Overview of the invasive alien species information and activities in Slovenia

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Abstract:
According to the latest information, the number of recorded alien species in Slovenia is similar to the number in adjacent countries. It has been evaluated that more than 280 alien fungi, plant and animal species are naturalised or invasive in Slovenia. There is no dedicated legislative or policy instrument developed particularly for invasive alien species (IAS) although preventive measures toward the introduction of alien species to nature are in place. However, public awareness projects in the last five years contributed towards better recognition of IAS issues, which along with recent research activities give a solid basis for future discussion on development of measures to prevent the threat of IAS.

Keywords:
Invasive alien species, IAS, Slovenia, policy, public awareness

Introduction

Slovenia is a country positioned in the outskirts of the Alps on one side and the Dinaric Mountains on the other. In the opposite direction it connects the Panonic lowlands with the Adriatic Sea. It has a broad variety of geology, hydrology, geomorphology, and climate conditions, which results in rich biodiversity. In addition, Slovenia is a country in the crossroads where transfer routes between the Balkans, Central Europe, Mediterranean and Eastern Europe cross, which increases the probability of introduction and spread of invasive alien species (IAS), especially since the traffic and transport have increased in the last two decades. Biodiversity in Slovenia is relatively well conserved and areas that are well conserved are generally less prone to influences of invasive alien species. However, according to the latest research, the number of alien species in Slovenia is similar to numbers in adjacent countries, which can lead to additional pressure on native biodiversity.

Policy

The main legislation on environment protection in Slovenia was prepared between the years 2000 and 2004. General knowledge or awareness of IAS at that period was not high, mainly because no major threats from IAS or major infestations by them had been recognised. Nevertheless, preventive measures towards alien species are included in the basic legislation of different sectors, which provides the main legal framework for preventive measures. Therefore, only measures towards alien species are defined in Slovenian legislation, and there has not been definition for invasive alien species.

The Nature Conservation Act (Ur. l. RS, No. 96/2004) is the main piece of legislation dealing with alien species in Slovenia. It defines alien species, introduces rules and requirements for introduction into the wild, and breeding of alien species. The introduction of plants or animals of non-indigenous species is prohibited, unless it has been determined during the assessment of risk to nature that the activity shall not threaten the natural balance or biodiversity components. Measures relate also to reintroduction, repopulation and captive breeding of alien species.

Provisions for the assessment of risk to nature are set by the Rules on the carrying-out of the assessment of risk to nature and on the obtaining of authorisation (Ur. l. RS, No. 43/2002). These Rules lay down the conditions and methods for the assessment of risk to nature prior to the introduction or repopulation of alien plant and animal species in the wild or the breeding of alien wild animal species. This provides a mechanism to control the intentional introductions of alien species, but does not address the control of unintentional introductions.

The Freshwater Fisheries Act (Ur. l. RS, No. 61/2006) aims to prevent the introduction and spread of alien species in inland waters. It prohibits release of alien species, regulates sustainable breeding of fish stocks and prohibits mixing of populations between catchment areas and also prohibits relocation of living organisms between different catchments. The implementing Regulation on fishing species caught in inland waters (Ur. l. RS, No. 46/2007) lists the fish species in two major river basins and specifically names the alien species of fish and crayfish.

In accordance with the Act on Forests (Ur. l. RS, No. 30/1993), all forest management practices have to incorporate guidelines for conservation or restoration of autochthonous forest communities.

The introduction and reintroduction of alien species of wild game is regulated by the Wild Game and Hunting Act (Ur. l. RS, No. 16/2004), which stipulates that the assessment of the risk to nature has to be carried out in accordance with the nature protection regulation. It also prohibits keeping in game pens of the alien animals that could change the genetic composition of native game animals in case of escape.

The Plant Health Act (Ur. l. RS, No. 62/2007) implements Council Directive 2000/29/EC of 8 May 2000 on protective measures against the introduction into the Community of organisms harmful to plants or plant products and against their spread within the Community (Council Directive 2000/29/EC)

and the International Plant Protection Convention (IPPC). In the last five years, Slovenia has been confronted with the increasing spread of the common ragweed (*Ambrosia artemisifolia)*. General public awareness in the most impacted parts of Slovenia, and increasing difficulties in health and agriculture sectors lead towards amendments of the Plant Health Act (Ur. l. RS, No. 36/2010). Amendments broadened the scope of the act in a way that not only quarantine pests recognised in accordance with Council Directive 2000/29/EC are regulated, but it also foresees measures for other plant species that are recognised as harmful to the economy, environment, and society. For now, only four species from the genus *Ambrosia* are included on the list; the already widely distributed *Ambrosia artemisifolia*, but also the not yet present *Ambrosia trifida*, *Ambrosia maritima,* and *Ambrosia coronopifolia*. In accordance with this change, owners of the property are obliged to remove this ragweed species from their property. In accordance with the amendments of the act, a Governmental Scientific commission for protection from harmful plants has been established. Experts from relevant sectors (environment, agriculture, health, transport, civil protection, and others) are represented in the commission in order to discuss and give guidance on the measures in the field of prevention, eradication, and prevention of spread of harmful plants.

Since the development of basic environment legislation, new policy documents have been prepared. With increased global recognition of IAS threats and due to the obligation under the multilateral environmental agreements such as Convention on protection of biodiversity (CBD) and Convention on the conservation of European wildlife and natural habitats (Bern Convention), additional measures towards the IAS have been planned. In accordance with the National Environment Programme (2005-2012) (Ur. l. RS, No. 2/2006), preparation of a national strategy on IAS is foreseen. Some measures dealing with IAS issues are included in the national Water management plan for the Danube and Adriatic Sea river basins for 2009-2015 (Ur. l. RS, No. 61/2011), as well as in the forest management plans. The use of only indigenous and local fish populations is also foreseen in freshwater fisheries plans that are in preparation.

Public awareness and capacity building

Most of the existing legislative measures provide a framework for regulation of intentional introductions, but measures for prevention of unintentional introductions, spread, eradication and control are mostly not yet established. Therefore, it is of great importance that public awareness is raised with the view to help reduce the rate of new introductions and limit the spread of already established IAS. In the last few years, activities with the aim of raising awareness have increased.

"Invasive alien species – an overlooked threat (Thuja)" was the first project with the main focus on IAS issues. It started in 2008 and its aim was to introduce the IAS issues to the general public, and to some selected interest groups. It was coordinated by the Institute Symbiosis (project leader) in cooperation with partner organisations: the Botanical Society of Slovenia, society Akvaviva, and Tourist Association Boštanj. During the project, awareness of IAS issues was raised on several levels. The general public was addressed through an information portal, alternative media (such as free postcards) and an interactive exhibition. Specific interest groups, which might significantly contribute to the spread of IAS, were addressed by an information booklet that was distributed as a supplement in a country-wide magazine on gardening and animal keeping (Kus Veenvliet et al. 2009). Several articles were also published in other specialised magazines for children, scouts and others. A workshop on IAS was organised and was attended by representatives of governmental, research, and nongovernmental institutions. At the workshop, an overview of the IAS problems was presented, and existing EU and Slovenian legislation was discussed, followed by an exercise on searching for solutions to address problems caused by selected representative species (Kus Veenvliet 2009). The aim of the workshop

was to start a conversation among different institutions and to prepare a basis for the future preparation of strategy on IAS. With the help of volunteers, an inventory of invasive alien plants at the protected area Radensko Polje was prepared. This action was followed by eradication activities in the year 2009. During the project, a training course for nature conservation wardens in protected areas was organised. The aim of the training was to teach the wardens how to recognise IAS that are most likely to spread in their protected areas. More information on this project can be reached through the official webpage of the ongoing project Thuja 2 (Thuja 2 2012). This second project builds on the experience gained in the first, and other projects performed by project leader and partners. Activities in this project are aimed towards recognising the importance of the IAS pressure on the environment. It addresses the general public and different interested groups. With the latter, the goal is to raise their interest to contribute with their responsible acting toward the prevention of infestation and spread of IAS. Methodology for monitoring alien plant species was prepared (Jogan et al. 2012), and it was followed by a course for the field workers, who later monitored IAS in selected sampling areas, based on the above-mentioned methodology. It is also planned that a methodology for the development of IAS indicator will be prepared. The project also focuses on the eradication activities. Several localised populations of *Heracleum mantegazzianum* were removed in annual actions of mechanical removal. Success of removal is monitored and removal is repeated if necessary, as the seed bank in the soil is already established. An aim of the project is also to inform traders and customers in the pet industry on the IAS issues. Courses will be provided for pet traders and information leaflets will be prepared for their customers. This part of the project also includes preparation of Slovenian code of conduct on pets and invasive alien species based on the European Code of conduct on pets and invasive alien species prepared under the Bern convention. Focus is also put toward inclusion of the IAS issues in the curriculum of primary schools. A travelling exhibition on IAS was prepared and a handbook for teachers on how to introduce the IAS issue to primary school children, including guidance for safe and educational outdoor activities. The project also foresees a symposium on IAS to be organised in the autumn of 2013.

There are some other ongoing smaller projects such as the Amc promo BID (2012). The aim of this project is to involve honey producers in the prevention of biodiversity loss through research of the influences of IAS on native bee *Apis mellifera carnica*. This is a bilateral project as partners come from Slovenia and Austria. Besides activities in the field (monitoring of IAS, eradication practices), several workshops were organised where IAS issues were introduced to participants, followed by the exchange of ideas. Among others, it was discussed how the use of meliferus invasive plants could be replaced by the use of native meliferus plants or by introducing different agriculture practices (for example growing of buckwheat in autumn) and how selected interest groups such as bee keepers could contribute towards the prevention of introduction and spread of IAS.

In 2009 the Ministry of the environment and spatial planning prepared a conference "Invasive alien species – what measures should we take?". The aim of the conference was to present the threats caused by IAS, with the emphasis on animal species that have been introduced as escaped or released pets, and plants that escaped from gardens and ponds. The discussion was oriented toward establishment of measures for addressing threats posed by those species. The Code of conduct on horticulture and IAS developed by the Bern Convention was introduced as one of the possible mechanisms and the possibility of developing a national Code of conduct was discussed. Regrettably, no further actions were taken later regarding this issue. For this occasion, the Code of conduct on horticulture and invasive alien plants has been translated in Slovene (MKO 2012a).

A pilot workshop was organised for municipality workers dealing with management of green areas in the Ljubljana municipality. During the workshop, introduction on IAS issues was given with the

emphasis on several common IAS plants. The need to be aware of the IAS characteristics and consequently adjustment of their management to prevent further spread of IAS was stressed during the workshop. Possible management options were discussed and compared to experiences from the participants. Since the workshop, the municipality of Ljubljana has been dealing with IAS regularly. It regularly informs its citizens on IAS issues, especially on their obligation to remove ragweed. It organised removal activities for selected IAS plants, where the citizens can recognise the plants and learn about them. They have also financed several monitoring projects within the municipality.

At the webpage of the Ministry responsible for the environment, a dedicated page on IAS has been established since 2009, with general information on IAS and more detailed information on several species. Contacts to relevant institutions are provided, as well as the advice on how an individual can contribute to the prevention of introduction and spreading of IAS. The webpage also provides links to recent publications and contains information on events in connection to IAS (MKO 2012b).

When the legislation on *Ambrosia* species was adopted, special attention was given to raising awareness. Leaflets for the recognition of species were provided; legal obligations explained, as well as contact information on relevant institutions was provided (FURS 2012). Articles were published in several publications, including the ones for municipalities and those for the general public (Knapič and Skoberne 2010).

Guidance was also developed for the incorporation of IAS issues in the management plans of protected areas, based on the results of a questionnaire filled out by management personnel in protected areas (Kus Veenvliet and Humar 2011).

The Biology Students' Society of Slovenia has also contributed to raising awareness on IAS with ongoing projects for biology students, linked with eradication activities for several plant species (*Rudbeckia laciniata, Fallopia* spp. and others) in the vicinity of the Faculty. Some other eradication projects for different plant IAS were organised on local scales.

Invasive alien species were the main theme of the competition in biology for the Proteus prize, organised for highschool children by the Slovenian popular scientific journal "Proteus" in the school year 2008/2009.

Slovenian national television has prepared several documentary broadcasts on invasive alien plants, IAS have been presented in several other broadcasts, including daily news, and there is also an increased coverage of IAS related topics in other media.

Research

Up until the year 2011 only a few research projects addressed IAS. Data about presence and establishment of species were only collected for selected higher plant species, fish species and crayfish species. Moreover, data for those groups were not collected with the aim of gathering data for alien species in particular, but were gathered in general for the inventories of species. General inventories of species contributed also to gathering information on alien species in other taxa. However, no comprehensive list of alien species was prepared until 2012. This resulted in deficient data that was included in the European and other projects dealing with IAS, such as DAISIE and others. These deficiencies continue to persist in further analyses that draw from these sources.

In order to gain a preliminary list of alien species and consequently IAS present in Slovenia, two projects were conducted. The first project **Neobiota of Slovenia: Invasive alien species and their impact on biodiversity and sustainable use of resources in Slovenia** (Neobiota 2012) produced a list of alien species (neobiota) that were recorded in Slovenia. For each alien species the following was determined, or if data was not available, evaluated based on the knowledge of scientists responsible for certain taxonomic group: origin, presence in adjacent countries (based on DAISIE), level of naturalisation (the value from 1-5 was given to each species based on them being from ephemeral (1) to naturalised (4) or invasive (5)),

prevalence (the value from 1-5 was given to each species based on them being recorded from individual specimen (1) to widespread (5)), trend, reliability of evaluation and for IAS also dissemination in four biogeographical regions in Slovenia, specific habitats that are endangered by this species (for example: marine habitats, riparian habitats, forest etc.), altitude interval of spread and also pathways and vectors of spread.

According to the above mentioned project, there are more than 800 alien species that were recorded in Slovenia. For some species it is evident that they are only ephemeral, but most of the species have established viable populations. The overview was done only for the following taxa, for which a different number of alien species was recorded: Fungi (245), Algae (3), Tracheophyta (342), Annelida (2), Cnidaria (1), Ctenophora (2), Mollusca (18) Crustacea (5), Aranea (7), Coleoptera (68), Diptera (19), Heteroptera (3), Hymenoptera (12), Lepidoptera (34), Pisces (20), Aves (49), and Mammalia (15). Some of the taxa include only marine species. For some taxonomic groups there were no specific scientist involved in the project, but alien species were recognised in general literature and they were also included in the report: Nematoda (6), Blattoptera (2), Thysanoptera (7), Homoptera (57), and Reptilia (3). The lists of alien species from different taxa are available on the webpage of the project which includes also the names of researchers involved in the review of the selected taxa.

IAS were selected according to the estimated level of naturalisation of alien species. In the project the definition of IAS that is recognised by the CBD (An alien species whose introduction and/or spread threaten biological diversity) was used. More than 120 of analysed species were evaluated as invasive (approximately 60 of them belonging to fungi, 30 to plants and 30 to animal species), and in addition more than 110 were evaluated as naturalised (approximately 5 of them belonging to fungi, 70 to plants and 35 to animal species). The final list of alien species, including the above mentioned invasiveness characteristics is still in preparation and will be available, together with the report on the webpage of the project.

A protocol for risk assessment was also developed in the project, based on a modified German–Austrian Black List Information System (GABLIS) (Essel et al. 2011). Beside some minor adjustments of the GABLIS protocol, the newly developed protocol allows additionally for the basic analysis of the socio-economic impact of species.

This was the first project that provided an overview of alien species of selected taxonomic groups. As a result, several articles were published (Jaklič and Vrezec 2011; Lipej et al. 2012; Vrezec et al. 2012) or are in preparation.

The second project: **Invasive alien plant species in Slovenia and their influence on biodiversity preservation and sustainable use of sources** (Kmetijski inštitut Slovenije 2012) was linked to alien species in agricultural environments and management of several selected invasive species. A list of IAS found in natural as well as in agricultural environments was prepared. From this list several taxa, for which shortened risk analysis was performed based on EPPO standards ((ISPM N° 11, PM 5/3 (5), 11-17053), and methodologies from other internationally recognised organisations were selected. The analysis considered ecology, economy and human health aspects. The risk analysis was performed for alien species from the genera *Ambrosia* (for 8 species), *Solanum* (for 5 species), *Heracleum* (for 3 species) and *Cyperus* (for 4 species). It has been evaluated that the probability for introduction is high for most of the analysed species especially as there are no foreseen preventive measures against the unintentional introductions. In *Heracleum* species the probability for introduction is moderate, but some isolated populations of *H. mantegazzianum* already exist. The probability for the establishment of introduced species varies however. In the genus *Ambrosia,* the species *A. psylostachia* and *A. trifida* were evaluated as the ones that have the highest probability for establishment of viable populations beside the already present *A. artemisiifolia*. In the genus *Solanum* those would be the species *S. carolinense* and *S. triflorum,* while in the genus *Cyperus,* the species *C. esculentus* has already some isolated populations.

However, the probability of establishment of these species varies among different geographical regions in Slovenia. Field studies were also performed for several IAS species with the main focus on ragweed and the competitiveness of this species with other plants was studied.

Some other small research projects are ongoing. Unfortunately, no research partners from Slovenia participated in any large EU research projects or prepared large research projects linked particularly to IAS, which would be financed by the EU financial mechanisms or funds.

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