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ASSESSMENT OF THE POTENTIAL OF INTRODUCTION, ESTABLISHMENT AND FURTHER SPREAD OF INVASIVE ALIEN PLANT SPECIES OF EUROPEAN UNION CONCERN IN LITHUANIA

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Abstract

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The list of invasive alien species of European Union concern currently includes 23 plant species. The aim of this study was to assess the potential and importance of introduction pathways for invasive alien plant species in Lithuania, to estimate probability of their establishment and further spread in the country. Analysis of all available information revealed that three species (*Asclepias syriaca*, *Heracleum sosnowskyi* and *Impatiens glandulifera*) currently occur in Lithuania and the latter two are widespread invasive species in the country. The remaining 20 plant species have not been registered in the wild in Lithuania so far. Four of these, *Gunnera tinctoria*, *Lysichiton americanus*, *Myriophyllum aquaticum* and *Pennisetum setaceum*, are occasionally cultivated in gardens or other outdoor areas, and six species, e.g. *Cabomba caroliniana*, *Eichhornia crassipes, Lagarosiphon major*, are cultivated in aquaria or other indoor spaces. Naturalization of seven species is unlikely in the country, whereas naturalization of 13 species (*Lysichiton americanus*, *Myriophyllum aquaticum*, *Pennisetum setaceum*, etc.) is plausible. Five of the analysed and still not recorded species are recognized as potentially invasive in Lithuania; the invasion of five species is plausible and that of 10 species is unlikely. The most important pathway of introduction of the analysed species is ornamental gardening. Three species that have not been recorded in Lithuania, but occur in the neighbouring regions of Europe (*Elodea nuttallii*, *Heracleum mantegazzianum*, *Heracleum persicum*) can enter the country by natural means. Importance of permanent studies and surveys on alien plants aiming to ensure early detection and eradication of invasive species is discussed.

Keywords: early detection, eradication, invasiveness, introduction pathways, risk assessment.

INTRODUCTION

The frequency of introductions of alien species is increasing at enormous rates with the increase of globalization (Perrings et al., 2005; Meyerson & Mooney, 2007; Hulme, 2009). Species being introduced outside their native ranges may be able to establish and disperse in new environments occasionally having a serious negative effect on the native biodiversity, on economy and human well-being (Ricciardi et al., 2013; Jeschke et al., 2014; Roy et al., 2015; Tsiamis et al., 2017). The first comprehensive estimate of the composition and structure of alien plants occurring in the wild in the European continent revealed a total of 3749 naturalized aliens in Europe, of which 1780 are alien species whose native range falls outside Europe (Lambdon et al., 2008).

With the aim to tackle effectively the problems linked to invasive alien species, to prevent the entry of new potentially invasive alien species, to set up a system of early warning and rapid response, to ensure a prompt eradication and efficient management of already established invasive species, the Regulation (EU 1143/2014) of the European Parliament and

of the Council on Invasive Alien Species has been adopted. Adoption of the Regulation has become an important attempt to set a common standard for combating invasive alien species across political jurisdictions at a multinational scale, and to minimize and mitigate the impact of invasive alien species on human health or on the economy (Tollington et al., 2017; Tsiamis et al., 2017).

It has been estimated that in different regions from 10% to 20% of the vast number of introduced species may become invasive (Pyšek et al., 2009, 2014; Richardson & Rejmánek, 2011). Invasive species often undergo rapid exponential growth occupying space and resources vital for the survival of native species (Mack et al., 2000). Invasive species can drastically change food webs, alter hydrological systems and affect ecosystem structure (Jeschke et al., 2014; Roy et al., 2015).

Prevention is always the best and least costly method of control and keeps an ecosystem free of invasive species (Jardine & Sanchirico, 2018). Once an alien species enters a new area, small populations begin to form and at this stage it is possible to remove all individuals from infested areas. During the containment phase, an invasive species rapidly reproduces and spreads to large areas, therefore, at this stage or later possibility of complete eradication decreases and costs significantly increase (Olson & Roy, 2008; Nuñez et al., 2017; Jardine & Sanchirico, 2018). When invasive species becomes widespread and abundant, its complete eradication becomes almost impossible, therefore, much efforts are needed even to control population growth. Protection of the highly valued natural areas from invasive species and their management is the most expensive form of control and involves continual time and resource investment (Jardine & Sanchirico, 2018).

An increasingly important component of invasive species management involves the formal assessment of risks associated with certain species becoming invasive and causing impact (Kumschick & Richardson, 2013). Expert judgement is considered an important element of the risk assessment, which is reflected at the level of expertise needed to complete the risk assessment (Verbrugge et al., 2010). However, risk assessment protocols require data on spatial distribution of certain alien species to predict its establishment and spread. Therefore, constant studies on the introduction of alien species, and the reproduction and state of populations should be performed aiming to obtain precise information needed for risk assessments, control and management of invasive species.

The aim of this study was to assess the potential and importance of introduction pathways for invasive alien plant species of European Union concern, to estimate probability of their establishment and further spread in Lithuania. This knowledge is important aiming to define means of prevention of their introduction, urgency of early detection and rapid eradication as well as management of already occurring invasive species.

MATERIALS AND METHODS

Twenty tree plant species, which are currently recognized as invasive alien species of European Union concern according to the Regulation (EU) 1143/2014 of the European Parliament and of the Council of 22 October 2014 on the prevention and management of the introduction and spread of invasive alien species and in the amendments made in 2016 and 2017 (EU 2016/1142, EU 2017/1263), were analysed in this study. The nomenclature of the analysed taxa is applied as it is used in the above-mentioned legal acts.

Pathways of the introduction of alien species (Table 1) were defined and classified according to the recommendations provided by the Subsidiary Body on Scientific, Technical and Technological Advice of the Convention on Biological Diversity (CBD, 2014).

Information on the characteristics of individual studied species was obtained from numerous publications dealing with their distribution (Preston & Croft, 1997; Fremstad & Elven, 2006; Nielsen et al., 2008; Sárkány et al., 2008; Poindexter, 2010; Prakasa & Satish, 2016, etc.), taxonomy (Jahodová et al., 2007; Iamonico & Pino, 2015, etc.), biology (Shen et al., 2005; Ruaux et al., 2009, etc.), ecology (Mitich, 2000; Rahlao et al., 2009; Hussner, 2012; Rutkowski et al., 2015, etc.), invasiveness (Castri et al., 1990; Alberternst & Nawrath, 2002; Gioria & Osborne, 2009; Wang et al., 2009; Gnanavel, 2013; Caño et al., 2014; Jasprica et al., 2017, etc.) or published risk assessments (Verbrugge et al., 2010; Nehring & Kolthoff, 2011; Lafontaine et al., 2013; Matthews et al., 2013, etc.).

Table 1. Pathways for the introduction of alien species (CBD, 2014; modified removing pathways irrelevant for the analysed plant species)

Pathway group	Code	Pathway
1. Release in nature	1.2.	Erosion control, dune stabilization (windbreaks, hedges)
	1.8.	Other intentional release
2. Escape from confinement	2.3.	Botanical garden, zoo, aquaria (excluding domestic aquaria)
	2.4.	Pet, aquarium, terrarium species (including live food for such species)
	2.9.	Ornamental purpose other than horticulture
3. Transport (contaminant)	3.1.	Contaminant nursery material
	3.3.	Food contaminant (including of live food)
	3.8.	Seed contaminant
	3.10.	Transportation of habitat material (soil, vegetation, etc.)
4. Transport (stowaway)	4.1.	Angling, fishing equipment
	4.2.	Container, bulk
	4.6.	People and their luggage, equipment (in particular tourism)
	4.8.	Ship, boat ballast water
	4.10.	Vehicles (car, train, etc.)
5. Corridor	5.1.	Interconnected waterways, basins, seas
6. Unaided	6.1.	Natural dispersal across borders of invasive alien species that have been introduced through pathways 1 to 5

The data on species occurring in Lithuania were obtained from the published studies (Gudžinskas & Sinkevičienė, 1995; Gudžinskas, 1998; Gudžinskas & Žalneravičius, 2017, etc.), herbarium collections stored at the Institute of Botany of the Nature Research Centre (BILAS) and the unpublished data on observations performed by the authors.

RESULTS

Analysis of all available information on 23 invasive alien plant species of European Union concern revealed that three species (*Asclepias syriaca*, *Heracleum sosnowskyi* and *Impatiens glandulifera*) currently occur in Lithuania in natural and anthropogenic habitats (Table 2). Two of these, *Heracleum sosnowskyi* and *Impatiens glandulifera*, are widespread and considered as invasive in the country, whereas *Asclepias syriaca* is quite rare naturalized plant and it should be treated as potentially invasive species.

Heracleum sosnowskyi is the most widespread invasive plant species of EU concern registered in Lithuania. It is common almost all-over the territory of the country except the southern part of West Lithuania and certain areas in South Lithuania, where dry pine forests prevail. *Heracleum sosnowskyi* occupies a wide range of habitats, primarily occurring in almost all types of meadows (dry grassland, mesic meadows, wet meadows and tall herb fringe communities, anthropogenic and cultivated grasslands). Quite frequently this species invades grey and black alder stands, forest edges, habitats of springs, certain types of wetlands. *Impatiens glandulifera* is also a widespread species in Lithuania; however, it is somewhat less frequent in Central and West Lithuania. This species invades almost all types of riparian habitats, however, the most frequent and abundant is in tall herb fringe communities, grey and black alder stands, springy areas and various anthropogenic habitats. Occasionally *Impatiens glandulifera* invades reed-beds, mixed and coniferous (spruce) forests. *Asclepias syriaca* has been registered in several localities of the southern part of Lithuania so far. This naturalized species occurs mainly in dry and mesic grasslands, along edges of forests, in anthropogenic habitats along former settlements; occasionally it occupies tall herb fringe communities. In several localities, the stands of *Asclepias syriaca* occupy significant areas, and it is a dominant species in the plant communities.

The remaining 20 plant species have not been registered in the wild in Lithuania so far. However, this group of species is also heterogeneous. At least four of 20 species (*Gunnera tinctoria*, *Lysichiton americanus*, *Myriophyllum aquaticum* and *Pennisetum setaceum*) are occasionally cultivated in gardens

Table 2. Occurrence, estimated probability of naturalization and invasiveness of alien plants of European Union concern in Lithuania

No.	Plant name	Occurrence	Naturalization	Invasion
1.	*Alternanthera philoxeroides*	not confirmed	unlikely	unlikely
2.	*Asclepias syriaca*	nature	naturalized	potential
3.	*Baccharis halimifolia*	not confirmed	possible	unlikely
4.	*Cabomba caroliniana*	indoors	unlikely	unlikely
5.	*Eichhornia crassipes*	indoors	unlikely	unlikely
6.	*Elodea nuttallii*	indoors	possible	possible
7.	*Gunnera tinctoria*	gardens	possible	unlikely
8.	*Heracleum mantegazzianum*	not confirmed	possible	potential
9.	*Heracleum persicum*	not confirmed	possible	potential
10.	*Heracleum sosnowskyi*	nature	naturalized	confirmed
11.	*Hydrocotyle ranunculoides*	indoors	possible	possible
12.	*Impatiens glandulifera*	nature	naturalized	confirmed
13.	*Lagarosiphon major*	indoors	possible	possible
14.	*Ludwigia grandiflora*	not confirmed	unlikely	unlikely
15.	*Ludwigia peploides*	not confirmed	unlikely	unlikely
16.	*Lysichiton americanus*	gardens	possible	possible
17.	*Microstegium vimineum*	not confirmed	unlikely	unlikely
18.	*Myriophyllum aquaticum*	gardens	possible	potential
19.	*Myriophyllum heterophyllum*	indoors	possible	unlikely
20.	*Parthenium hysterophorus*	not confirmed	unlikely	unlikely
21.	*Pennisetum setaceum*	gardens	possible	possible
22.	*Persicaria perfoliata*	not confirmed	possible	possible
23.	*Pueraria montana* var. *lobata*	not confirmed	possible	possible

or other outdoor areas. Thus, these species are more likely to be found escaped from cultivation in the areas close to places of their cultivation. Six species (e.g. *Cabomba caroliniana*, *Eichhornia crassipes, Lagarosiphon major*) are cultivated in aquaria or various indoor spaces (Table 2), therefore, their escape or even intentional release to the wild could not be excluded. The occurrence of ten species (e.g. *Alternanthera philoxeroides*, *Baccharis halimifolia*, *Ludwigia grandiflora*) in gardens, outdoor collections or indoor spaces has not been confirmed in Lithuania, though their existence could not be excluded.

Analysis of the native and alien distribution areas of the studied species and climatic conditions of Lithuania revealed that naturalization of seven species (*Alternanthera philoxeroides*, *Cabomba caroliniana*, *Eichhornia crassipes*, etc.) is unlikely (Table 2). Naturalization of 13 species (*Lysichiton americanus*, *Myriophyllum aquaticum*, *Pennisetum setaceum*, etc.) is possible, at least in certain regions of Lithuania. For example, *Baccharis halimifolia* may become established in coastal areas with relatively mild and less contrasting climate. Besides, urban areas are more suitable for naturalization of the major part of species in case of their introduction. Once naturalized, after a certain lag phase they can start spreading from urban habitats into other suitable areas. There is no doubt about high probability of the naturalization and spread of *Elodea nuttallii*, *Heracleum mantegazzianum* and *Heracleum persicum* in Lithuania, because these species are already naturalized and invasive in the neighbouring countries with similar or even cooler climate. Five of the analysed and still not recorded species are recognized as potentially invasive in Lithuania. Invasion of other five species is possible, whereas invasion of the remaining 10 species is unlikely (Table 2).

The number of possible introduction pathways varies among the studied species. Some species may be introduced by two or three pathways (e.g. *Baccharis halimifolia*, *Cabomba caroliniana*, *Hydrocotyle ranunculoides*), whereas the introduction of other species may happen by five or more pathways (e.g. *Elodea nuttallii*, *Heracleum mantegazzianum*, *Heracleum persicum*) (Table 3).

Table 3. Probable introduction pathways of the alien plants of EU concern to Lithuania. Codes of the introduction pathways are presented in Table 1

Pathways	Plant name
1.2.	*Baccharis halimifolia*
1.8.	*Asclepias syriaca*, *Impatiens glandulifera*
2.3.	*Alternanthera philoxeroides*, *Baccharis halimifolia*, *Heracleum mantegazzianum*, *Heracleum persicum*, *Heracleum sosnowskyi*, *Ludwigia grandiflora*, *Ludwigia peploides*, *Pennisetum setaceum*
2.4.	*Cabomba caroliniana*, *Eichhornia crassipes*, *Elodea nuttallii*, *Hydrocotyle ranunculoides*, *Lagarosiphon major*, *Myriophyllum aquaticum*, *Myriophyllum heterophyllum*
2.9.	*Alternanthera philoxeroides*, *Asclepias syriaca*, *Baccharis halimifolia*, *Cabomba caroliniana*, *Eichhornia crassipes*, *Elodea nuttallii*, *Gunnera tinctoria*, *Heracleum mantegazzianum*, *Heracleum persicum*, *Heracleum sosnowskyi*, *Hydrocotyle ranunculoides*, *Impatiens glandulifera*, *Ludwigia grandiflora*, *Ludwigia peploides*, *Lysichiton americanus*, *Microstegium vimineum*, *Myriophyllum aquaticum*, *Myriophyllum heterophyllum*, *Pennisetum setaceum*, *Persicaria perfoliata*, *Pueraria montana* var. *lobata*
3.1.	*Alternanthera philoxeroides*, *Heracleum mantegazzianum*, *Heracleum persicum*, *Heracleum sosnowskyi*, *Parthenium hysterophorus*, *Pennisetum setaceum*, *Pueraria montana* var. *lobata*
3.3.	*Parthenium hysterophorus*, *Persicaria perfoliata*
3.8.	*Microstegium vimineum*, *Parthenium hysterophorus*, *Persicaria perfoliata*
3.10.	*Heracleum mantegazzianum*, *Heracleum sosnowskyi*, *Impatiens glandulifera*, *Lysichiton americanus*, *Pennisetum setaceum*
4.1.	*Elodea nuttallii*
4.2.	*Parthenium hysterophorus*
4.6.	*Gunnera tinctoria*, *Heracleum mantegazzianum*, *Heracleum persicum*, *Heracleum sosnowskyi*, *Microstegium vimineum*, *Pennisetum setaceum*
4.8.	*Persicaria perfoliata*
4.10.	*Asclepias syriaca*, *Gunnera tinctoria*, *Heracleum mantegazzianum*, *Heracleum persicum*, *Heracleum sosnowskyi*, *Impatiens glandulifera*, *Pennisetum setaceum*, *Persicaria perfoliata*
5.1.	*Elodea nuttallii*, *Heracleum mantegazzianum*, *Heracleum sosnowskyi*, *Impatiens glandulifera*
6.1.	*Elodea nuttallii*, *Heracleum mantegazzianum*, *Heracleum persicum*, *Heracleum sosnowskyi*, *Impatiens glandulifera*

Individual pathways of the introduction of alien species are also of different significance (Fig. 1). Four pathways (1.2. Erosion control, dune stabilization; 4.1. Angling, fishing equipment; 4.2. Container, bulk; 4.8. Ship, boat ballast water) may be important for introduction of only one species, whereas other pathways (e.g. 2.3. Botanical garden, zoo, aquaria (excluding domestic aquaria); 2.4. Pet, aquarium, terrarium species (including live food for such species); 3.1. Contaminant nursery material) may contribute to introduction of seven or more species. It should be noted that the most important pathway for the analysed species is introduction of plants for ornamental purposes (2.9.) (Fig. 1). This pathway can contribute to the introduction of 21 analysed species.

Special attention should be paid to the natural dispersal across the state borders of invasive alien species that have already been introduced by other introduction pathways (6.1.). This introduction pathway is important for five species, three of which have not been recorded in Lithuania, but occur in the neighbouring or relatively close regions of Europe (*Elodea nuttallii*, *Heracleum mantegazzianum*, *Heracleum persicum*).

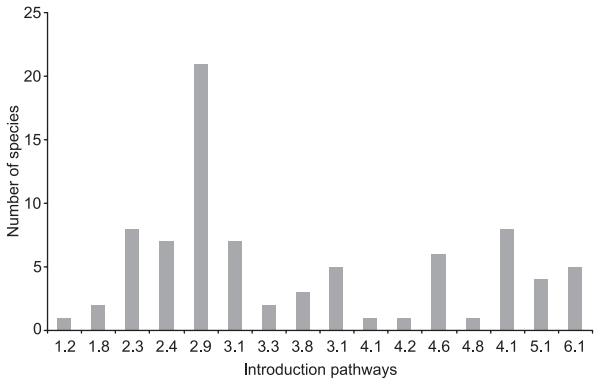

Fig. 1. Importance of the introduction pathways for invasive alien plants of EU concern in Lithuania. Most of plant species may be introduced by more than one pathway, therefore, the sum of species accross the pathways is significantly higher than the total number of the analysed plant species. Codes of the introduction pathways are presented in Table 1

Probability of introduction to Lithuania of five analysed species (*Alternanthera philoxeroides*, *Ludwigia grandiflora*, *Ludwigia peploides*, *Microstegium vimineum* and *Pueraria montana* var. *lobata*) was estimated as low. Moderate probability of introduction to the country was estimated for five species (*Baccharis halimifolia*, *Gunnera tinctoria*, *Hydrocotyle ranunculoides*, *Parthenium hysterophorus* and *Persicaria perfoliata*), and the probability of introduction of the remaining ten species (species already occurring in the country were excluded) was estimated as high (Table 4).

DISCUSSION

Introduction and naturalization of alien species is always hardly predictable and depends on many stochastic events and their various combinations. Nevertheless, based on information about current distribution of species, risk assessments, pathways of introduction and ecological requirements it is possible to predict the probability level of introduction and invasion for each species (Table 4).

In planning measures for the prevention of introduction and possible invasion, the highest priority should be paid to the prevention of introduction and early detection of species with a high probability level of introduction and particularly to the species with both high probability of introduction and invasion (Table 4). Pathways and potential places of introduction of the species with moderate probability of invasion should be permanently controlled and observed. Introduction pathways of species with low probability of introduction and invasion should be also permanently controlled, but places of their possible introduction may be observed periodically with several year intervals.

Most significant introduction pathway of invasive plant species of European Union concern to Lithuania is ornamental gardening. Among 18 plant species legally recognized as invasive in Lithuania, 12 species

Table 4. Probability levels of introduction and invasion of alien invasive plants of European Union concern, which still have not been recorded in Lithuania

Probability level	Introduction	Invasion
Low	*Alternanthera philoxeroides* *Ludwigia grandiflora* *Ludwigia peploides* *Microstegium vimineum* *Pueraria montana* var. *lobata*	*Alternanthera philoxeroides* *Baccharis halimifolia* *Cabomba caroliniana* *Eichhornia crassipes* *Gunnera tinctoria* *Ludwigia grandiflora* *Ludwigia peploides* *Microstegium vimineum* *Myriophyllum heterophyllum* *Parthenium hysterophorus*
Moderate	*Baccharis halimifolia* *Gunnera tinctoria* *Hydrocotyle ranunculoides* *Parthenium hysterophorus* *Persicaria perfoliata*	*Elodea nuttallii* *Hydrocotyle ranunculoides* *Lagarosiphon major* *Lysichiton americanus* *Pennisetum setaceum* *Persicaria perfoliata* *Pueraria montana* var. *lobata*
High	*Cabomba caroliniana* *Eichhornia crassipes* *Elodea nuttallii* *Heracleum mantegazzianum* *Heracleum persicum* *Lagarosiphon major* *Lysichiton americanus* *Myriophyllum aquaticum* *Myriophyllum heterophyllum* *Pennisetum setaceum*	*Heracleum mantegazzianum* *Heracleum persicum* *Myriophyllum aquaticum*

have been introduced as ornamentals (Gudžinskas & Žalneravičius, 2017). However, studies on the diversity of cultivated ornamental plants and search for species that could pose threat of invasion in the future, is a very complicated task because of large number of private gardens with multitude of ornamental plants introduced from various sources, and difficult or even impossible access of private areas for investigators. Therefore, in cases of introduction of dangerous species it becomes possible only after certain time, when plants become more frequent in cultivation or start spreading from gardens into surrounding areas. Thus, continual investigations on the diversity of alien species close to gardens, around settlements, in rural and urbanized areas and their vicinities are necessary to reveal new alien species.

It is even more difficult to study the diversity of plant species cultivated in private aquaria, terraria or other indoor areas. Many of aquatic plant species may escape accidentally or can be released intentionally to the bodies of water. Control of plants cultivated in aquaria, terraria and other indoor spaces is extremely difficult. Total prohibition to sell invasive species cannot stop their cultivation, because people frequently obtain plants through exchange. Mislabelling of aquatic and terrestrial plants provided for sale also becomes increasingly frequent after a ban to trade certain species enters into the force (Sarver et al., 2008; Thum et al., 2012; Zaya et al., 2017).

Several aquatic plant species have moderate probability of invasion in Lithuania. Conditions of aquatic habitats are less contrasting compared to terrestrial habitats and even in winter temperatures in the water remain positive (Bornette & Puijalon, 2011) and aquatic alien species, if introduced, have more possibilities to naturalize. Therefore, special attention should be paid to the investigations on water bodies with higher risk of accidental or intentional introduction of alien species (bodies of water located within or in proximity of cities and villages).

Special attention should be paid to possible introduction of *Heracleum mantegazzianum* and *Heracleum persicum*, because these species have been recorded in the neighbouring countries (EPPO, 2009). If introduced, they could easily become naturalized and invasive, as climate conditions in Lithuania correspond to the climate in regions where these species are naturalized or invasive (Klingenstein, 2007; EPPO, 2009; Rijal et al., 2017). Although *Heracleum mantegazzianum* and *Heracleum persicum* have not been recorded in Lithuania so far, occurrence of their isolated populations cannot be excluded and, therefore, thorough taxonomic study on this genus is required.

Although the most important pathways of unintentional introduction of many alien species are common across the European Union member states, certain peculiarities of introduction pathways vary among regions or countries depending on their geographic location, natural conditions, economy, trade, traditions and even geopolitical environment. European Union countries, e.g. Lithuania, bordering with non-member states, meet with a higher risk of unintentional introduction of invasive alien species from countries in which the Regulation is not applied and in which different policy towards alien species is being applied. Higher risk of invasion under the influence of natural factors can be illustrated by an example of Lithuania and the neighbouring Kaliningrad Region of Russia. Several plant species that are recognized as invasive in Lithuania and their intentional propagation is restricted (e.g. *Gypsophila paniculata*, *Rosa rugosa*, etc.) in Kaliningrad Region are legally considered as protected species (i.e. *Gypsophila paniculata*) or intensively planted for erosion control and ornamental purposes (i.e. *Rosa rugosa*) (Gubareva, 2017).

Different legislation on invasive species is also being applied in Belarus (Dubovik et al., 2017). The list of invasive plants, which are prohibited to cultivate in Belarus, was adopted in 2016 and it includes nine species, however, there are no legal limitations for trade and cultivation of invasive plant species of European Union concern. As the main rivers in Lithuania (the Nemunas and Neris) flow from Belarus, there is a high probability that some invasive plants may enter Lithuania by water and river valleys. It is well known that rivers are among the most important migration corridors for aquatic alien species (Calçada et al., 2013; Rakauskas et al., 2016; Rinaldo et al., 2018). However, control of plant migration by natural pathways is very complicated or even impossible. Therefore, harmonization of legal acts and search for common solutions with neighbouring countries are among the priority tasks aiming to prevent and control the spread of invasive species.

Early detection and eradication of alien plant species is the most important task aiming to prevent further spread of harmful invasive species (Westbrooks, 2004; Mehta et al., 2007; Simpson et al., 2009). However, early detection of alien species requires good knowledge about the native plant species and general expertise in plant taxonomy. Unfortunately, a rapid decrease of student interest in plant taxonomy and, therefore, reduction of the number of trained practicing taxonomists already is a serious obstacle to perform thorough studies on certain plant groups and in the nearest future the situation could become even more complicated. Therefore, it is very important to ensure continuous training of specialists.

A significant contribution to the knowledge about the diversity and distribution of native and alien species in some European countries comes from citizens (Crall et al., 2010; Gallo & Waitt, 2011; Tsiamis et al., 2017). In Lithuania, unfortunately, traditions of the citizen science in the field of botany are quite weak and only few amateurs periodically report to specialists their findings of easily recognizable and spectacular plant species. Nevertheless, rising of public awareness about invasive species and involvement into surveys nature conservation specialists working in administrations of protected areas as well as employed at the local authorities could contribute significantly to the early detection of invasive alien species. Detection of potentially dangerous alien species enables to respond and act immediately. Early detection, rapid response and immediate eradication of invasive species enable to reduce costs of invasive species control and diminish negative effect on the nature.

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EUROPOS SĄJUNGOS SUSIRŪPINIMĄ KELIANČIŲ SVETIMŽEMIŲ INVAZINIŲ RŪŠIŲ AUGALŲ INTRODUKCIJOS, NATŪRALIZACIJOS IR TOLESNIO PLITIMO GALIMYBIŲ LIETUVOJE VERTINIMAS

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Santrauka

Į Europos Sąjungos susirūpinimą keliančių svetimžemių invazinių rūšių sąrašą dabar įrašytos 23 augalų rūšys. Šio tyrimo tikslas buvo įvertinti galimus invazinių rūšių introdukcijos į Lietuvą kelius ir jų reikšmingumą, nustatyti rūšių natūralizacijos ir tolesnio plitimo šalyje tikimybę.

Išnagrinėjus ir įvertinus visą turimą informaciją apie Europos Sąjungos susirūpinimą keliančias svetimžemes invazines rūšis nustatyta, kad Lietuvoje aptinkamos trys rūšys (*Asclepias syriaca*, *Heracleum sosnowskyi* ir *Impatiens glandulifera*). Dvi iš jų (*Heracleum sosnowskyi* ir *Impatiens glandulifera*) Lietuvoje yra plačiai paplitusios ir laikomos invazinėmis. Kitų 20 rūšių augalai šalies teritorijoje gamtoje iki šiol nebuvo aptikti. Iš jų keturių rūšių augalai (*Gunnera tinctoria*, *Lysichiton americanus*, *Myriophyllum aquaticum* ir *Pennisetum setaceum*) kartais auginami gėlynuose arba lauko kolekcijose, o dar šešių rūšių augalai (pvz., *Cabomba caroliniana*, *Eichhornia crassipes, Lagarosiphon major*) auginami akvariumuose, kambariuose arba kitose patalpose.

Nustatyta, kad septynių į sąrašą įrašytų rūšių natūralizacija Lietuvoje yra mažai tikėtina, o 13 rūšių natūralizacija yra galima. Penkių nagrinėtų rūšių augalai, kurie Lietuvoje iki šiol neaptikti gamtoje, yra potenciaiai invaziniai, penkių rūšių augalai gali tapti invazi-

niais, o dar 10 rūšių augalų invazija yra mažai tikėtina.

Svarbiausias Europos Sąjungos susirūpinimą keliančių svetimžemių invazinių rūšių introdukcijos kelias yra dekoratyvinė sodininkystė. Trijų rūšių augalai, kurie iki šiol Lietuvoje neaptikti, bet randami gretimose Europos valstybėse arba netolimuose regionuose (*Elodea nuttallii*, *Heracleum mantegazzianum*, *Heracleum persicum*), į šalį gali patekti natūraliais plitimo keliais (pernešami vėjo, vandens, gyvūnų ir kt.).

Straipsnyje aptariama nuolatinių ir išsamių svetimžemių augalų ir potencialių introdukcijos vietų tyrimų svarba. Labai svarbu užkirsti kelią šioms rūšims patekti į aplinką arba kuo anksčiau nustatyti invazinių rūšių židinius ir laiku imtis naikinimo priemonių. Kai invaziniai organizmai pradedami naikinti vos patekę į naują teritoriją, juos galima visiškai išnaikinti, o priemonėms įgyvendinti reikia palyginti nedidelių laiko ir lėšų sąnaudų.