actions and early eradication of these species deserve to be conducted in priority. Indeed, the ecological damages they may cause can still be restricted to a minimum at a low cost if actions are undertaken without delay. This is the reason why these 18 species have been proposed to be considered in a new Royal Decree (expected in early 2010) aiming at restricting their importation, exportation and rearing.

Another 30 detrimental species are already widely distributed in Belgium (A2 & A3) and cannot be eradicated anymore. However, it is still worthwhile avoiding further secondary releases to slow down the invasion process. Voluntary codes of conduct developed in partnership with key sectors of activity (horticulture, pet industry, etc.) may help to reduce the introduction of these species in the wild (Branquart & Halford 2009). In addition to preventive actions, the monitoring and the management of those species is strongly recommended in areas of high conservation value in order to preserve native red-listed species and threatened habitats (Tu 2009).

At last, it is now widely acknowledged that early warning and rapid response are crucial for mitigating the impacts caused by biological invasions in Europe. Early warning tools should ideally be developed through information exchange at a regional scale and need a strong international scientific collaboration, a common understanding of invasiveness issues and shared risk assessment schemes (Genovesi et al. 2009, Hulme et al. 2009). A standardised ISEIA-like protocol deserves to be developed at a European scale to reach that goal.

Acknowledgements

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Appendix – List of non-native species with a high detrimental impact on the environment

Scientific name	English name	Taxonomic group*	List category
Species not established in Belgium			
Callosciurus finlaysonii	Finlayson's squirrel	M	A0
Carpobrotus spp.	Hottentot fig	P	A0
Cervus nippon	Sika deer	M	A0
Muntiacus reevesi	Reeves' muntjac	M	A0
Mustela vison	American mink	M	A0
Neogobius melanostomus	Round goby	F	A0
Nyctereutes procyonoides	Raccoon dog	M	A0
Perccottus glenii	Rotan, Amur sleeper	F	A0
Sciurus carolinensis	Grey squirrel	M	A0
Threskiornis aethiopica	Sacred ibis	B	A0
Species with isolated populations in Belgium			
Callosciurus erythraeus	Pallas's squirrel	M	A1
Crassula helmsii	Australian swamp stonecrop	P	A1
Egeria densa	Brazilian waterweed	P	A1
Lagarosiphon major	Curly waterweed	P	A1
Ludwigia peploides	Water primrose	P	A1
Myocastor coypus	Coypu, Nutria	M	A1
Myriophyllum heterophyllum	Variable watermilfoil	P	A1
Rana catesbeiana	American bullfrog	A	A1
Species with a restricted distribution in Belgium			
Acer negundo	Box-elder, Ash-leaved maple	P	A2
Ailanthus altissima	Tree of heaven	P	A2
Baccharis halimifolia	Eastern baccharis	P	A2
Branta canadensis	Canada goose	B	A2
Cornus sericea	Red-osier dogwood	P	A2
Cotoneaster horizontalis	Rockspray	P	A2
Hydrocotyle ranunculoides	Water pennywort	P	A2
Ludwigia grandiflora	Water primrose	P	A2
Myriophyllum aquaticum	Parrotfeather	P	A2
Pelophylax ridibundus	Marsh frog	A	A2
Persicaria wallichii	Himalayan knotweed	P	A2
Procyon lotor	Raccoon	M	A2
Pseudorasbora parva	Topmouth gudgeon	F	A2
Rhododendron ponticum	Rhododendron	P	A2
Rosa rugosa	Rugosa rose	P	A2
Spiraea spp.	Meadowsweet	P	A2

Appendix (cont'd) – List of non-native species with a high detrimental impact on the environment

Widespread species in Belgium

Aster americ.	North American asters	P	A3
Carassius gibelio	Prussian carp	F	A3
Elodea canadensis	Canadian waterweed	P	A3
Elodea nuttallii	Nuttall's waterweed	P	A3
Fallopia japonica	Japanese knotweed	P	A3
Helianthus tuberosus	Jerusalem artichoke	P	A3
Heracleum mantegazzianum	Giant hogweed	P	A3
Impatiens glandulifera	Indian balsam	P	A3
Mahonia aquifolium	Oregon grape	P	A3
Ondatra zibethicus	Muskrat	M	A3
Prunus serotina	Black cherry	P	A3
Rattus norvegicus	Brown rat	M	A3
Solidago canadensis	Canada goldenrod	P	A3
Solidago gigantea	Giant goldenrod	P	A3

* Taxonomic groups: amphibians (A), birds (B), fishes (F), mammals (M) and vascular plants (P).