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Invasive alien plant species in Finnish garden related businesses

A case study and survey

Martina Annette Hildén

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Author: Martina Annette Hildén
Degree Programme: Master of Natural Resources, Raseborg
Specialization: Natural Resource Management
Supervisor(s): Patrik Byholm, Jonna Engström-Öst, Eeva-Maria Tuhkanen

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Abstract

Throughout history many plant species have been introduced into new ecosystems. Some of these species have started to spread and with time become invasive, threatening the habitats of native species. Over all, invasive species are one of the main reasons for the current biodiversity loss. Most alien plant species are horticultural introductions and every year new species are introduced while already established ones are spreading into new areas. Although major steps in preventing alien species from spreading have been made, many of these, already labeled as invasive species, are still being utilised by different businesses in branches related to horticulture.

To find out why this is occurring, this thesis produced a case study and an online survey including people working in these businesses. The studies included questions about plant knowledge as well as the usage of invasive species. The studies showed that many invasive alien species are still being actively used by garden related businesses. Most obvious reasons were the lack of education, resources and cohesive regulation guidelines. Increased information and tools are needed for the management of invasive alien species.

Language: EN Key words: invasive alien species, plants, garden, landscaping, horticulture

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EXAMENSARBETE

Författare: Martina Annette Hildén
Utbildning och ort: Master of Natural Resources, Raseborg
Inriktningsalternativ/Fördjupning: Natural Resource Management
Handledare: Patrik Byholm, Jonna Engström-Öst, Eeva-Maria Tuhkanen

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Abstrakt

Genom tiderna har främmande växtarter avsiktligt samt oavsiktligt importerats till nya områden för användning inom jordbruk, trädgårdar eller skogsbruk. I gynnsamma förhållanden kan vissa av dessa arter föröka sig och sprida sig i omgivningen, vilket kan hota de vilt förekommande arternas existens. Dessa främmande växtarter är en av de främsta orsakerna till minskning av biologisk mångfald.

Flera främmande arter importeras som trädgårdsväxter i dekorativt syfte och årligen dyker nya arter upp, samtidigt som redan förvildade arter sprider sig till nya områden. Även om man kontinuerligt försöker hämma spridningen av dessa arter förekommer vissa ännu i trädgårdshandeln eller används inom landskaps- och trädgårdsplanering.

Syftet med detta examensarbete är att svara på varför vissa främmande arter ännu används och varför de inte bekämpas mer effektivt. Arbetet omfattade en fallstudie samt en enkätundersökning bland yrkesgrupper aktiva inom trädgårdsbranschen och landskapsplanering. Till frågeställningen hörde artkännedom samt frågor angående växtanvändning. I svaren förekom att skadliga främmande arter fortfarande används inom flera branscher, att det finns osäkerhet inom branschfolkets artkännedom samt att bekämpningsmetoderna inte är kända. Det finns ett omfattande behov av mera resurser och utbildningen samt exakta instruktioner för att framgångsrikt kunna bekämpa främmande växtarter.

Språk: ENG Nyckelord: främmande växtarter, trädgård, landskapsplanering

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OPINNÄYTETYÖ

Tekijä: Martina Annette Hildén
Koulutus ja paikkakunta: Master of Natural Resources, Raasepori
Suuntautumisvaihtoehto/Syventävät opinnot: Natural Resource Management
Ohjaaja(t): Patrik Byholm, Jonna Engström-Öst, Eeva-Maria Tuhkanen

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Tiivistelmä

Kasvilajeja on sekä tahallisesti että tahattomasti tuotu uusille alueille sekä otettu käyttöön muu muassa viljelmillä, puutarhoissa ja metsätaloudessa. Jotkut näistä lajista kykenevät lisääntymään ja leviämään uhaten luonnonvaraisten kasvien elintilaa. Nämä haitalliset vieraslajit ovat yksi suurimpia syitä luonnon monimuotoisuuden katoamiselle.

Useimmat vieraslajit tuodaan maahan koristekasveiksi puutarhoihin. Uusia lajeja ilmestyy vuosittain, samalla kun monet jo haitalliset lajit leviävät edelleen. Vaikka haitallisten vieraslajien leviämistä on yritetty torjua monin keinoin, monia niistä käytetään sekä myydään edelleen eri puutarha -aloilla tai käytetään maisemasuunnittelussa.

Tämä opinnäytetyö on etsinyt vastauksia sille, miksi näitä kasveja edelleen on käytössä sekä miksi niitä ei torjuta. Työ sisälsi tapaustutkimuksen ja kyselyn eri puutarha alan yrityksissä työskentelevin keskuudessa. Kysymyksiin kuului sekä kasviosaamista että kasvinkäyttöön liittyvää. Vastauksissa ilmeni, että vieraslajeja käytetään edelleen monella alalla, lajeja ei tunneta tarpeeksi hyvin eikä keinoja niiden torjuntaan osata. Koulutukselle, lisäresursseille sekä selkeille ohjesäännöille olisi suuri tarve.

Kieli: ENG Avainsanat: vieraslajit, kasvit, puutarha, maisemasuunnittelu

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1 Introduction

The natural occurrence of certain plants has been massively influenced through human actions. Through spreading of seeds, planting trees and shrubs and moving soil, human actions have given species the opportunity to move to locations that previously were out of their reach. (Weber 2013, 11; Lockwood, Hoopes & Marchetti 2013, 17). In the future there will be few ecosystems that are not influenced by invasive alien species in any way. The interaction between threats associated with invasive species and other environmental pressures will become more complex. (Richardson 2011, 400).

1.1 Background

The introduction of a plant species into new habitats has been happening throughout history (Lehtiniemi, Nummi & Leppäkoski 2016, 25), but reached new levels in the 15th century when the Europeans discovered the American continent. This gave start to a more intense and faster exchange of species. Plant species introduced before 1500 are known as *Archaeophytes,* i.e., plants introduced post 1500 are called *Neophytes*. (Weber 2013, 12). Invasion occurs when a species is transported from its native habitat to a new area where it manages to reproduce and spread (Travlos, et.al. 2016, 82). Of all naturalised alien neophytes in Europe, 50% arrived later than 1899, 25% after 1962 and 10% after 1989. Approximately 6 species that are able to naturalise in the environment arrive annually. (Lambdon, et.al. 2008, 102).

A species can be introduced into a new habitat either unintendedly or intendedly; however, most introductions are assisted by human (Crooks & Suarez 2006, 454; Weber 2013, 11; Lehtiniemi, et.al. 2016, 24). Unintended or accidental introductions often occur as a cause of various human economic activities (Hellmann, Byers, Bierwagen & Dukes 2008, 537).

These species travel along with packaging material and luggage, human clothing, shoe-bottoms or other means of transportation (Lockwood, et.al. 2013, 17; Weber 2013, 11). After being introduced, the species typically reach new regions via human aided soil movement or different other activities (Hellman, et.al. 2008, 537; Lehtiniemi, et.al. 2016, 24).

Human actions do not only make it easier for invasive species to get introduced and distributed, but also shape mechanisms which are driving the invasion (Theorides & Dukes 2007, 260; Kueffer 2017, 724). Species are purposefully introduced for a variety of reasons including biological control, horticulture or agriculture. Such plants are for example decorative garden plants, plants for aquaria or fishery, fodder plants, forestry grown plants or other utility plants. (Crooks & Suarez 2006, 455; Hellman, et.al. 2008, 537; Weber 2013, 11; Lehtiniemi, et.al. 2016, 24). More than 50% of the alien plant species originally were introduced for ornamental usage or horticulture, which is the most common pathway of species to get introduced into new areas. (Lambdon, et.al. 2008, 102; The European Network on Invasive Alien Species NOBANIS 2018a). For example, 75% of the species which are included on the list of harmful invasive alien species in Switzerland were originally imported as utility plants (Wittenberg, et.al. 2006, 19). In Europe, a majority of the invasive species (62%) have been intentionally introduced. Most of these species appear as naturalised in industrial areas while almost 60% grow on arable land, in parks and in gardens. (Lambdon, et.al. 2008, 102). Habitats that have been disturbed by human activities are typical spreading areas for alien species (Heikkinen, Pöyry, Fronzek & Leikola 2012, 78). Usually harsh environments that are cold, shady, dry and nutrient poor have been left intact from invading species. However, increased human land use activities have also changed these marginal areas and left them vulnerable for alien plant intrusions. (Kueffer 2017, 725).

Biological invasion is a process which occur over a longer time period and includes different stages: transport and introduction, colonialization and establishment and finally, naturalization and a fast spread outside the normal succession area (Theorides & Dukes 2007, 258; Lorenzo, Hussain & Gonzalez 2013, 4). All introduced species do not establish and become invasive. To successfully arrive in the recipient ecosystem the species must overcome geographical barriers and challenges during transportation. After arrival, surviving in the new recipient area acquires matching environmental conditions. (Crooks & Suarez 2006, 456; Hellmann, et.al. 2008, 536). The species must be able to find life

important resources, tolerate natural enemies and possibly form mutualistic relationships with other species. The species that are more successful in these stages usually have a stronger impact on their surroundings. (Hellmann, et.al. 2008, 536).

Most alien species come from 213 different families that are dominated by large global families with weedy traits (Lambdon, et.al. 2008, 102). Besides the species weedy tendency and ability to adapt in the new area there are other traits that make some plant species become invasive. The ability to reproduce in the new habitat is critical; in addition to growing quickly from the germination stage to reproductive stage, as well as successful pollination, are essential factors affecting the adaption. (Theorides & Dukes 2007, 260; Lorenzo, et.al. 2013, 4-5). Other typical traits are high growth with large leaves, a long lasting and early flowering time, as well as spreading through vegetative reproduction (Theorides & Dukes 2007, 262; Heikkinen, et.al. 2012, 78). Some invasive alien species release allelochemicals into the recipient area. The effects of allelochemicals are numerous, including manipulation of the nutrient cycle in the soil or interference on the photosynthesis of the native species. This ability seems to play an important role in the invading process and help the alien species dominate in the new ecosystem. (Lorenzo, et.al. 2013, 8, 12-13).

Depending on how long time has passed since the first introduction of a species, the more likely it is to start spreading and become invasive (Heikkinen, et.al. 2012, 78). After being introduced into a new ecosystem the speed at which an alien species distributes is depending on certain key factors, including productivity, mortality, range of distribution and the complexity of the new habitat (Hui & Richardson 2017, 21). The success of an alien species often is dependent on the absence of natural enemies, competition, herbivores and parasites in the recipient area (Heikkinen, et.al. 2012, 77). The spread of a species might not occur immediately since a population often go through a dormant phase that can last for several years. Changes inside the recipient environment can suddenly alter the spread after which it accelerates until all available habitats are occupied. (Hui & Richardson 2017, 21). In New Zealand, dormant phases have lasted from 20 to 30 years, while for some species it has taken more than 40 years to start spreading (Hui & Richardson 2017, 35).

By causing fragmentation of habitats and changes to the ecosystem the invasion of alien species is one of the main reasons for the current biodiversity loss (Lorenzo, et.al. 2013, 15; Weber 2013, 15). Once an alien species has reached an invasive status, it may cause severe damages to the recipient ecosystem, agriculture, landscapes and even infrastructure (Lehtiniemi, et.al. 2016, 12). Damages include changes in the biodiversity which directly reflects on the insect and animal diversity. Secondly, some species promote soil erosion or increase the level of nitrogen in the soil, which can endanger the survival of native species. (Weber 2013, 15, 16). Invasive species, can, in some cases hybridise with native species often to the disadvantage of the natives. This can with time lead to the loss of native species and subsequently to loss of ecosystem services. (Lockwood, et.al. 2013, 18). If the percentage of the intruding species becomes dominant, it can cause a decline of native species populations and in some cases even local extinction (National Research Council U.S 2002, 100; Thiele & Otte 2007, 149).

The need for management and prevention of invasive alien species leads to high economical costs which in the end may have socio-economic consequences (European Environment Agency EEA 2012, 6, 15; Ludwig, M., Gebhardt, H., Ludwig, H.W. & Schmidt-Fischer, S. 2000, 22, 23). Although the harm caused by many species remains unknown, the total cost of invasive alien species management in Europe is estimated to be approximately 10-12.5 billion € per year (Kettunen, et.al. 2008, 1; Heikkinen, et.al. 2012, 77; EEA 2012, 6).

A typical example of an invasive alien species that have had a major impact on its recipient environment, and human health, is the giant hogweed *Heracleum mantegazzianum*. The species is native to the Caucasus region and was introduced to Europe in the beginning of the 19th century. (DAISIE 2006; Lehtiniemi, et.al. 2016, 44). The plant can grow 3-5 m in height, with a thick stalk. The leaves can grow up to 1 -meter. In addition to its enormous growth, it also produces phototoxic sap, which if in contact with human skin, can cause severe burns. (DAISIE 2006; Lauber & Wagner 2012, 990; NatureGate 2018a). In sites where *H. mantegazzianum* spreads, it tends to introduce a new tall vegetation layer over the existing lower herb level. This leads to shading, and as the layer of *Heracleum* grows thicker, the lower herb level will decrease in percentage. Therefore, a high percentage of *H. mantegazzianum* can cause major damages to the native flora. (Thiele & Otte 2007, 146).

Considering the species that are alien to Europe, about 46% originally came from North or South America, and another 46% from Asia. However, most invasive alien species in European countries originate from the European continent. (Lambdon, et.al. 2008, 102). Some species that are listed as harmful and invasive in Finland, are native to other parts of Europe, e.g., *Sambucus racemosa* (Lauber & Wagner 2012, 1000). In Europe, biological invasion has a particularly long history in the Mediterranean region (Travlos, et.al. 2016, 82). However, the most invasive alien plant species have been reported in Belgium, the United Kingdom and the Czech Republic (Lambdon, et.al. 2008, 102). Statistics of alien species according to habitat distribution show the highest amount of invasive alien species in areas which are disturbed by human actions. In Finland, 38 invasive alien species and 19 potentially invasive alien species have been reported in these areas. (NOBANIS 2018b). The habitat with second most invasive alien species intrusions are wetlands, followed by urban areas. The statistics also state that the majority of invasive species to Finland are due to horticultural introductions. This group peaks the statistics with 48 invasive alien species, and 53 potentially invasive alien species introduced. The following largest groups are species introduced by agriculture and various transportation pathways. (NOBANIS 2018a).

The future threats include the discussion about climate change and increased globalisation. These changes will affect the environment indirectly through new pests, pathogens, and invasive plant species (Travlos, et.al. 2016, 85). Climate change might with time change the patterns of human transportation which also would lead to new ways for species to spread (Hellmann, et.al. 2008, 537). Over all, the increased movement of people and transportation within Europe will increase the threats of species spreading (Heikkinen, et.al. 2012, 77).

Climate change impacts the distribution of species and alters competitive interactions between species in ecosystems around the globe. The increasing level of CO_2 in the atmosphere is affecting the climate and causing problems for species which rely on a stable environment. (Dukes 2010, 346-347). Invasive species are more likely to tolerate a wider range of temperatures than native ones (Dukes 2010, 350). Climate change is also likely to affect some species by boosting their competitive ability, altering their dispersal range and by causing changes in the plant composition in the environment (Travlos, et.al. 2016, 85). As a consequence of climate change, some species will become more invasive, whereas

some will become less invasive. Some native species will also change their area of distribution. (Hellmann, et.al. 2008, 535).

By studying global and intercontinental maps of climate development Heikkinen et al. (2013, 35) have come to conclusions about how the future climate in Finland will affect the distribution of invasive alien species. According to estimations the climate in southern Finland will remind of the climate in the Baltic countries and Denmark in the coming decades. In the archipelago, there might be areas where the climate will remind of the climate in Belgium and Germany. As a result, there might be totally new species arriving while others, already introduced species, might start invading new ecosystems.

1.2 Current alien species legislation and strategies

In Europe, there have been considerable improvements concerning risk assessment of biological invasions (Pyšek & Hulme 2011, 84), but according to the European environmental agency (EEA) (2012, 6) the problems caused by invasive alien species have been underestimated, and so far, there has been a lack of common European legislation. However, the issue is increasingly attracting attention and from 1. January 2015 the European Parliament put into effect the *Regulation on the prevention and management of the introduction and spread of invasive alien species* (1143/2014). Additionally, the EEA has invested a higher amount of resources to include the problems caused by invasive alien species in other EU initiatives. The common cause is to halt the loss of European biodiversity. There is work being done to create an early warning system for invasive alien species which would make it easier to recognise new threats. (EEA 2012, 9).

The threat from invasive alien species was already acknowledged in the *Finnish Nature Conservation Act* (1096/1996) from 20 December 1996, where it is stated that the spread of non-native species, without an established range in the Finnish wild, are not to be planted or sown outside a garden, field or other site distinguished for special purposes.

More recently, as complementary to the EU regulations (1143/2014) the Finnish Ministry of Agriculture and Forestry applied the *Act on Managing the Risk Caused by Alien Species* (1709/2015), which was valid from January 2016 onwards. According to the act, it concerns plants that nationally cause damages to the biodiversity, human health or native ecology (§11).

Additionally, in the *National Strategy on Invasive Alien Species* from 2012, the Ministry of Forestry and Agriculture (MMM) presents a strategy on how to deal with invasive alien species. The species are divided into categories of damaging and potentially damaging for the environment. In the table found as appendix (appendix 1), the current list of harmful invasive plant species in Finland is displayed next to the ones that are prohibited to distribute or sell inside the EU according to the updated list of Invasive species of union concern, published by the European Commission (EC), 2017. The list of invasive species is updated continuously. For example, on 20 June 2017 the EU Member States agreed on adding six terrestrial and three aquatic plant species to the list of plants which are forbidden to distribute inside the EU (MMM 2017). The list is easy to follow up by using updated alien species websites, such as the Finnish *www.vieraslajit.fi* (Finnish Museum of Natural History LUOMUS 2018a).

While writing this thesis, (13. March 2018), the Finnish Ministry of Agriculture and Forestry has passed the first official management plan for preventing invasive alien species. The management plan is based on the EU regulation 1143/2014. Currently, the regulations include 49 different species, which are prohibited to intentionally distribute inside the EU. For the 12 species added to the list in 2017, management plans are being made this year. (MMM 2018, 2-3).

By passing the management plan from 13 March, priorities and standards are set for which species should be removed. One example is the giant hogweed *H. mantegazzianum*. The management plan states that the species should first be removed from settlement and nature protection areas. Invasive alien ornamental plants are prohibited to bring into the country and their access to nature areas should be prevented. (MMM 2018, 3). According to the Finnish law on invasive alien species 1709/2015 these precautions and measures are

controlled by the Finnish centres for economic development, transport and the environment. The Finnish customs is responsible for controlling which species enter the country. (§7).

The Ministry of Forestry and Agriculture instructs and publishes guidelines for the public and companies on how to deal with alien species. An article from 2014 specifically mentions that garden businesses should stop using species that can spread into the environment (MMM 2014). Additionally, the Finnish transport agency has published their own guidelines on management of invasive alien species (Soosalu & Karhunen 2017). The guidelines state how to decide on responsibility and cooperation between different stakeholders. The management can be done in cooperation between the landowner and the city responsible. In some cities private landowners can separately make an agreement with the city care taking sector on removal and management of invasive alien species.

There are several different projects and websites on a national and international level working on spreading information about invasive alien species and providing ways for the public and experts to get involved. In Finland, there is the previously named *www.vieraslajit.fi* internet site which is maintained by the Finnish Museum of Natural History (LUOMUS) in cooperation with other organisations, including the Finnish Natural Resource Institute Luke. (LUOMUS 2018a). On an international level there is additional information provided by The European Network on Invasive Alien Species NOBANIS (2017) and DAISIE – Delivering Alien Invasive Species Inventories for Europe (2017).

The DAISIE programme and website is developed with the support from the European Commission (EC) and has published a list of the 100 most invasive species in Europe (DAISIE 2018). The list contains animal and plant species. Some of these species, for example *Rosa rugosa, H. mantegazzianum, Impatiens glandulifera* and *Fallopia japonica* are already established invasive alien plant species in Finland (DAISIE 2018; Mossberg & Stenberg 2003; LUOMUS 2018b).

1.3 Aim of the work

Although the impacts related to invasive alien species can cause serious damage on economy, human health and the ecosystem, only 2% of Europeans feel that invasion ecology is seriously threatening the biodiversity. There would be a need for building awareness and involve the public in finding alternatives and solutions. (Pyšek & Hulme 2011, 85).

The main goal of this study was to find out how well people working with plants know the invasive alien species in Finland and how commonly these species still might be sold or used in different projects. Secondly, the research aimed to find out if there is a lack of information about invasive alien species and the management methods. As an example, do the workers use the existing tools that are available for obtaining information about the theme, or do the different companies inform the customers about the species that are used? My aim was also to find out if there are any tools the workers might need to tackle challenges that invasive alien species might cause in their work. Third, this thesis also aimed to increase the awareness and function as a reminder about existing invasive alien species and give people the chance to get involved.

The reason this topic was chosen is due to my personal concern that the different businesses working with garden plants are not taking enough responsibility in preventing harmful alien species from spreading into the environment. The concern is based on observations of garden building companies planting harmful alien species, invasive alien species growing in public green areas and observations of some plant species being sold in garden retail (see figure 1 and 2). The different species used as example in the research was selected based on their occurrence on the list of invasive alien species included in the National Strategy on Invasive Alien Species, published by the Finnish Ministry of Forestry and Agriculture in 2012. The research is focused on terrestrial plant species.

Another concern is combined with the prognosis of climate change. A report by Heikkinen et al. (2012, 76) concludes that several alien species that have been established in other parts of Europe may have the potential to spread further north as a response to climate warming. A corner stone in the report is the comparison of regions in Europe and other parts of the world with climate similar to Finland, predicting which species might arrive in the future.

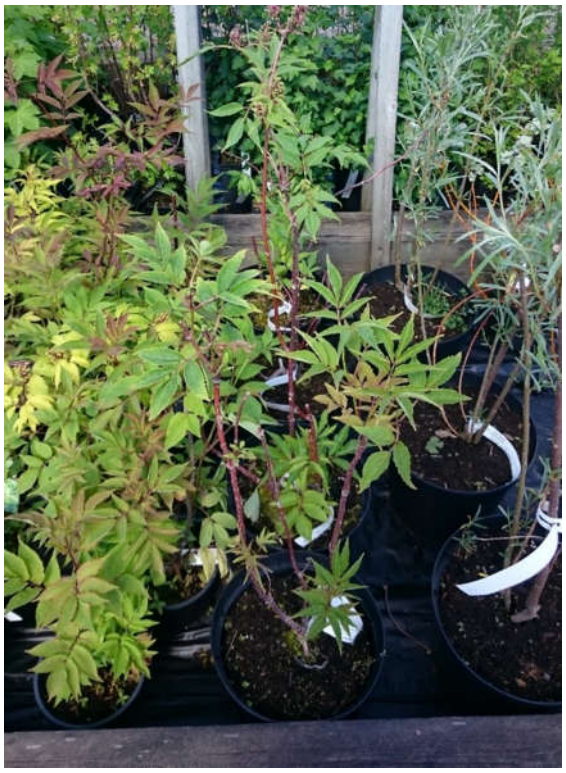

Figure 1. Invasive alien species *Sambucus racemosa* found among the plants sold in a garden retail market. (Hildén 2017)

This thesis gives a picture of the current situation in the use of alien species. By raising awareness, it can help maintaining biodiversity inside gardens and settlement surroundings. It can also help develop the management tools simultaneously reducing the need for prevention work. Additionally, to the studies this thesis presents, I have the following hypotheses (H0):

1. People working in branches that use or grow plants do not have enough knowledge about invasive alien species.
2. There are neither enough resources available for practical removal of invasive alien species, nor is it a priority in the garden related branches.

3. Invasive alien species are being sold, planted and used by most businesses related to the garden sector.
4. Available tools, such as internet information sites, are not being fully used or recognized.

Figure 2. This river, *Kvarnby å*, in Kirkkonummi is bursting with the invasive alien species *Impatiens glandulifera.* (Hildén 2017)

2 Methods

In this thesis, there was two studies done. The first one was a case study which purpose was to uncover the current alien species situation in garden retail, garden construction and plant nurseries. The second study included an online survey which questions were based on conclusions made during the case study and the literature study.

The results from the studies have mainly been projected in a quantitative manner which requires that the results can be displayed in numbers (Andersen 1994, 70, 73; Hirsijärvi, Remes & Sajavaara 2009, 140). Additionally, open questions gave the responders a possibility to comment and add personal ideas to the replies. The open replies have been summarised and analysed according to the mentioned themes.

In both parts of the research, a pilot study (Hirsijärvi, et.al. 2009, 204; Taylor 2010, 53), which aims to find the weaknesses in used methods and material, was made. According to the pilot studies, the methods were improved.

2.1 The case study

A case study is research referring to a smaller group that relate to each other. The material in a case study can be gathered by using different methods. (Hirsijärvi, et.al. 2009, 134, 135). In my case, it was conducted through observations and interviews.

The goal was to find out if there was any invasive alien species in the selection of species, as well as how well employees and customers were informed about the usage of invasive species. The study took place during April and June 2017. In the case study, eleven

companies active in garden related businesses in Finland, were visited. In the first stage of this method the company's selection of plants were observed. The observation also included looking for signs, posters or other displayed information about invasive alien species.

The observations were followed by a short interview with one member of the staff or the manager of the company. The questions used in the interview were as simple and structured as possible (see appendix 2), mainly giving the possibility to answer Yes or No but still allowing discussion when needed. Interview guidelines were applied according to Andersen, ed. (1994, 80, 82, 83).

2.2 The survey

The information collected during the case study was used to form the questions in the following online survey which took place in the beginning of October 2017. The survey (see appendix 3) was a way to gather information on a broader scale. Different people working in companies, including garden construction and planning companies, plant nurseries, garden retail shops and landscape architects were invited per e-mail to participate in the survey. The goal was to find out how frequently certain harmful invasive alien species are being used or sold. The survey also included a plant identification test which aimed to find out how well the target group recognised a selected group of invasive alien species. The original questions were written in Swedish and Finnish.

For preparing the survey, guidelines by Andersen, ed. (1994, 87); Hirsijärvi et al. (2009, 199-208) and Taylor, ed. (2010, 53) were used. To obtain as exact replies as possible the survey strived to be as standardised and structured as possible, giving the respondents very little freedom, as described by Hirsijärvi et al. (2009, 134).

For creating the survey, the programme Webropol was used. See *www.webropol.fi* for detailed information about the program. All e- mail addresses receiving the link to the survey were found by using internet search engines. Search words like “landscape architect”, “garden constructor” and “plant nurseries” where used. The survey was also sent to people in public duty, such as city gardeners.

Out of 620 e-mails sent, 102 were sent to people working in the field of landscape architecture while 344 were addressed to people working in garden planning and construction as well as garden maintenance. The remaining 174 surveys were sent to people working in plant nurseries and plant production (71) as well as garden retail (103).

The survey was opened on 3 October 2017. Additionally, a reminder of the survey was sent out on 26 October. The survey was closed on 3 November, after being open for one month. The results are displayed in figures and tables. Some of the questions are statistically analysed. The open answers have been sorted and condensed according to themes.

2.3 Statistical analysis

Some of the results have been statistically analysed by using a Chi-square (χ^2) test of unequal frequencies, which is used to see if there is a relation between two categorical variables. The analysis compares the results with the null hypothesis (H_0), which describes the theoretical average value of the responses. If there is no relation the frequency will be equally divided between the groups of responders and the H_0 is true. When the results show divergence the H_0 is rejected. (Ranta, Rita & Kouki 1999, 107-108, 136-138).

The results from the χ^2-test gives a level of significance which is described by probability-values (p_r) (Ranta, et.al. 1999, 111-113). The test answers are analysed in fixed categories as following:

$p_r > 0.05$ = Not significant

$0.01 < p_r < 0.05$ = significant trend

$0.001 < p_r < 0.01$ = significant

$p_r < 0.001$ = High significance

A lower p_r-value and a high χ^2-value shows that the H_0 is discarded and that the result is of statistical significance (Ranta, et.al. 1999, 111-112, 138). The degree of freedom (df) describes how many free observations there is in the collected responses (Ranta, et.al. 1999, 127-128).

Additionally, some results have been analysed with standardised residuals (St. residual) which show the result divergence within one certain question. The St. residual is the difference between the observed and the expected frequency in relation to the expected frequency. The frequencies are statistically significant when the St. residual score is ± 1.96. (Ranta, et.al. 1999, 117).

3 Results

3.1 The case study pilot

The pilot for the case study involved three different companies active in different garden branches. Following observations were made during the pilot:

- There were plants which had no name on display.

- The employees have not received information about how to handle invasive alien plant species, no information for customers was displayed.

- A garden construction company is often bound to build according to a plan made by a landscape architect. Therefore, it is hard for the garden constructor to influence the plant selection.

- People interviewed showed interest in the theme and the *www.vieraslajit.fi* portal was known. Informing customers was also considered important.

Conclusions done following the pilot:

- People who got their education in recent years seem to have more knowledge about invasive alien species.
- Companies have used and are still using or selling some species that are invasive, including: *Rosa rugosa, Sorbaria sorbifolia, Amelanchier spicata* and *Prunus pensylvanica,* which are listed as invasive species in Finland according to LUOMUS, 2018b.
- Media sometimes give misleading information.
- People working in garden related branches do not have enough knowledge about invasive alien species.
- It is not always clear how soil from a building site gets handled or where it ends up, which might cause seeds from an invasive alien species spreading into a new area.
- Some people even prefer to use invasive alien species since they are known to be robust. One example mentioned was *R. rugosa*.
- As a result, a list of questions (appendix 2) were chosen to be used in the case study.

3.2 The case study

The case study found, that 9 out of 11 visited companies had invasive alien species in their selection (table 1), which proves that some invasive species still are commonly sold and used by the garden sector (hypothesis 3). Some of the species detected are included on the list of the 100 most invasive species in Europe published by DAISIE (2018). Note: The plants in the selection might vary according to the season and some plants can be ordered although they are not in the selection at the moment.

Table 1. List of invasive alien species found in the visited companies.

Species	**Number of companies where the species were found**
Rosa rugosa	5
Amelanchier spicata	6
Sorbaria sorbifolia	5
Prunus pensylvanica	7
Sambucus racemosa	1
Malus domestica	1
Alchemilla mollis	3

The following species found in the selection of garden retail companies should also be mentioned:

- *Rhus typhina*. The species is one of the 100 most invasive species in Europe (DAISIE 2018).

- *Buddleja davidii.* This species is invasive in central Europe (Weber 2013, 98).

- *Fallopia japonica* var. compacta. Related species, *Fallopia japonica* (syn. *Reynoutria japonica)* is listed as invasive alien species in Europe (DAISIE 2018).

- *Mahonia aquifolium*. This species is listed as one of the 100 most invasive species in Europe (DAISIE 2018).

- *Pennisetum setaceum* (syn. *Cenchrus setaceus*). This species, which was found in one of the companies, was added to the list of forbidden species in EU starting from 20.06.2017 (MMM 2017).

Other conclusions made following the case study:

- Some companies have stopped selling certain invasive alien species. However, in the same companies, other invasive species are still found in the selection.
- The main reason why some invasive species are found in the selection is due to customers preferences. *A. spicata, S. sorbifolia* and *R. rugosa*, in particular, are very popular.
- Knowledge about invasive alien species was not based on educational background. Also, a high knowledge level of the matter did not seem to influence the selection of plant species used or sold in the company.
- Almost all people interviewed had not received enough information about invasive species during their education.
- In some cases, the managing staff had the impression that his/her employees were informed about invasive alien species. However, there did not seem to be knowledge concerning at what level the employees were informed. In some companies this was due to that some workers only were employed for the season, and did not necessary have a garden related education.
- Only one company was confident that the workers were informed. In the same company none of the species listed as invasive in Finland was found.
- None of the companies had informative signs or posters on display for the customers. Only one company had leaflets concerning invasive alien species on display.
- Responders pointed out that informing customers often is situation dependent and relies on the customer's interests.
- The portal *www.vieraslajit.fi* was partially known. 50% of the persons interviewed had visited the homepage.

Following propositions and thoughts surfaced:

- Information would probably be good but (I) do not have time to read it.
- More sensible discussion and communication would be needed. The vegetation zones in Finland should be taken in consideration in policy making.
- All information should be sent in wintertime. In the shop it is often hectic and you do not have time to consider these issues.
- The leader of the corporative group decides what is being sold in the shop, which makes it hard to influence the plant selection.
- The origin of plants should be clearly stated so that we can choose more carefully when placing orders.
- The responders wished for more reliable information and updates from the Finnish "garden alliance" (Puutarhaliitto) or other reliable sources.
- More clear instructions on how to remove or eliminate the plants should be available.
- Measures to fight the giant hogweed from spreading should be taken.
- Consumers should be more informed, in particularly about removing the plants.
- TV programs and media should take more responsibility.
- More native plants should be used.
- Different plants have different reputation. Some plants like *A. spicata* take up the whole discussion, whereas other species, which also grow invasively, are not mentioned at all. Some species are locally invasive, for example *Rosa rugosa*.
- Different methods for prevention should be taken in consideration. In the case of *I. glandulifera* also cutting would work for preventing the spread. The measures are too area concentrated.
- More resources should be used for hands -on measures rather than for research.

The case study managed to awake awareness and over all the response to the interviews was positive. However, some responders thought it is good, only if the research lead to concrete results and practical measures.

3.3 The online survey

The online survey (appendix 3) got 173 responses which is 27.9% of the original 620 e-mails that were sent. Table 2 shows the response rates for the separate questions.

Table 2. The response rate of the survey displayed in percentage (%). The table displays the response rates of all the separate questions, first compared to the 620 surveys that were sent, then in comparison to the final number of respondents.

Question	**Number of replies**	**% of the 620 surveys sent**	**% of the total 173 survey respondents**
1	172	27.7	99.4
2	173	27.9	100
3	172	27.7	99.4
4	169	27.3	97.7
5	164	26.5	94.8
6	168	27.1	97.1
7	173	27.9	100
8	171	27.6	98.8
9	159	25.6	92
10	172	27.7	99.4
11	170	27.4	98.3
12	173	27.9	100
13	107	17.3	62
14	78	12.6	45
15	48	7.7	27.7

Over 50% of the respondents work in the southern regions of Finland. In figure 3 the responses have been divided according to the six Regional State Administrative Agencies in Finland.

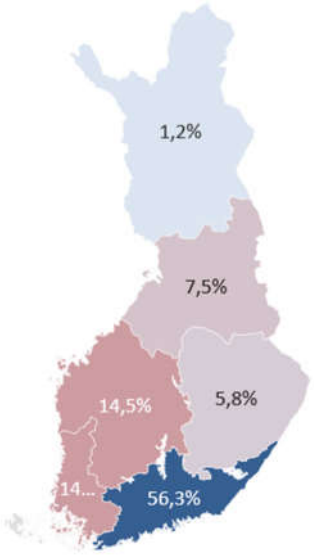

Figure 3. The areal division of the respondents.

The biggest group of respondents were working in garden construction and maintenance (33%) as well as landscape planning (28 %, fig. 4). Over 60% of the responders came from these two groups. The 15% who answered “other” are working in the following fields: city planning, green area maintenance, architecture, land use planning, city technical duties, as city managing gardeners, in flower or iron stores, in teaching, guidance or supervision, green development and administrational tasks, as well as seed production. Some of the respondents were working in more than one field, which may be the reason for them not being able to choose one of the alternatives.

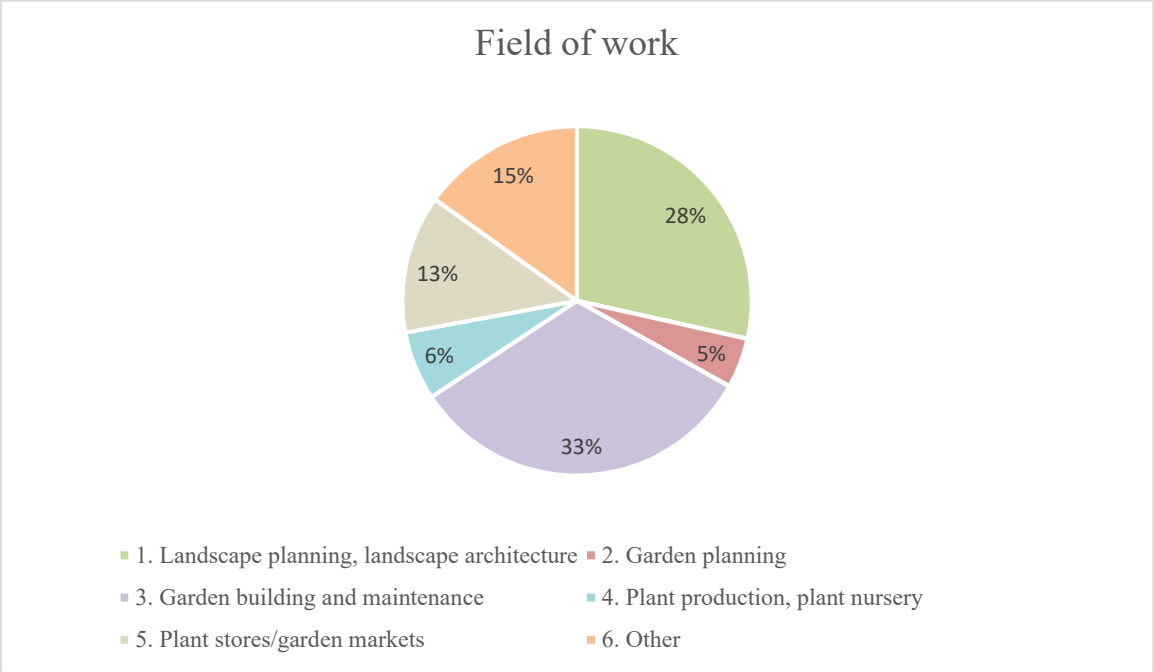

Figure 4. The responders divided according to field of work.

Table 3. Statistics concerning question 9 where respondents were asked to mark the plants that they have planted, sold, grown or used in a plan during their education time, internship or during their working life. The statistics show the replies divided according to field of work concerning the species *R. rugosa.* The responses have been analysed using a Chi square (χ^2) test of unequal frequencies. Since a few observations have a sample size < 5, the statistical result is indicative.

Field of work	**Yes**	**No**
Landscape planning	27 (55%)	22 (45%)
Garden building and maintenance	48 (86%)	8 (14%)
Plant production	9 (82%)	2 (18%)
Plant stores	20 (91%)	2 (9%)
Garden planning	7 (87.5%)	1 (12.5%)
Other	14 (54%)	12 (46%)
Results: $\chi^2 = 22.09$, $p_r = 0.001$, df = 5		

Among all respondents, it was more likely to have used *R. rugosa* (72.7%) than not having done so (27.3%) ($p_r = 0.001$, table 3). Only in the field of landscape planning and among the respondents who answered "other" there was a mentionable amount of No responses (45% and 46%), whereas in the field of garden building it seems very common to have used the species (86% of total 56 responses). This result prove that invasive species still are being sold and used (hypothesis 3).

Table 4. Statistics concerning question 12 where respondents were asked if they inform customers about invasive species. The answers are divided according to field of work. The responses were analysed by using a χ^2-test of unequal frequencies. Additionally, the responses St. residuals were analysed. The frequencies are statistically significant when the St. residual score is ± 1.96. Since a few observations have a sample size < 5, the statistical result is indicative. The responses are categorised with letters according to level of significance. The letters indicate that responses with the same letter do not differ from each other while, for instance, responses marked with "a" differs from "b".

Field of work	**Yes**	**No**	**St. Residual**	
			Yes	**No**
Landscape planning	39 (79.6%)$_b$	10 (20.4%)$_b$	0.9	-1.3
Garden building and maintenance	42 (75%)$_b$	14 (25%)$_b$	0.5	-0.8
Plant production	6 (54.5%)$_{ab}$	5 (45.5%)$_{ab}$	-0.6	0.9
Plant stores	8 (36.4%)$_a$	14 (63.6%)$_a$	-1.9	2.8
Garden planning	6 (66.7%)$_{ab}$	3 (33.3%)$_{ab}$	-0.1	0.1
Other	19 (73%)$_{ab}$	7 (27%)$_{ab}$	0.2	-0.3
Result: $\chi^2 = 15.87$, $p_r = 0.007$, df = 5				

69% of all responders said that they inform customers about invasive alien species whereas 31% ($p_r = 0.007$) does not (table 4). The different planning and the garden building branches are more likely to inform their customers, while plant stores more likely do not inform the customers.

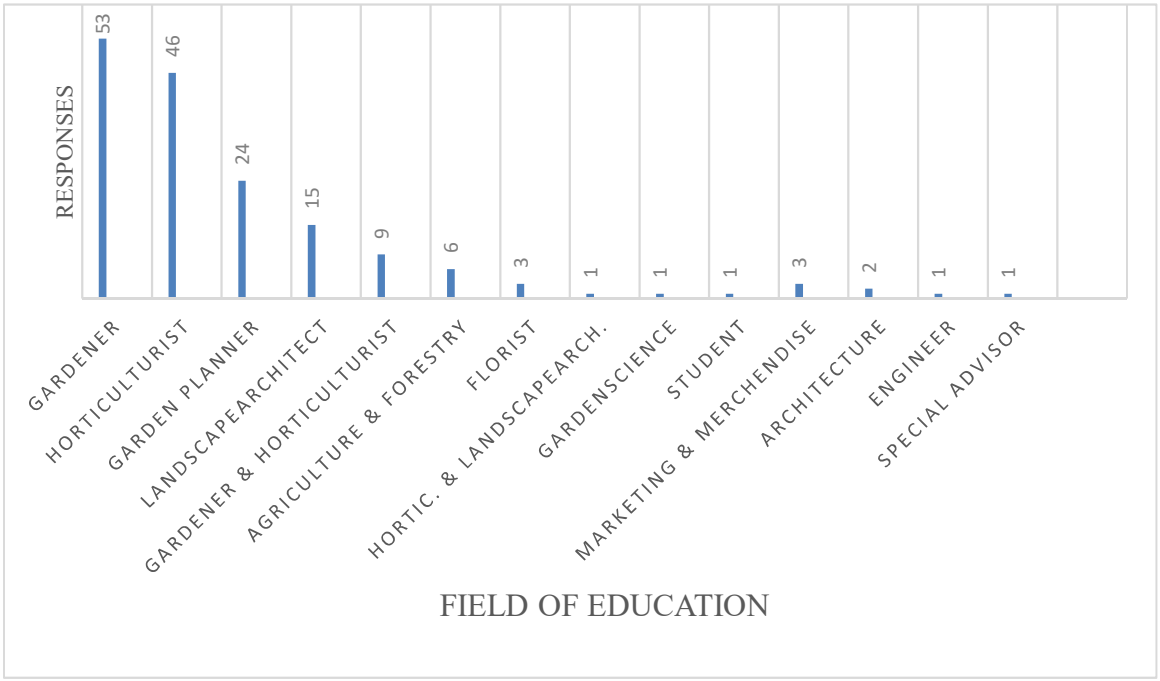

Figure 5. The respondents divided according in which field they got their education.

153 (89%) of all the respondents replied that they have a garden related education (fig. 5), while 19 (11%) of the respondents did not have a garden related education. A majority of the respondents had a horticultural or landscaping related education (83%, fig. 5). There were 72 (42%) responders with a Bachelor in Natural Resources, when including the respondents with a dual education. Table 5 displays how the bachelor degree horticulturists (Bachelor of Natural Resources) replied to some of the questions.

Table 5. The table shows how the horticulturists replied to some of the questions.

Horticulturists (Bachelor degree)	Responses
Was able to name 3 harmful plant species in Finland	72 (100%)
Informs customers about harmful species	58 (80.5%)
Have used *Mahonia aquifolium*	39 (54%)
Identified all species correctly in question number 8 (table 8)	8 (10.52%)

The responses by horticulture graduates with a bachelor degree show that there are some problematic issues concerning plant identification, as only 10.52% of the responders identified correctly all the species in question 8 (see table 5 and 8). However, all responders in this group could name three different harmful invasive alien species in Finland (see figures 7-9).

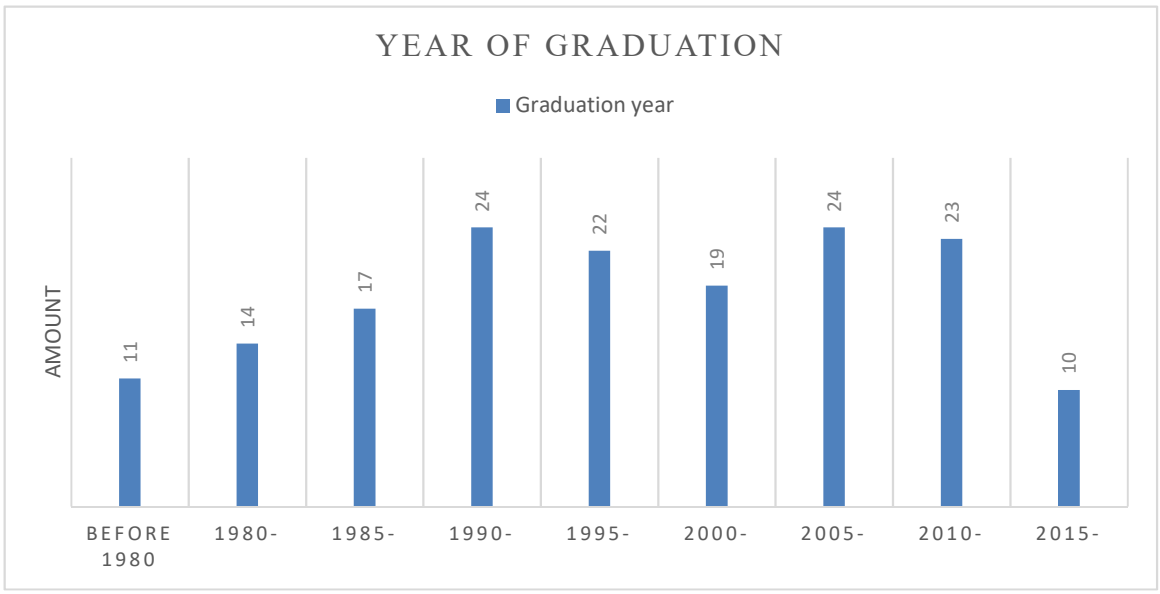

Figure 6. The respondents divided according to year of graduation.

Figure 6 show the years when the respondents graduated. Most responders graduated between 1990 and 2015 (65%). The biggest groups were the ones who graduated 1990-95 (14%) and 2005-10 (14%).

Most respondents (85%), answered that they did not receive enough information about invasive alien species during their study time. Only 15% answered that they did. Among the groups who graduated before year 2000, it is obvious that they have not obtained enough education about invasive alien species ($p_r \leq 0.000$, table 6). However, after year 2000, the number of Yes responses show a slight increase, although the number of No replies still is very high (74.3%). All respondents (100%) answered that they know what an invasive alien species is.

Table 6. When asked if they received enough information about invasive species during their education time the respondents answered as shown below. The analysis was done by Chi square (χ^2) test of unequal frequencies. Many observations had a sample size < 5, so the analysis was done with pooled groups resulting in one probability – value. The responses are categorised with letters according to level of significance.

Year of graduation	**Yes**	**No**
Before year 2000	5 (0.5%)$_{ab}$	83 (94.5%)$_{ab}$
2000-	7 (16.7%)$_{ab}$	35 (83.3%)$_{ab}$
2010-	7 (32%)$_{ab}$	15 (68%)$_{ab}$
2015-	5 (50%)$_{a}$	5 (50%)$_{a}$
Result: $\chi^2 = 20.78$, $p_r \leq 0.000$, df = 3		

In question 7 the respondents were asked to name three harmful invasive alien species is Finland. All 173 respondents answered the question. Figures 7-9 display how the answers were grouped.

The most commonly named species belonged to the *Heracleum persicum* – group, which was named as first species by more than 50% of the responders. It is evident that this group of species is most commonly known by the respondents.

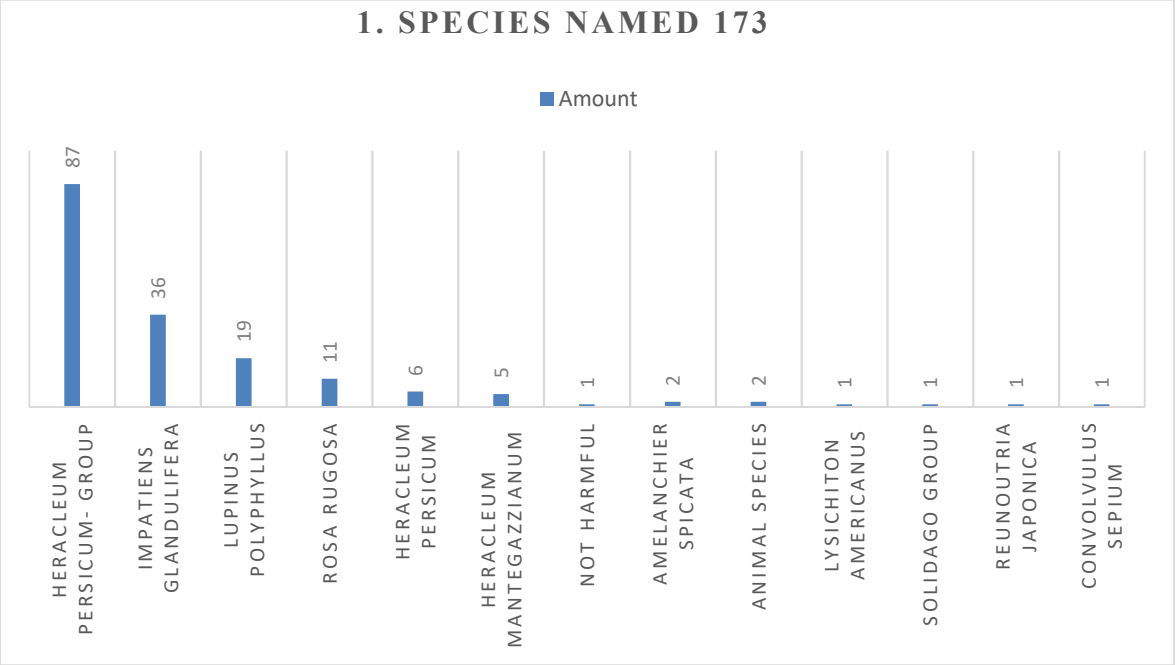

Figure 7. The division of the first species the responders named. Note that the answers sometimes have been divided according to group, sometimes by species. This is due to unspecified answers.

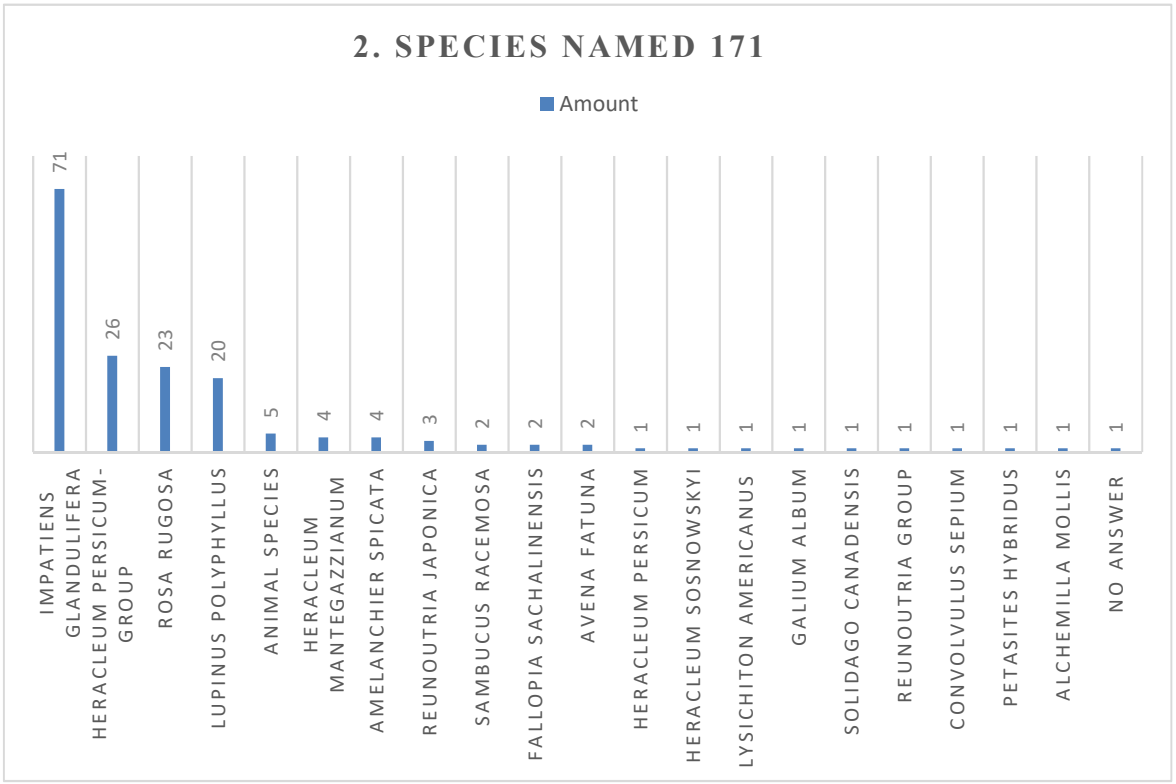

Figure 8. The division of the second species the responders named.

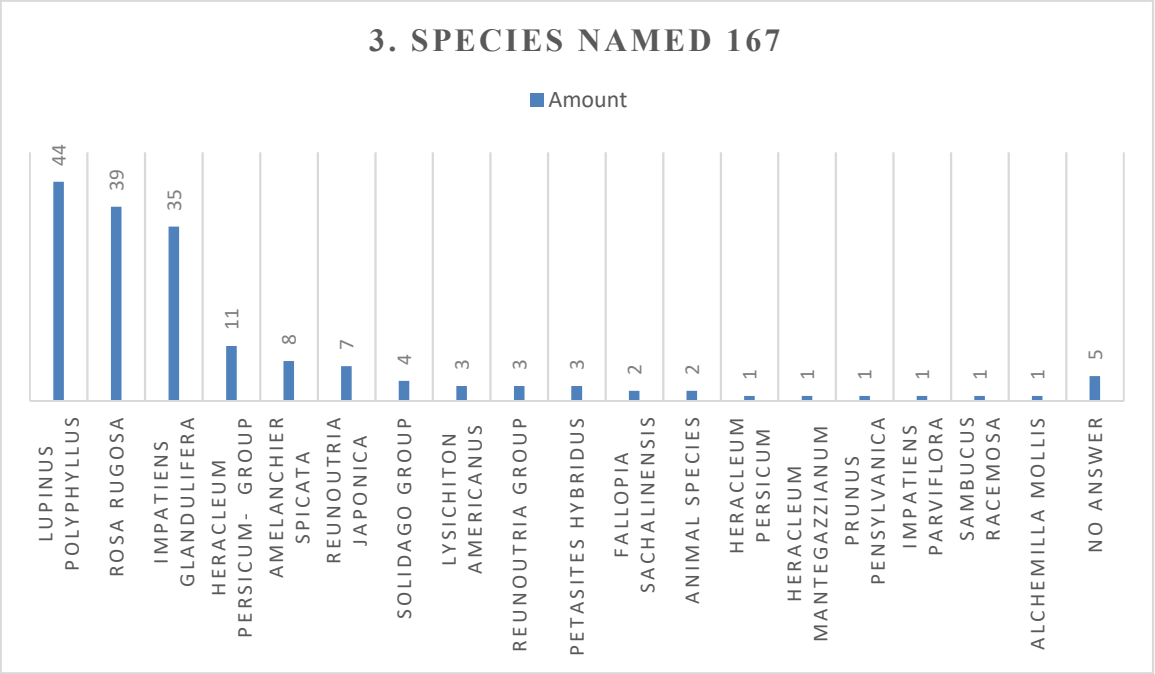

Figure 9. The division of the third species the responders named.

I. glandulifera was named as second species by almost 42% of all responders. The answers by the third species showed more variance, as *L. polyphyllus* was the most frequently named (26%) *I. glandulifera* (23%) and *R. rugosa* (21%) were close runner ups. Other species were absent in the top four of named species, but the most invasive species in Finland seem to be widely known by the respondents. It is also necessary to mention that the number of responses seem to decrease depending on how many species is asked to be named. The first species got 173 (100%) responses, the second species 171 (98.8%), while the third species got 167 (96.5%) responses. Although the differences are not large, it still indicating that it is more difficult to name several invasive alien species.

Table 7. Statistics concerning question 7: Name three invasive alien plant species in Finland that you know. The four most frequently named species are displayed. The responses are analysed by using a χ^2-test of unequal frequencies. Additionally, the responses St. residuals were analysed. The responses are categorised with letters according to level of significance. Responses marked with "a" differ from responses marked with "b" or "c".

First species named	**Named**	**Not named (reflected on all 173 responses)**	**St. residual**	
			Named	**Not named**
Heracleum persicum - *group*	113 (65.3%)$_a$	60 (34.7%)$_a$	1.8	-2.0
Impatiens glandulifera	142 (82%)$_b$	31 (18%)$_b$	4.8	-5.3
Lupinus polyphyllus	63 (36.4%)$_c$	110 (63.6%)$_c$	-3.3	3.6
Rosa rugosa	62 (36%)$_c$	111 (64%)$_c$	-3.4	3.7
Results: $\chi^2 = 108.47$, $p_r \leq 0.000$, df = 3				

If H_0 (hypothesis 1) would apply, the answers would be divided equally between the Named and Not Named responses. There were, however, major differences between Named and Not Named responses ($p_r \leq 0.000$, table 7), indicating that *Heracleum* species, as well as *I. glandulifera* are better known than all other invasive alien plant species. In line with hypothesis 1, this shows us that the respondents do not have enough diverse knowledge about invasive alien species.

In question 8 the respondents were asked to identify pictures of the alien species that are invasive in Finland (table 8). The statistics for the question show a clear significance ($p_r \leq 0.000$). The species with the highest significance are *S. racemosa, H. mantegazzianum* and *A. spicata.* Almost all respondents (96.5%) were able to identify *H. mantegazzianum.* This might be due to the typical form of the leaf. Half of the respondents did not identify *A. spicata* as invasive, and a majority (76.6%) did not identify *S. racemosa*, which indicates

that hypothesis 1 is true for some selected species. In line with hypothesis 3, both species are also still being sold and used in garden related businesses.

Table 8. The statistics concerning the question which species are invasive and which ones are not. The analysis was done by Chi square (χ^2) test of unequal frequencies. Additionally, the responses St. residuals were analysed. Since some of the observations have a sample size < 5 the statistical result is indicative. The responses are categorised with letters according to level of significance. Responses marked with the same letter influence the significance equally.

Plant species	**Right**	**Wrong**	**St. residual**	
			Right	**Wrong**
Geranium sylvaticum (not)	168 (98.2%)$_c$	3 (1.8%)$_c$	4.2	-6.6
Sambucus racemose	40 (23.4%)$_d$	131 (76.6%)$_d$	-7.4	11.6
Heracleum mantegazzianum	165 (96.5%)$_c$	6 (3.5%)$_c$	3.9	-6.2
Calla palustris (not)	136 (79.5%)$_b$	35 (20.5%)$_b$	1.3	-2.0
Impatiens glandulifera	129 (75.4%)$_b$	42 (24.6%)$_b$	0.7	-1.0
Amelanchier spicate	92 (54%)$_a$	79 (46%)$_a$	-2.7	4.2
Results: $\chi^2 = 337.13$, $p_r \leq 0.000$, df = 5				

In question 9 (see appendix 3) the respondents could mark which species they have used from a selection of 6 invasive alien species. Only 13 (7.5%) of the respondents did not pick any of the species. A majority (78.6%, table 9) has used *R. rugosa* as well as *S. sorbifolia* (72%), as both are popular plants along highways and in suburban areas. *A. mollis* was reported as a potentially invasive species in 2014 (LUOMUS, 2018b), but has been observed to be sold in garden retail as late as summer 2017 (see table 1). This species has been used the most by the respondents (89.5%).

The result ($p_r \leq 0.000$) indicates that the species that are being used are still being used frequently as opposed to species which are seldom sold or used. A species which is equally often used (49%), or not used (51%), is *Solidago canadensis*.

Table 9. Statistics for question 9 show the division between Yes and No answers considering if the species have been used or not. The analysis was done by Chi square (χ^2) test of unequal frequencies. Additionally, the responses St. residuals were analysed. The responses are categorised with letters according to level of significance. Responses marked with the same letter influence the significance equally.

Plant species	**Yes**	**No**	**St. Residual**	
			Yes	**No**
Rosa rugosa	125 (78.6%)$_{bc}$	34 (21.4%)$_{bc}$	-2.2	2.1
Lupinus polyphyllus	40 (25%)$_{b}$	119 (75%)$_{b}$	-4.2	4.0
Alchemilla mollis	128 (89.5%)$_{a}$	31 (19.5%)$_{a}$	5.9	-5.7
Fallopia japonica syn. *Reynoutria japonica*	32 (20%)$_{b}$	127 (80%)$_{b}$	-5.1	4.9
Sorbaria sorbifolia	115 (72%)$_{a}$	44 (27.7%)$_{a}$	4.4	-4.2
Solidago canadensis	78 (49%)$_{c}$	81 (51%)$_{c}$	2	-2.0
Result: $\chi^2 = 196.60$, $p_r \leq 0.000$, df = 5				

The results seem to be depending on the year of graduation ($p_r = 0.02$, table 10). Among the respondents who graduated before year 2005, a clear majority (83.1%) has used *R. rugosa*. After 2005, 66% of the responders admits to using the species, which indicates that the usage might be decreasing. However, as observed during the case study *R. rugosa* is still being sold in garden retail.

Table 10. Statistics for replies concerning year of graduation and the usage of *R. rugosa.* The analysis was done by Chi square (χ^2) test of unequal frequencies. Many of the observations have a sample size < 5, which means that the p_r – value is indicative.

Year of graduation	**Yes**	**No**
Before 1980	10	1
1980-	13	1
1985-	15	2
1990-	20	4
1995-	15	7
2000-	16	3
2005-	14	10
2010-	12	11
2015-	6	4
Results: $\chi^2 = 18.19$, $p_r = 0.02$, df = 8		

The replies to question no. 10 (appendix 3) were also analysed in groups according to time of graduation (table 11). Altogether, 59 (34%) respondents had not visited the homepage *www.vieraslajit.fi,* whereas for 113 (66%) persons the page was familiar. This indicate that hypothesis 4 is not completely true. Available tools are, at least partially, being used. It is notable that the time of graduation does not seem to influence if the person visited the homepage or not ($p_r = 0.707$).

Table 11. Statistics concerning question 10: Is the homepage *www.vieraslajit.fi* familiar to you? Answer statistics per year of graduation. The analyse was done by Chi square (χ^2) test of unequal frequencies. Additionally, the responses St. residuals were analysed. The responses are categorised with letters according to level of significance. Responses marked with the same letter influence the significance equally.

Year of graduation	**Yes**	**No**	**St. residual**	
			Yes	**No**
Before year 1980	6_a	5_a	-0.5	0.7
1980-	7_a	7_a	-0.8	1.1
1985-	10_a	7_a	-0.4	0.5
1990-	16_a	8_a	0.0	0.0
1995-	17_a	5_a	0.6	-0.9
2000-	13_a	6_a	0.1	-0.1
2005-	16_a	8_a	0.0	0.0
2010-	24_a	9_a	0.4	-0.6
Result: $\chi^2 = 4.62$, $p_r = 0.707$, df = 7				

In question 13 the purpose was to find out how well the respondents know the European invasive alien species and how much they have used these species. Table 12 shows the variety of answers.

Many respondents have used the different species that are invasive in Central Europe. The species influencing the statistics (table 12) are *Prunus laurocerasus* and *Mahonia aquifolium* ($p_r \leq 0.000$). *P. laurocerasus* has not been used so much, whereas *M. aquifolium* has been used by more than half of the respondents (56.6%).

Table 12. The table displays the division between yes and no answers. The analysis was done by a Chi square (χ^2) test of unequal frequencies. Additionally, the responses St. residuals were analysed. The responses are categorised with letters according to level of significance. Responses marked with the same letter influence the significance equally.

Species	**Used**	**Have not used**	**St. Residual**	
			Yes	**No**
Rhus typhina	32 (18.5%)$_a$	141 (81.5%)$_a$	-2.3	1.5
Mahonia aquifolium	98 (56.6%)$_b$	75 (43.4%)$_b$	7.2	-4.5
Buddleja davidii	49 (28.3%)$_a$	124 (71.7%)$_a$	0.1	-0.1
Prunus laurocerasus	14 (8%)$_c$	159 (92%)$_c$	-4.9	3.1
Result: $\chi^2 = 112.46$, $p_r \leq 0.000$, df = 3				

3.4 Analysis of the open answers

In the end of the survey the respondents had the possibility to comment and give propositions about the theme. Due to the large amount of answers a complete summary is placed under appendices (appendix 4).

Partially confirming hypothesis 1, many responders showed uncertainty in species identification and management. There was a common wish for more information, particularly concerning which species are obligatory to remove, as well as instructions about how to remove them successfully. Figure 10 shows in which forms this information should be communicated. Most responders wanted updated information through online channels while many responders also wished for published material including photographs.

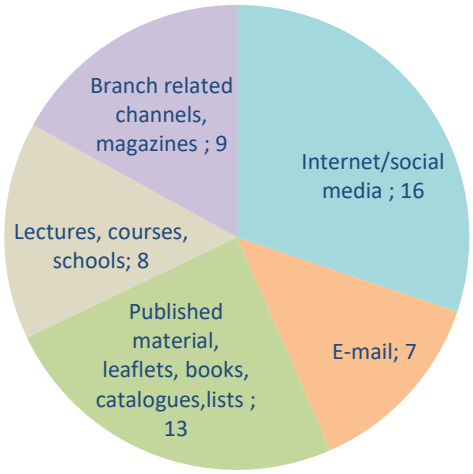

Figure 10. The responders to the open answers wished for more information about invasive species, especially through these channels.

The following central problems and concerns were mentioned concerning invasive alien species:

- Confirming hypothesis 2, there are too little resources for care taking and management of invasive species.
- Many people do not take the issue seriously enough and continue using some of these species which contribute to the species spreading.
- Consumers and private garden owners should be better informed so that they also can react and remove harmful species from their premises.
- Better information is needed about the removal of the different plants. The responders want to know how the removal can be done sustainably and which species should be prioritised.

Following propositions were made:

- The laws concerning harmful alien species should be stricter.

- The issue should be emphasised in schools and during education time.
- Increased resources should be put on the actual removal of the plants, also private garden owners should be obliged to remove invasive species from their premises.
- Different cities should have their own strategies for the removal of the harmful plant species and the city workers need to be appropriately schooled.
- Concerning usage of alien species, the spatial differences should be taken into consideration so that resources can be effectively targeted on the species that cause harm in the region.

The complete answers to the open questions are found as appendix (appendix 4).

4 Discussion

4.1 Education and information

Reactions and responses to this study were altogether positive and it also managed to gather attention. Respondents in different companies were easily approachable and the amount of open answers, comments and ideas show that people are ready to get involved and that invasive alien species provoke discussion.

More than 85% of the respondents said that they did not learn enough about invasive species, or the removal of invasive species during their studies. Identifying invasive alien species that have been labelled as invasive in Finland already for several years (see MMM, 2012) was considered problematic (table 8). This is confirmed by hypothesis no. 1, showing that people working in garden related businesses do not have enough knowledge in managing or identifying the invasive species. Especially worrying was that only 10.52% out of 72 of the Horticulturists with a Bachelor's degree (BSc) were able to identify all the invasive alien

species in question 8 (table 5). Especially this group could be increasingly informed and it seems necessary to integrate the theme already during education and internship. Schools need to provide the students with updated information as well as guidance of safe plant removal.

After 2010 the availability of education about invasive species seems to be increasing (table 6); however, the graduates from previous years also need to be educated in the current issues concerning invasive alien species. The information, however, needs to be provided from a reliable source or authority, such as the Ministry of Forestry and Agriculture (MMM), the Centre for Economic Development, Transport and the Environment (ELY Centre) or the Natural Resource Institute, Luke.

Many respondents seemed overwhelmed with the issue and replied that there is too much information, from too many sources published, which makes it hard to know what to prioritise. This shows that even though there might be information available for management and prevention of invasive alien species, there is a lack of cohesive guidelines and authorities who would control the usage of these species.

Although many respondents claimed that they inform customers about invasive species, there was only one company with information on display. Informing customers only verbally is not efficient enough since all customers do not necessarily have the possibility to talk to a staff member. The responsibility to choose the right plants is majorly left on the consumer. Particularly plant stores should be increasingly encouraged to inform customers more actively. This could be through labels, poster or leaflets. However, authorities need to provide the stores with the updated and correct material.

In line with hypothesis no. 3 the usage of harmful invasive species is quite common (table 9). A major part of the respondents was aware of the most harmful species, but there was some disagreement concerning species that are invasive only in certain ecosystems. *R. rugosa* was most frequently used by the garden building sector. The species is particularly favoured because of its resilience. The usage of the species needs to be restricted and the

garden building sector needs to be informed about equally resilient alternatives that can be used.

Hypothesis no. 4, concerning already available tools can partially be dismissed as it seems that pages like *www.vieraslajit.fi* are familiar. Many responders knew about the site (66%), however, 34% did not (table 11). The site has potential to be increasingly applied as a tool in education as well as to provide more information about management and removal of the plants.

4.2 Management tools and resources

Depending on how extensively a species has spread, the harder it will be to manage it or remove it from nature (Heikkinen, et.al. 2012, 78). Additionally, the overall trend shows that a prolonged damage control lead to higher costs (Simberloff, et.al. 2013, 61; Bundesamt für Umwelt BAFU 2016, 8). A major part of the control of invasive plant species depends on effective management measures. In line with hypothesis no. 2 the biggest problems concerning the management of invasive alien species seem to be the lack of resources. According to the respondents there are not enough resources invested in the practical management work of removing the invasive plant species. There is a lack of tools, time and knowledge to actively prevent the spread of invasive alien species.

The management of invasive species seems especially problematic for the garden maintaining sector in cities. Cities need to provide efficient equipment, invest more in the landscape care and increasingly inform private garden owners how to stop species from spreading from their gardens onto city ground. The garden maintaining sector need to be schooled in weeding and managing of invasive species so that they also proactively are able to recognise a possible threat as well as prevent species from spreading further.

Knowledge about species distribution patterns and altering components is crucial when planning the management (Hui & Richardson 2017, 21). Management, monitoring and

prevention need to be more cohesive and there must be more interaction between researchers and the people working with plants, including all the target groups in this study. As concluded by Braun, Schindler and Essl (2016, 56), management practice and exchange in expertise should be included in the management coordination. Also, the managing of the invasive species should not be tackled as a separate problem, but instead included in the landscape development (Wittenberg, et.al. 2006, 22). There should be more exact guidelines and it needs to be clear which species to prioritise. Education in management and plant ecology knowledge is strongly needed, following more efficient resources.

4.3 Future prospects

We have learned that climate change will bring new alien species threats (Heikkinen, et.al. 2012, 79). As a cause of globalisation, the risks combined with invasive alien species are growing constantly (Kettunen, et.al. 2008, 1), and there are more species arriving continuously (Lambdon, et.al. 2008, 102). This fact makes it important to detect the threats in time, or in an early stage and even stop species from getting imported. By analysing how human activities will change the landscape, it is possible to predict which invading species run the risk of growing into a future problem (Kueffer 2017, 725).

Many of the respondents mentioned that they had used species that are invasive for Central Europe (table 12); and, in the open answers, the responders speculated that some species will never be able to establish in Finland due to the cold climate. However, according to Hellmann et al. (2008, 536) generalisations about whether a species might, or might not spread are difficult to make, especially since many species need a certain time to adapt before starting to spread (Hui & Richardson 2017, 21).

This leads us to the conclusion that even though a species might not be able to spread in the beginning, it can probably do so in the future. Looking into which regions species have arrived from, it is possible to predict which species have a higher possibility to spread (Heikkinen, et.al. 2012, 49). An early detection system together with education measures for everyone involved would minimize the risks (Simberloff, et.al. 2013, 63-64). Especially

concerning the plant production as well as retail sector need to be involved in preventing new species from spreading. These sectors could work together with regulatory authorities in order to find suitable alternative to the invasive alien species. Ultimately, however, the responsibility lies on the controlling authorities. Plants that pose a possible threat should not be imported.

4.4 Conclusions and propositions

Already in 2001, a report from the Ministry of the Environment, Nummi (2001, 20) concluded that there should be more measures taken for research, management and awareness raising about alien species. Management of invasive alien species should receive increased funding, legislation needs to include more restrictions and responsibilities need to be stated for various species.

Although some regions have tried to manage and constrain the spread of invasive alien species for decades, there are no signs of the invasion slowing down (Richardson 2011, 400). However, present knowledge can provide an excellent basis for management actions. Europe represents the continent with the most integrated and inclusive information on alien species, particularly considering distribution patterns, invasion history and impacts. (Pyšek & Hulme 2011, 85). There has been some major development regarding regulating and management of invasive alien species. The main driver has been the EU, and Finland has followed, creating own management plans and regulations. However, the results from this study show that there is a critical need for more education and resources.

However, there is also growing interest, as well as development in detecting, mapping and managing various invasive alien species. On European and International levels, there are NOBANIS, *The European Network on Invasive Alien Species* (NOBANIS 2017) and DAISIE *Delivering Alien Invasive Species Inventories for Europe* (DAISIE 2017), which are collecting information about invasive alien species and providing updated information about existing and upcoming threats concerning invasive alien species.

In Finland there is the previously named *www.vieraslajit.fi* internet site, which provides people with the possibility to report sights of invasive species through a mapping system. Knowledge about this site, and the possibilities to use the information provided, would be crucial for different workers in garden related branches. In particularly people working outdoors could, if encouraged, increasingly use the site to report their observations of invasive species.

The different actors including garden specialists, landscaping companies and garden shops, but also governments need to work together to find a way to stop these species from causing more damages. This can be through informing the public but also by choosing native plants except for exotic plants in the gardens and through weeding actions. In Switzerland, civil service units are involved in the invasive species management; perhaps, this could be a solution in Finland too. The garden related branch carry great potential since invasive species management can be integrated in their work whereas the planning sector needs to adjust its selection of species.

As conclusion for my thesis the following statements are made:

- Information about the species, their ways of spreading, the management and removal should be easily accessible and cohesive. The information could be in a printed field guide, and also, on an updated online site.
- There should be cohesive, boarder overlapping regulations and management between cities, landowners, authorities, the media and the public. Management measures should be standardized when possible.
- All invasive alien species need to get attention, not only the invasive ones that pose a threat for human health.
- Invasive alien species should be prohibited to sell and use in garden retail and nurseries as well as gardening business. The current situation creates a wrong picture

as the responsibility is put on the consumer. Information about the species should be on display for customers.

- There needs to be more information on which plants are safe to use. Native species should always be prioritised. Landscape architects and planners can work as examples through adjusting their choice of species to more native ones when planning green areas.
- Future threats are to be taken seriously and new species introductions should be stopped before they have the chance to spread. By monitoring which species might arrive in the future it is possible to save resources.
- Invasive alien species should be more included in the education of all branches related to horticultural products.
- More resources for the practical management is needed and management of invasive alien species should be included in policy making.

This thesis gives a picture of the current situation concerning the use of invasive alien species in garden related branches. The problematics concerning these species seem to be known, but not yet fully understood. Many people do not take the risks concerning invasive alien species seriously enough as the information often include inconsistencies. As long as people working in garden related branches do not integrate the reduction of threats caused by these species in their work, a great potential is lost. Increased management measures against invasive alien species would help stagnate the current biodiversity loss.

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Figures references:

Figure 1 and 2: Photos by M. Hildén 2017.

Figure 3: Map provided by Bing Maps. DSAT for MSFT, GeoNames, Microsoft, Navteq, 2018.

Scientific name	**English name ***	**Finnish name ***	**Swedish name ***	**Origin of the species** Note: Due to uncertainties the information is indicative.	**Invasive alien plant species forbidden to distribute in EU**	**Invasive alien plant species on Finnish national strategy 2012 and later**
Baccharis halmifolia	Groundsel-bush	pilvisutilatva	saltbaccharis	Eastern parts of North America	◆	
Hydrocotyle ranunculoides	Floating pennywort	sumasammakonputki	flytspikblad	South America, Tropical Africa	◆	
Persicaria perfoliata	Mile-a-minute weed	raastotatar	gisselpilört	Eastern Asia	◆	
Pueraria montana var. Lobata	Kudzu-vine	purppurakudzu	kudzoböna	Eastern Asia	◆	
Parthenium hysterophorus	Whitetop weed	piinahelmikki	flikpartenium	Central America, Mexico	◆	
Heracleum persicum	Persian hogweed	persianjättiputki	tromsöloka	Middle East	◆	◆
Heracleum sosnowskyi	Sosnowsky's hogweed	armenianjättiputki	bredloka	Caucasus	◆	◆
Heracleum mantegazzianum	Giant hogweed	kaukasianjättiputki	jätteloka	Caucasus	◆	◆
Ludwigia peploides	Water primrose	loikorusolehti	krypludvigia	American continental	◆	
Alternanthera philoxeroides	Alligator weed	vesikaijalehti	alligatorblad	South America	◆	

*Some species do not have a name in every language, or they have several different names including the ones mentioned on this list. The scientific name is of significance whereas the other names are indicative.

Ludwigia grandiflora	Water primrose	lauttarusolehti	storblommig ludwigia	Central- and South America		
Lysichiton americanus	Western skunk cabbage	keltamajavankaali	gul skunkkalla	Western North America		
Eichhornia crassipes	Water hyacinth	kelluvesihyasintti	vattenhyacint	South America, Amazon		
Cabomba caroliniana	Carolina fanwort	karheaviuhkalehti	kabomba	South- and North America		
Myriophyllum aquaticum	Parrot feather	isoärviä	storslinga	South America		
Myriophyllum heterophyllum	Variable-leaf watermilfoil	kampaärviä	kamslinga	Southeast and Midwest USA		
Lagarosiphon major	African elodea	afrikanvesihäntä	afrikansk vattenpest	Southern parts of Africa		
Lupinus nootkanensis	Alaskan lupine	alaskanlupiini	sandlupin	Western parts of North America		
Leymus innovatus	Downy ryegrass	albertanvehnä	kanadaråg	North America		
Epilobium adenocaulon	Hairy willow weed	rusoamerikanhorsma	amerikansk dunört	North America		
Petasites hybridus	Common butterbur	etelänruttojuuri	pestskråp	East- South-eastern Europe		
Petasites japonicas subsp. Giganteus	Giant Japanese butterbur	japaninruttojuuri	pestskråp	Eastern Asia		
Jacobaea cannabifolia	Hempleaf ragwort	hamppuvillakko	hampstånds	North- East Asia		

Ceratophyllum submersum	Tropical hornwort	hentokarvalehti	vårtsärv	South, Central and East Europe		
Anisantha sterilis	Sterile brome	hietakattara	sandlosta	Europe		
Avena fatua	Common wild oat	hukkakaura	flyghavre	Eurasia/Global species		
Fallopia x bohemica	Bohemian knotweed (hybrid)	hörtsätatar	hybridslide	Eastern Asia		
Reynoutria japonica **syn.** ***Fallopia japonica***	Japanese knotweed	japanintatar	parkslide	Eastern Asia		
Reynoutria sachalinensis **syn.** ***Fallopia sachalinensis***	Giant knotweed	jättitatar	jätteslide	Eastern Asia		
Cornus alba	Siberian dogwood	idänpensaskanukka	rysk kornell	Eastern Europe, Siberia		
Cornus alba **subsp.** ***Stolonifera***	American dogwood	lännenpensaskanukka	videkornell	Eastern Europe, Siberia		
Solidago gigantean	Giant goldenrod	isopiisku	höstgullris	North America		
Glyceria maxima	Great manna grass	isosorsimo	jättegröe	Eastern parts of Europe, Central Siberia		
Amelanchier spicata	Low juneberry	isotuomiphlaja	häggmispel	North America		
Impatiens glandulifera	Himalayan balsam	jättipalsami	jättebalsamin	Himalaya		
Impatiens parviflora	Small balsam	rikkapalsami	blekbalsamin	Central Asia		

Impatiens capensis	Orange balsam	lännenpalsami	apelsinbalsam	North America		
Thuja plicata	Pacific redcedar	jättituija	jättetuja	North America		
Erigeron canadensis* syn. *Conyza canadensis	Canadian fleabane	kanadankoiransilmä	kanadabinka	North America		
Solidago canadensis	Canadian goldenrod	kanadanpiisku	kandensiskt gullris	North America		
Solidago altissima	Goldenrod	korkeapiisku	jättegullris	North America		
Elodea canadensis	Canadian waterweed	kanadanvesirutto	vattenpest	North America		
Elodea nuttalii	Nuttall´s pondweed	kiehkuravesirutto	smal vattenpest	North America		
Lupinus ploryphyllus	Garden lupine	komealupiini	blomsterlupin	North America		
Malus domestica	Apple tree	tarhaomenapuu	apel	Local threat because of hybridisation		
Calystegia sepium	Hairy bindweed	karhunköynnös	snårvinda	Unclear		
Rosa rugosa	Japanese rose	kurtturuusu	vresros	Northeastern Asia		
Nymphoides peltata	Fringed water-lily	lammikki	sjögull	Central Europe - Asian border		
Ambrosia artemisiifolia	Common ragweed	marunatuoksukki	malörtsambrosia	North America		
Galium album	Hedge bedstraw	paimenmatara	stormåra	Eurasia		
Galium x pomeranicum	Pomeranian bedstraw	piennarmatara	gulmåra	Hybrid from *Galium* Eurasian species		

Symphyotrichum x salignum	Common michaelmas daisy	pajuasteri	videaster	Hybrid from North America		
Lysimachia arvensis* syn. *Anagallis arvensis	Scarlet pimpernel	peltopuna-alpi	rödmire	European weed		
Alopecurus myosuroides	Slender meadow foxtail	rikkapuntarpää	renkavle	European weed		
Symphytum x uplandicum	Russian comfrey	ruotsinraunioyrtti	uppländsk vallört	Central - and South Europe		
Abies balsamea	Balsam fir	palsamipihta	balsamgran	North America/Canada		
Abies sibirica	Siberian fir	siperianpihta	pichtagran	North - and Central Asia		
Prunus pensylvanica	Bird cherry	pilvikirsikka	amerikanskt häggkörsbär	North America		
Papaver rhoeas	Red poppy	silkkiunikko	kornvallmo	European weed		
Setaria pumila	Yellow foxtail	sinipantaheinä	grå kavelhirs	European weed		
Sambucus racemosa	Elderberry	terttuselja	duvfläder	South - and Central Europe		
Sorbaria sorbifolia	False spiraea	viitapihlaja-angervo	rönnspirea	Temperate Asia		
Rorippa sylvestris	Yellow fieldcress	rikkanenätti	strandfräne	Europe		
Symphytum officinale var. Bohemicum	Comfrey	valkoraunioyrtti	vallört hybrid	Central - and South Europe		

Symphytum officinale var. Officinale	Comfrey	tummarohtoraunioyrtti	vallört hybrid	Central - and South Europe		
Epilobium ciliatum	Fringed willowherb	vaalea-amerikanhorsma	amerikansk dunört	Common all over the American continent		
Setaria viridis	Green foxtail	viherpantaheinä	kavelhirs	South Europe		
Amaranthus retroflexus	Red-root amaranth	viherrevonhäntä	svinamarent	Tropical America		
Poa chaixii	Broad-leaved meadow-grass	puistonurmikka	parkgröe	Central Europe		
Galega orientalis	Fodder galega	rehuvuohenherne	fodergetruta	Caucasus		
Echinochloa crus-galli	Cockspur	rikkakananhirssi	hönshirs	Asia/ uncertain		
Acer pseudoplatanus	Sycamore maple	vuorivaahtera	tysk lönn	Central Europe		
Echinochloa muricata	Barnyard grass	lännenkananhirssi	amerikanskt hönsris	North America		
Gunnera tinctoria	Giant rhubarb	värigunnera	röd jättegunnera	Southern Chile		
Microstegium vimineum	Japanese stiltgrass	peittolapanheinä	japanskt styltgräs	Asia		
Asclepias syriaca	Common milkweed	mesisilkkiyrtti	sidenört	Southern Canada		

Pennisetum setaceum* syn. *Cenchrus setaceus	Crimson fountaingrass	arabiansulkahirssi	fjäderborstgräs	East Africa		
Rosa glauca	Redleaf rose	punalehtiruusu	daggros	Central, Southern Europe		
Lactuca serriola	Prickly lettuce	piikkisalaatti	taggsallat	Unclear/Southern Europe/Asian border		
Alchemilla mollis	Lady's-mantle	jättipoimulehti	jättedaggkåpa	Southeastern Europe, Southwestern Asia		

(MMM 2012, 61-65; Nobanis 2018c; MMM 2018, 18, 20-21; LUOMUS 2018; Swedish environmental protection agency 2018; NatureGate2018b).

 Species which are forbidden to distribute inside the EU.

 Species listed as invasive in Finland and are named in the Finnish national strategy of invasive alien species.

 Species which are newcomers and potentially invasive.

1. Company and field of expertise:
2. Area/Region:
3. Does the company have invasive alien plant species in their selection/usage? Yes No. If Yes, which ones:
4. Does the person interviewed have a garden related education? Yes No What education?
5. When and where did the interviewed person get his/her education?
6. What position does the interviewed person have in the company?
7. Are the employees in the company informed about the usage of invasive plant species? Yes No
8. Are the customers informed about invasive alien plant species (with signs/posters/leaflets)? Yes No
9. Do the employees inform customers about non-invasive alternatives? Yes No
10. Is the person interviewed aware of the *www.vieraslajit.fi* internet site? Yes No
11. Does the person interviewed wish to have more tools/information in his/her use? What kinds of tools/information?
12. What does the person interviewed think is the biggest problem concerning the issue of invasive alien species in the business?
13. How did the company/ the person interviewed respond to the study? Positively (wishes to get more information) Negatively (feels confronted)

Tunnetko haitalliset vieraskasvilajit? Känner ni de skadliga främmande växtarterna?

Tähän kyselyyn voi vastata täysin anonyymisti. Vastaukset tulevat tutkimustyön käyttöön. Yrityksenne/työpaikkanne nimi ei liity tutkimukseen eikä mainita missään tuloksissa. Tutkimusta varten on erityisen tärkeää, että vastaatte todenmukaisesti ja selkeästi, apuvälineitä käyttämättä (esim. kirjoja/internettiä). Kommenteille ja vapamuotoisille vastauksille on tilaa lomakkeen lopussa. Lomakkeen täyttöön kuluu noin 5-8 min.

Man kan svara på blankettens frågor fullständigt anonymt. Svaren kommer att användas till forskningssyfte. Ert företags eller er arbetsgivares namn är inte relevant för forskningen och kommer inte att nämnas någonstans. Då ni svarar på frågorna är det ytterst viktigt att ni svarar sanningstroget och exakt utan att använda hjälpmedel såsom böcker eller internet. I slutet av blanketten finns det plats för kommentarer och öppna svar. Svarandet tar cirka 5-8 minuter.

1. Millä paikkakunnalla työpaikanne/yrityksenne sijaitsee? I vilken stad befinner sig ert företag/er arbetsplats?

2. Millä alalla työskentelette pääsääntöisesti? I vilken bransch arbetar ni huvudsakligen?

- ○ Maisemasuunnittelu, -arkkitehtuuri/ Landskapsplanering,-arkitektur
- ○ Puutarhasuunnittelu/ Trädgårdsplanering
- ○ Viherrakentaminen,- ylläpito/ Trädgårdsbygge,- skötsel
- ○ Taimisto/ Plantskola
- ○ Puutarhamyymälä/ Trädgårdsbutik
- ○ Muu. mikä?/ En annan, vilken?

3. Onko teillä puutarha-alan koulutus? Har ni en utbildning inom trädgårdsbranschen?

- ○ Kyllä/Ja Mikä puutarha-alan koulutus teillä on? Vilken utbildning inom trädgårdsbranschen har ni?
- ○ Ei/Nej Mikä koulutus teillä on? Vilken utbildning har ni?

4. Missä koulussa saitte ammatillisen koulutuksenne? I vilken skola fick ni er arbetsrelaterade utbildning?

5. Milloin valmistuitte? När tog ni examen?

Vuonna/År

Seuraava -->

Tunnetko haitalliset vieraskasvilajit? Känner ni de skadliga främmande växtarterna?

6. Tiedättekö mitä termillä "vieraslaji" tarkoitetaan? Vet ni vad termen "främmande art" betyder?

- ○ Kyllä/Ja
- ○ Ei/Nej

7. Mainitkaa 3 tuntemanne haitallista vieraskasvilajia Suomessa? Nämn 3 skadliga främmande växtarter ni känner till i Finland?

1.
2.
3.

<-- Edellinen Seuraava -->

Tunnetko haitalliset vieraskasvilajit? Känner ni de skadliga främmande växtarterna?

8. Mitkä seuraavista kasveista ovat Suomessa haitallisia vieraslajeja? Vilka av de följande växterna är skadliga främmande arter i Finland? Klikatkaa kuvia/ Klicka på bilderna

1.

2.

3.

4.

5.

6.

<-- Edellinen Seuraava -->

Tunnetko haitalliset vieraskasvilajit? Känner ni de skadliga främmande växtarterna?

9. Merkatkaa ne kasvit, joita olette koulutuksenne, työssänne tai harjoitteluaikananne istuttaneet, myyneet, kasvattaneet tai käyttäneet suunnittelussa. Markera bilderna på de växter som ni under er studietid, på er arbetsplats eller under er praktiktid planterat, sålt, odlat eller använt i en planering.

1. Rosa rugosa

2. Lupinus polyphyllus

3. Alchemilla mollis

4.Fallopia japonica

5. Sorbaria sorbifolia

6. Solidago canadensis

← Edellinen Seuraava →

Tunnetko haitalliset vieraskasvilajit? Känner ni de skadliga främmande växtarterna?

10. Onko teille internetsivut Vieraslajit.fi tuttu? Känner ni till internetsidan Vieraslajit.fi?

- ◯ Kyllä/Ja
- ◯ Ei/Nej

11. Saitteko mielestänne riittävästi tietoa haitallisista vieraskasvilajeista koulutuksenne aikana? Fick ni tillräckligt information om skadliga främmande växtarter under er studietid?

- ◯ Kyllä/Ja
- ◯ Ei/Nej

12. Informoidaanko asiakkaita haitallisista vieraskasvilajeista työpaikallanne? Esim. suullisesti/lomakkeilla/julisteilla? Informerar ni kunder om skadliga främmande växtarter på er arbetsplats? T.ex. med blanketter/skyltar/muntligt?

- ◯ Kyllä/Ja
- ◯ Ei/Nej

13. Seuraavat kasvilajit ovat Keski-Euroopassa haitallisia vieraslajeja. Ilmastomuutoksen myötä nämäkin kasvit voivat tulevaisuudessa lisääntyä Suomessa. Oletteko käyttäneet seuraavia kasveja? Merkatkaa rastilla. De följande växtarterna är skadliga främmande arter i centrala Europa. Som följd av klimatförändring kan dessa arter i framtiden också etablera sig i Finland. Har ni använt någon av de följande arterna? Markera med krux intill.

- ☐ Rhus typhina/Rönnsumak/Samettisumakki
- ☐ Mahonia aquifolium/Mahonia
- ☐ Buddleja davidii/Syrikkä/Syrenbuddleja
- ☐ Prunus laurocerasus/Laakerikirsikka/Lagerhägg

<-- Edellinen Seuraava -->

Tunnetko haitalliset vieraskasvilajit? Känner ni de skadliga främmande växtarterna?

14. Toivotteko lisätietoa aiheesta, missä muodossa? Önskar ni er mer information om ämnet, i vilken form?

15. Tässä kohtaa saatte vapaasti kommentoida kysymyksiä/aihetta. Här kan ni fritt kommentera frågorna/ämnet.

16. Jos haluatte kuulla miten tutkimuksessa kävi voitte jättää sähköpostiosoitteenne tähän. Om ni vill höra om resultaten från undersökningen kan ni skriva er e-mail adress här. Kiitos/Tack!

Sähköposti

<-- Edellinen Lähetä

Summary of open answers

In questions number 14 and 15 the respondents could comment or give suggestions concerning invasive alien species. Due to the large amount of replies the answers have been summarised according to themes.

Answers that are irrelevant to the study, personal questions and remarks or inappropriate answers have been left out from this summary. Also, technical remarks on the survey itself has been left out from the text.

1. Problematics issues concerning invasive plant species

There were several responses expressing concerns about how the issue with invasive species is being handled. There was a wish for more information about the species that are obligatory to remove. The public and officials should learn how to identify these plants and how to remove them in an efficient way. The information should be in a compact and practical form.

There also seem to be a problem concerning private land owners that usually do not know the invasive species very well; often they even think that it is nice that the plants are spreading. The responders pointed out that people are carelessly dumping garden compost in the surroundings which adds to the problem. The city workers in particular have problems with landowners who do not care to remove the harmful invasive plant species in their gardens. This causes extra work for the city care take units, when they repeatedly have to remove the plants which have spread onto city premises. The workers often cannot reach the landowner and they have to rely on their already scarce resources to stop the plants from spreading even further. It would be impossible to intervene and use fiscal money to remove the invasive plants from a privately -owned garden.

Among the responders in the landscape business, there were concerns that other people in the field do not take the issue seriously enough to avoid using alien species in their planning work. Many workers seem to use e.g., *Prunus pensylvanica* and *Amelanchier spicata* in their plans.

2. The media and other information channels

More of the responders wanted to see more general information through the different branch channels like garden branch related magazines and through organised lessons and courses from branch -related organisations. They also wanted to know more about species that might cause a future threat.

The information and reminders should also be directed to the consumers and garden owners. Information should be given in garden markets and in garden related magazines. The magazines should publish the information during the main garden season.

The different online platforms were also currently named. Responders wanted to have more e-mail information as well as information through various social media. Several responders showed interest in a webpage with gathered, up -to -date information about the species, their ability to spread and how to remove them successfully. Responses concerning the existing *www.vieraslajit.fi* portal showed that the page is appreciated, but that it lacks instructions about which species that you are supposed to remove and which ones that are still allowed to be used. The webpages should include pictures and remarks concerning how to identify the species in the field.

However, increased communication with colleagues was emphasised. People should also take responsibility to inform themselves through the already existing platforms. The development of alien species strategies in cities and counties would be welcome.

3. **Tools that would be necessary to develop, the work with invasive species, ideas and remarks.**

The most common comments concerned a written, printable guide or booklet which would contain pictures as well as information about the habitats, spreading areas, ways of distribution and other important species related information. The guide should also include plants that potentially can become invasive in the future. When new species are added to the list it would be necessary to learn how to identify them and to repeat the information with regular intervals in order to keep the knowledge updated.

In the guide, the different species could be divided according to level of harmfulness. The negative effects of the species spreading should also be included. Table guides in which you can check the information would also be practical. An annually updated guide about plants that are prohibited to sell was also mentioned.

The responders also wished for ready -to -use material for lectures, including handouts. Written, printable, material with coloured pictures of the species including a link to more information, for the employees in the garden shop and for the customers, would be useful and save time.

In addition to more information about habitats, the responders wanted to know more about plants in urban and cultural areas. The question was, would these plants be harmful if they do not spread in the surroundings?

The responders wished for more practical instructions in how to effectively prevent the spreading of invasive plants. For example, one suggestion concerned guidance in removing the flowers before these produce seeds. Guidance in the selection of planting and growth place should also be directed to private households, in addition to more advice on how to handle the garden compost in a correct way.

There were also more specific remarks concerning some species. These were:

- There should be more information on how to remove *Heracleum* safely.
- Some of the responders did not find all the species mentioned harmful, *Amelanchier spicata* and *Sambucus racemosa* where mentioned among them.
- *Rosa rugosa* and cultivated varieties was a frequently mentioned theme. The responders wanted to know more about the different cultivars, how they behave and which ones are safe to use in comparison to the original *Rosa rugosa.* There also seem to be a lack of information concerning the harmfulness of the common hedge plant *Amelanchier spicata* and the risks concerning *Lupinus polyphyllus.*
- In the case of *Impatiens glandulifera* people should be advised to keep the plant from flowering and producing seeds, so that it cannot produce seeds capable of germination.
- Some responses expressed that this matter has lost focus from the most urgent issues, such as the problems with *Heracleum-persicum* species.

4. Resources

Many responders pointed out limited resources as a problem when fighting invasive alien species and wished for more information about which species should be prioritised in their work. More resources for the actual prevention work in the field is needed, including efficient equipment and machines.

One comment by respondent managed to describe this theme effectively, also giving some ideas on how to face the challenge: “A common sense is needed in approaching the issue, since unnecessary prevention work use up already limited resources. Some of the harmful species cause more risks than others. The plants should be listed according to risk level, for example by colour marking”

5. Remarks on education and legislation

Many of the responders mentioned that the theme of invasive alien plant species was not included in their education (mostly in the 1980s and 1990s). The issue was not known, and therefore not taken into consideration. Most of the responders, however, feel that the theme should be taken more seriously in both legislation, education, and in garden related branches.

Responders mentioned that during the last thirty years there has been a remarkable increase of interest concerning this matter. In the 1980 -s, the term "invasive alien species" was not really known, although species such as *Lupinus* and *Sambucus racemosa* were known to spread and important to keep an eye on.

6. Current situation in the field

Several respondents mentioned how they have taken the problems with the species into consideration in their work, some even organise meetings to discuss the theme. However, the lack of time and resources seem to be a common issue. Here are some of the separate replies quoted:

"The city of Espoo in southern Finland has its own strategy for invasive plant species. Prevention work for *Heracleum* has been done since the last 10 years, and it is slowly showing results. There are only some solitary *Heracleum* individuals emerging now and then, but *Impatiens glandulifera* is spreading like fire and information concerning how to remove the plants in a professional manner has been hard to find. The city workers see no chance to control the situation, even though it would be relatively easy. Help from volunteers and the environment institutes is needed. Only the areas having an existing problem have received guidance in how to remove the invasive plant species."

"Among the invasive plant species, we only use *Rosa rugosa* and *Sorbaria sorbifolia.* The different *Fallopia* species mainly spread from private gardens, and it is necessary to cut them down on a regular basis."

"We have done prevention work for the last 10 years; 40 years ago, the situation was completely different. These species were sold in garden stores and they were popular. "

"We have been trying to remove *Impatiens glandulifera* in our city by using many different tools but with poor outcome. More resources would be needed and peer support would be welcome".

"It is good to get a reminder about the issue now and then; in our village we have tried to remove *Impatiens glandulifera* during several seasons, but there is still a lot of work to be done"."

"I have tried to campaign the matter for the last two years. At least the landowners do not know or recognise the species and it would be the first thing I would change."

Many responders reacted positively to the survey and pointed out the importance of the work against invasive alien plant species. Here are some of the responses quoted:

"Previously, before the whole discussion about the harmful invasive species started, I used these species in my work. Nowadays I do not use them anymore. If we take immediate action, it is still possible to prevent a situation like the one in St. Petersburg where *Heracleum* is growing everywhere."

"This is a good subject, hopefully people learn more and avoid using these plants in the future."

"Good subject, every year I am waiting with dread when the *Lupinus* will come to our village and all the beautiful native plants will disappear."

"This is a very interesting subject and I noticed that I do not know enough about it. More information about this theme would be necessary for the employees and for the customers."

The importance of sharing information was mentioned:

"Common enlightenment is needed to stop people from spreading the invasive species. A change in legislation would also be appropriate in order to stop species from spreading."

“If a planner uses a harmful invasive plant species the plans should also include information about species ecology and how to prevent the plant from spreading in the surroundings.”

“This is an important issue, but as I mainly construct what other people have planned, I do not care much about the plants and I do not know them well enough to be considering issues such as this.”

“It would be good if the plant stores would provide information about whether the species is spreading with root sprouts. Some species would be nice to use but they spread too aggressively. However, there is too little information available about this issue in the markets.”

Some responders thought that it is hard to find supplementary species to use:

“I have not been able to keep myself from using certain invasive species since they are the best ones available, e.g., *Amelanchier spicata.*”

“The cultivated varieties of e.g., *Rosa rugosa* should not be condemned together with the original species. Many of these cultivars are manageable and endurable park roses”.

“In my opinion, there is too much fuss about the invasive alien species. The branch professionals are able to plan sites with *Prunus pensylvanica* or *Alchemilla mollis* without them being able to spread in nature. Some of these species are beautiful, healthy, grow in harsh conditions and are easy to maintain. I do not think using them should be prohibited. There is enough space in the Finnish nature for new species.”

“It should be noted that many of the invasive species have suitable cultivars that are safe to use, since they do not produce root sprouts or seeds. For instance, there are many safe varieties of *Rosa rugosa*. However, it would be good to get more information about this, related to which are the differences between the species and which ones should be preferred in stores and in garden building.”

Spatial differences were also mentioned:

"In our area there is not so many invasive species. The species mentioned in the last question are too sensitive for the low temperatures, indicating they are not able to spread into the surroundings."

"In my experience, *Prunus laurocerasus* does not even cause problems in the south since it is so sensitive for the cold climate. Also, the Bamboo species that are causing major problems in Germany do not grow here since they are fed upon by rabbits or do not grow at all."

"In the discussion about the invasive plant species there has been too much fuss about how dangerous these plants are. The traditional nature protection has suffered in these circumstances. There are big spatial differences in Finland and most species are not able to survive or spread in our climate. Certainly, the harmful species in Finland are different than those that are harmful in southern parts of Europe"

"In the case of some of the invasive species there has occurred some exaggeration. *Rosa rugosa* does not grow on clay, and spread only in the archipelago area. *Reunoutrya japonica* is not very common in our area. *Lupinus* is competing for habitat with *Artemisia vulgaris,* which in many cases is much more invasive and also include seeds from middle Europe."

"The discussion about the invasive plant species is too concentrated to southern Finland. Some of the harmful species in the south do not spread to the northern areas. One example is *Amelanchier spicata,* which mainly occupies space from *Sorbus aucuparia.* However, one very harmful species, *Ribes rubrum,* which spreads in broad -leaf woodland areas, has been totally ignored in the discussion. There should be more information about how to use the species safely to keep them from spreading, rather than criminalise the use of them."

Other remarks:

"I would like an appropriate discussion about the issue rather than a hysterical fuss that puts a bad label on the garden plantations. *Lupinus polyphyllus* takes over the roadsides, which is today a common growing ground for fragile native species. The spreading of *L. polyphyllus* should be taken seriously, also on a national level."

“The presence of some of the listed species I do not understand. In parks, exotic species are approved to use. Some of them were introduced 100 years ago. We like to have endurable species for our parks, but when they grow well they suddenly become harmful?”

“Hopefully the issue is handled professionally. Let us focus on the species that are seriously harmful and possible to remove.”

“The internet does not control the spread of invasive species in the surroundings.”