

ADDITIONS AND CORRECTIONS TO THE LIST OF ALIEN PLANT SPECIES OF LITHUANIA

Zigmantas GUDŽINSKAS

Nature Research Centre, Institute of Botany, Žaliūjū Ežerų Str. 49, Vilnius LT-08406, Lithuania
 E-mail: zigmantas.gudzinskas@gamtc.lt

Abstract

Gudžinskas Z., 2018: Additions and corrections to the list of alien plant species of Lithuania. – *Botanica*, 24(1): 26–36.

Addition of nine alien plant species and correction of the taxonomic position of one alien species was provided in this publication. Occurrence of three species, *Gossypium hirsutum*, *Leymus racemosus* and *Senna obtusifolia*, has not been reported in Lithuania, yet. *Gossypium hirsutum* and *Senna obtusifolia* are casual grain immigrants and their naturalization in the country is unlikely. *Leymus racemosus* probably has spread to Lithuania from Kaliningrad region of Russia, where it has been introduced intentionally. Currently, this species is treated as naturalized in the Curonian Spit (Western Lithuania). The status of *Bellis perennis*, which previously had variously been treated as native or alien species in Lithuania, was discussed. Although *Malus domestica*, *Medicago ×varia*, *Oenothera casimiri* and *Salix ×fragilis* have been reported occurring in Lithuania long ago, their status in the country has not been clearly defined. Considering non-native origin of one or both parental species of these four species, they also should be treated as alien in the country. Based on the results of taxonomic treatments, the occurrence of *Salix euxina* in Lithuania was confirmed. Cultivated and escaped plants, formerly known under the name *Aronia melanocarpa*, in fact are intergeneric hybrids and should be treated as *×Sorbaronia mitschurinii*. Distribution, habitats, naturalization and impact of ten alien species were discussed. Notes on the taxonomy of several alien species were presented. Comments on improper documentation of several published molecular studies were presented and problems of the result interpretation were discussed.

Keywords: alien species, distribution, hybrids, invasion, naturalization, nomenclature, taxonomy.

INTRODUCTION

More than thirty years have passed since the start of my studies in 1987 on alien plant species in Lithuania. During this time, more than 200 species of earlier non-registered alien plants have been discovered, and a lot of information on their distribution, naturalization, ecology and biology has been collected (GUDŽINSKAS, 1989, 1993, 1994, 1997a, 2017; GUDŽINSKAS & PETRULAITIS, 2014; GUDŽINSKAS et al., 2014, 2017). Some plant species have not been identified immediately, and only after several decades, with additional information gathered, it has become possible to determine their identity, although a small fraction of the samples collected so

far have not been identified and this should be done in the future. The opinion on the status of some species in the country has also changed due to the accumulation of more information on their distribution, habitats and population structure (GUDŽINSKAS, 1997b).

During the last decades, the taxonomic treatment of some plant groups has changed significantly because of the acceptance of broader or narrower species concept and, thus, certain corrections have become necessary (BELYAEVA, 2009; SENNIKOV & PHIPPS, 2013, etc.). There is no doubt that in the future, based on the results of new researchers, the taxonomic position of other species will be clarified, and appropriate changes will be required.

Human activities promote species hybridization by breaking the isolation barriers between the species and creating new habitats suitable for hybrids (GUO, 2014). The increase of the number and frequency of hybrids between the native and alien species in many regions of the world has been acknowledged (VILĀ et al., 2000; RICHARDSON & PYŠEK, 2006; BLAIR & HUFBAUER, 2010; PLISZKO & ZALEWSKA-GALOSZ, 2016).

Several decades ago, it was believed that hybrids between the native and alien species should be considered as native (e.g., NATKEVIČAITĖ-IVANAUSKIENĖ, 1980; ROSTAŃSKI, 2004, etc.), however, now the concept to treat such hybrids as aliens is widely accepted (PYŠEK et al., 2004; GUO, 2014). Therefore, some previously reported natural hybrids between the native and alien species or between alien species should be added to the list of alien species.

The aim of this study was to update information on alien species, which were first recorded in Lithuania several decades ago and only recently have been identified, to evaluate the disputable status of several species in the country as well as to present corrections of the taxonomic treatment of earlier reported alien plant species.

MATERIALS AND METHODS

Results of the field studies performed in the period from 1988 to 2016 were used to prepare this publication. Herbarium material of the analysed species stored in the collections of the Herbarium of the Institute of Botany of the Nature Research Centre (BILAS) and the Life Sciences Centre of Vilnius University (WI) were studied. Voucher specimens of the newly reported alien species and those collected by the author were deposited at BILAS.

Plant families were provided in accordance with an updated Angiosperm Phylogeny Group Classification for the orders and families of flowering plants (APG, 2016).

RESULTS AND DISCUSSION

New species

Gossypium hirsutum L. (Malvaceae) is native to the region of the Gulf of Mexico and the Caribbean

Sea (FRYXELL, 1992; FRYXELL & HILL, 2015). Nowadays, *Gossypium hirsutum* on an industrial scale is cultivated for textile fibre in more than 50 countries of the world, which comprises about 90% of world cotton production (SEELANAN et al., 1999; SMITH, 1999).

Gossypium hirsutum was first recorded in Lithuania in 1989 in the yard of railway freight station in Vilnius. Single individual at vegetative stage was found among railway tracks. In the same year, this species was also recorded in Varėna grain mill yard and at Paneriai (Vilnius city) railway station, among railway tracks. One individual of this species was recorded in 1990 at Kaunas railway station. In all cases, vegetative individuals of various sizes (10–40 cm high) were found. This species has probably been introduced to Lithuania accidentally with imported grain or with other supplements used for preparation of the compound feed. *Gossypium hirsutum* is a casual species in Lithuania and its establishment in the country is almost impossible because of unsuitable climatic conditions.

Leymus racemosus (Lam.) Tzvel. (Poaceae). In Lithuania, it was first recorded in 1996 on the dunes of the Baltic Sea in the environs of Pervalka and Nida (Curonian Spit) by J. Stankevičiūtė (BILAS, No. 66990, 67003). This species has also been recorded on shifted dunes of the Nagliai Strict Nature Reserve. Plants collected in Lithuania belong to the type subspecies, *Leymus racemosus* subsp. *racemosus*.

This species is native to the south-eastern Europe and Asia, where it usually grows on sands in steppes and semi-deserts (TZVELEV, 1976). According to KRALL et al. (2003), *Leymus racemosus* in Lithuania has been planted; however, there is no other available information on intentional introduction of this species to the Lithuanian part of the Curonian Spit. It was introduced to the southern part of the Curonian Spit (Kaliningrad region of Russia) in the 20th century, and currently is considered as well-established species (GUBAREVA, 2017). Therefore, this species presumably has spread from the territory of Kaliningrad region by natural vectors, i.e. seeds have been carried by storm winds, by the sea water or other means.

Currently, *Leymus racemosus* is a naturalized species, and its further spread can be expected. Although it has not reached the stage of invasion now, this species can be considered as potential threat to biodiver-

sity and natural habitats, because it can compete with the native species *Leymus arenarius* (L.) Hochst. As infraspecific hybridization is quite frequent between the species of the genus *Leymus* (TZVELEV, 1976), a hybridization of *Leymus racemosus* with *Leymus arenarius* is quite possible, though it has not been registered so far.

Senna obtusifolia (L.) H. S. Irwin et Barneby (Fabaceae). *Senna obtusifolia*, earlier usually treated as the representative of the genus *Cassia* (*Cassia obtusifolia* L.), is native to tropical South America, but has become widespread throughout the tropics and subtropics (LORENZI & JEFFERY, 1987; MARTINS et al., 2002; STAPLES et al., 2003). In the native range this species is bushy, 1.5 to 2.5 m height annual or short-lived perennial herb. In Europe, this species has been reported occurring in Spain (RECASENS & CONESA, 1995), Norway (GEDERAAS et al., 2012) and Belgium (VERLOOVE, 2006).

Senna obtusifolia was first recorded in Lithuania in 1988 in the yard of grain mill in Vievis (Elektrėnai distr.). Several individuals growing solitary along the railway were found in vegetative condition. In the same year, one individual of this species was found in the yard of railway station in Kretinga on the railway embankment at the wagon cleaning lot. Single individual of *Senna obtusifolia* was repeatedly recorded in the yard of Kretinga railway station in 1992, and no new findings of this species were made later. This species has been introduced to Lithuania accidentally, probably with imported grain. *Senna obtusifolia* is a casual species in Lithuania, and its establishment in the country is almost impossible, because it can grow and reproduce in the regions with the mean summer temperature of about 25°C (HOLM et al., 1997).

Changes in the status or taxonomic position

Bellis perennis L. (Asteraceae). Discussions about the status of *Bellis perennis* in Lithuania have a long history. In the earliest publications on the flora of Lithuania, *Bellis perennis* was reported as a plant cultivated in gardens for ornamental or medicinal purposes (B.S. JUNDZILL, 1791, 1811; J. JUNDZILL, 1830). ABROMEIT et al. (1898) indicated that in former East Prussia, part of which is the territory of nowadays Lithuania, this species was occasionally recorded escaped from cultivation. NATKEVIČAITĖ (1951) and

SNARSKIS (1954) also treated this species as escaped and locally naturalized in the country. LAZDAUSKAITĖ (1980) believed that in certain meadow communities *Bellis perennis* was native species, whereas in parks and villages it was represented by escaped populations. Based on that opinion, *Bellis perennis* was excluded from the list of alien species of Lithuania (GUDŽINSKAS, 1997c). However, later LAZDAUSKAITĖ et al. (2003) stated that this species was widely naturalized and quite frequent species in Estonia, Latvia and Lithuania. These facts illustrate very well the doubts concerning the status of this species in Lithuania.

First records of escaped *Bellis perennis* in Lithuania were made at the end of the 19th century. ZELENCOV (1890) was probably the first who reported this species escaped in Vilnius, near the St. Peter Church (probably the Church of St. Peter and Paul). Until the middle of the 20th century, this species was quite rare (NATKEVIČAITĖ, 1951). The most intense spread of *Bellis perennis* was in the second half of the 20th century. Now this species is quite frequent and naturalized in Lithuania. Sometimes locally it is dominant in intensively managed swards of urbanized areas. Further spread and wider naturalization of *Bellis perennis* in Lithuania is expected. Considering the abundance of this species in some localities, it should be treated as potentially invasive.

Malus domestica (Suckow) Borkh. (Rosaceae). In Lithuania, *Malus domestica* is a frequent escaped species; however, for a long time it has been neglected, and in the herbaria of Lithuania is represented only by a few specimens collected during the last three decades. Analysis of the published information revealed that *Malus domestica* probably was first reported as escaped species in 1970s in the former Anykščių Šilelis Landscape Reserve (JANKEVIČIENĖ et al., 1979). Later CINOVSKIS et al. (1996) reported this species frequently escaped in the Baltic Countries, which occurred mainly along roads. It should be noted that *Malus domestica* as a naturalized or casual species occurs over a large part of Europe (KURTO et al., 2013).

Nowadays *Malus domestica* is distributed all over the territory of Lithuania and occupies a wide range of natural and anthropogenic habitats. The highest concentrations of escaped individuals occur along roads and railways, in wastelands, abandoned meadows, on banks of rivers and lakes, on forest edges, along

forest tracks, less frequently in light woodlands. Although *Malus domestica* is frequent, usually it does not form pure stands nor becomes dominant in the habitat and cannot be recognized as invasive species. Nevertheless, its negative impact on genetic stability of the native *Malus sylvestris* to a certain extent is highly probable. Hybridization of *Malus domestica* with *Malus sylvestris* has been documented in other regions of Europe (SCHNITZLER et al., 2014; WAGNER et al., 2014) and the hybridization is thought to be having a significant impact on the stability of *Malus sylvestris* population leading to its inclusion into the Red Lists of several European countries (KIK et al., 2011).

The spread of *Malus domestica* is influenced by several factors. High frequency of this species along roads is determined by human habits to throw away seeds containing cores of eaten apples through the window of a car. Rotten apples are frequently dumped together with other garden wastes on forest edges or river banks. Birds and mammals in autumn or winter feed on non-harvested apples in village orchards, which also contributes significantly to the dispersal of seeds. In Lithuania, *Malus domestica* is a naturalized species, the spread of which to natural habitats should be controlled to prevent its impact on the native populations of *Malus sylvestris*.

Nomenclature of *Malus domestica*, which is cultivated almost worldwide for its fruits, has been a subject of disputes for a long time (QUIAN et al., 2010). Frequently, the name *Malus pumila* Mill. and to a lesser extent *Malus communis* Desf. is applied for this species. Aiming to preserve the usage of widely accepted name *Malus domestica*, its conservation and rejection of other competing names (*Malus pumila*, *Malus communis*, etc.) has been proposed (QUIAN et al., 2010) and approved (APPLEQUIST, 2017). Thus, the name *Malus domestica* (Suckow) Borkh. (with a corrected citation of the authors of the name) remains in current use.

Medicago ×varia Martyn (Fabaceae). *Medicago ×varia* is a hybrid originating from the hybridization between the native *Medicago falcata* L. and introduced *Medicago sativa* L. In Lithuania, *Medicago ×varia* was first recorded at the end of the 19th century in Klaipėda [*Memel, S. Plantage b. Memel, 1884*] (ABROMEIT et al., 1898). STANCEVIČIUS (1971) has described this hybrid as a member of the flora

of Lithuania, however, no data on the distribution and frequency is provided. Analysis of herbarium specimens in the Herbaria of Lithuania revealed that the oldest specimen was collected in Panevėžys in 1949, on a slope of the River Nevėžis by P. Snarskis (BILAS, No. 34025). Until the middle of the 20th century, this hybrid was rare (SNARSKIS, 1954). Even at the end of the 20th century, *Medicago ×varia* was still considered as quite rare in Lithuania and in all Baltic countries (LEKAVIČIUS, 1989; TABAKA et al., 1996). Most of *Medicago ×varia* specimens have been collected at railways, along roads or in other anthropogenic habitats. However, in my opinion, this hybrid to a certain extent is neglected by botanists, and, therefore, its distribution in Lithuania is underestimated. Currently, this species in Lithuania is widespread, naturalized and should be treated as an invasive.

Considering current distribution, abundance and occupied habitats by *Medicago ×varia*, it should be treated as invasive species, which threatens stability of the native *Medicago falcata* populations by extensive genetic impact (KALJUND & LEHT, 2013). VYŠNIAUSKIENĖ et al. (2015) basing on the results of inter-simple sequence repeat markers and haplotype analyses of three regions of chloroplast DNA of the *Medicago sativa* and *Medicago falcata* complex from Lithuania have found low genetic differentiation among three subspecies (or species, as accepted here) and concluded existence of an intensive gene flow among the subpopulations. Unfortunately, voucher specimens from populations analysed during this study (VYŠNIAUSKIENĖ et al., 2015) have not been preserved and verification of the identity of the analysed plants or impact of introgression on the morphological characteristics of plants are impossible. In my opinion, low genetic differentiation among the studied taxa could be influenced by the selection of sampled populations. Almost all populations of *Medicago falcata* and *Medicago ×varia* have been sampled on road-sides (VYŠNIAUSKIENĖ et al., 2015). Currently, *Medicago ×varia* is a frequent species in anthropogenic and seminatural habitats. In some studied areas in the southern part of Lithuania this hybrid in dry meadows, which are characteristic habitats for *Medicago falcata*, has become dominant and only a small fraction of individuals has no morphological features of introgression of *Medicago*

sativa. Although in some studied populations of presumed *Medicago falcata* from the southern Lithuania the individuals with variegated, green or black flowers were absent and all plants were with yellow flowers, they differed from typical *Medicago falcata* by evidently larger light-yellow petals and longer inflorescences containing more flowers. Moreover, individuals in such presumably introgressive populations were more robust compared to plants in isolated populations of *Medicago falcata*. Ecological performance and impact of *Medicago* × *varia* (which also includes all swarms of back-crosses with the parental species) on natural habitats and plant communities is insufficiently known and should be evaluated in detail.

Taxonomy of *Medicago sativa* and *Medicago falcata* complex is disputable and two main concepts are usually accepted. Some authors accept *Medicago sativa* with several subspecies, including *Medicago sativa* subsp. *sativa*, *Medicago sativa* subsp. *falcata* (L.) Arcang. and *Medicago sativa* nothosubsp. *varia* (Martyn) Arcang. (SMALL, 2011; KALJUND, 2013, etc.), whereas others treat them as separate species *Medicago sativa* and *Medicago falcata* and their hybrid *Medicago* × *varia* (SAVOVA et al., 1996; WEI & VINCENT, 2010). In my opinion, acceptance of one species, *Medicago sativa*, which includes *Medicago falcata* at the rank of subspecies, is not substantiated. Although SMALL (2011) has proposed widely circumscribed *Medicago sativa* with five subspecies (subsp. *sativa*, subsp. *caerulea* (Less. ex Ledeb.) Schmalh., subsp. *falcata* (L.) Arcang., subsp. *glomerata* (Balbis) Rouy and subsp. × *varia* (T. Martyn) Arcang.) and several varieties, he has not provided clear and justified evidences of such decision. Oversplitting as well as over-lumping of species without hard evidences should be avoided and particularly in cases when extensively cultivated plant species are involved. It is evident that taxonomical questions concerning this species complex can be resolved analysing material collected from native populations rather than based on cultivated plants or naturalized populations, which can frequently include plants affected by breeding or spontaneous hybridization.

Oenothera casimiri Rostański (Onagraceae). This putative hybrid between *Oenothera biennis* L. and *Oenothera rubricaulis* Kleb. has been described

based on specimens from the environs of Druskininkai, South Lithuania (ROSTAŃSKI, 2004). In mixed populations of the parental species it is quite common and has been recorded all over the Eastern Europe (Estonia, Latvia, Lithuania, Poland, Belarus, Ukraine) (ROSTAŃSKI, 2004).

Although *Oenothera casimiri* has been described quite recently, its first specimens in Lithuania were collected in 1930s. The oldest record was made in the environs of Preila (Curonian Spit) in 1934 by E. Purvinas (WI). *Oenothera casimiri* grows in fallow lands, along roads, on dunes, eroded river banks, railway embankments, occasionally in other disturbed areas.

This hybrid is rather easily distinguished from parental species by small flowers and lack of red tubercles on the axis of the inflorescence. This species has been recorded mainly in the eastern and western parts of Lithuania and usually is quite abundant (ROSTAŃSKI & GUDŽINSKAS, 2004). *Oenothera casimiri* is a naturalized species; however, based on current knowledge, its invasion is not likely. Because in the treatment of *Oenothera* species from Lithuania (ROSTAŃSKI & GUDŽINSKAS, 2004), the senior author strictly followed the concept that hybrids originating in Europe from hybridization of non-native species should be considered as native plants, *Oenothera casimiri* has not been recognized as alien. Accepting the current treatment of the status of such hybrids, *Oenothera casimiri* should be listed as alien species in Lithuania as well as in other European countries.

Salix euxina I.V. Belyaeva (Salicaceae). The natural distribution area of *Salix euxina* includes the mountains of Asia Minor and South Georgia in the region of the Black Sea (CHRISTENSEN & JONSELL, 2005; BELYAEVA, 2009). This species has been introduced in Europe and has become widely naturalized; however, because of nomenclatural problems and insufficient knowledge of taxonomy, it has not been separated from *Salix* × *fragilis* L. (BELYAEVA, 2009).

Almost half a century ago, SKVORTSOV (1973) discussed the origin and status of *Salix fragilis* L. in detail, although his concept of the species was slightly different, because he included hybrid and non-hybrid individuals. SKVORTSOV (1973) concluded that this species in Europe was not native. He also noted that ANDERSSON (1868) was the first who expressed the

opinion that *Salix fragilis* was not truly wild and autochthonous in Europe and that it probably originated in southwest Asia (SKVORTSOV, 1973).

HRYNIEWIECKI (1933) has described *Salix fragilis* var. *sphaerica* Hryn., which in fact is synonym of *Salix euxina* (BELYAEVA, 2009; ARGUS, 2010), and has noted that these plants were introduced in western Lithuania in 1785 from Sweden. Furthermore, HRYNIEWIECKI (1933) has treated this species as cultivated plant growing along roads in Lithuania and Latvia. It is possible that this species in the first half of the 20th century was not yet naturalized or was not recorded outside the places of cultivation. Thus, naturalization of *Salix euxina* in Lithuania started presumably in the first half of the 20th century. In Latvia, this species is quite widely cultivated (usually treated as *Salix fragilis* ‘Bullata’) and there are no indications about its naturalization (LAIVIŅŠ et al., 2009).

Analysis of quite scanty herbarium specimens from Lithuania revealed that *Salix euxina* occurs all over the territory; however, in the western part of the country it is somewhat more frequent. This species is naturalized in Lithuania, and judging by the available information, it is not invasive. Nevertheless, detailed studies on reproductive biology, distribution and habitat preferences of this species in Lithuania are required. It should be noted that HRYNIEWIECKI (1933) has recorded only male individuals of *Salix fragilis* var. *sphaerica*. Female plants of *Salix euxina* were not found among the available herbarium specimens from Lithuania, though most of collections are represented by vegetative parts only. Thus, studies on the gender structure of populations should be also performed.

***Salix ×fragilis* L.** (Salicaceae). According to the current concept (BELYAEVA, 2009), *Salix ×fragilis* is a hybrid originating from crosses between *Salix euxina* and *Salix alba* L. It is widely naturalized in Europe, Asia, North America, South America, South Africa and Australia (SKVORTSOV, 1973; BELYAEVA, 2009; ARGUS, 2010). Although *Salix ×fragilis* is a hybrid, it constitutes a characteristic landscape feature over much of Europe (CRONK et al., 2015).

History of the introduction of this species and *Salix euxina* to Europe is not perfectly clear (SKVORTS-

OV, 1973). It is possible that in some areas *Salix ×fragilis* has been introduced, whereas in other regions it could rise spontaneously from crosses between the introduced *Salix euxina* and the native *Salix alba*. In the first studies on the flora of Lithuania, *Salix ×fragilis* has been mentioned as frequent species, growing along water courses, in other wet habitats (B.S. JUNDZILL, 1791, 1811; J. JUNDZILL, 1830) and along roads (ZELENCOV, 1890). Occurrence of this species in Latvia was first reported in 1791, and now is treated as common naturalized species (LAIVIŅŠ et al., 2009).

Studies of the herbarium specimens revealed that this species is distributed all over the territory of Lithuania and is significantly more frequent than *Salix euxina*. It is naturalized in Lithuania, and judging by the available information, it has already reached final stage of invasion, i.e. occupied all suitable habitats and further spread could only take place in the event of the creation of new habitats. Male and female individuals are presented among herbarium specimens of *Salix ×fragilis*; however, female individuals comprise very small fraction of all herbarium specimens. Therefore, studies on the gender structure of *Salix ×fragilis* populations should be also evaluated and may shed light on the potential of its generative reproduction and impact on the integrity of *Salix alba* populations via hybridization.

Although several important genetic studies on the hybridization of *Salix* species have been performed, many unanswered questions remain. Furthermore, sometimes it is difficult to interpret results of molecular studies on *Salix alba* and *Salix fragilis* (MENEHETTI et al., 2007; TRUNG et al., 2008), including very recently published ones (e.g. RUNGIS et al., 2017), because there are no references to voucher specimens and, therefore, it is not possible to verify the accuracy of identification of the studied samples. Furthermore, accepted concept of the species is not always clear. RUNGIS et al. (2017), for example, have treated *Salix fragilis* in a broad sense, probably including both *Salix euxina* and *Salix ×fragilis*, but the true meaning of their hybrid ‘*Salix alba* × *Salix fragilis*’ remains unknown. Judging by the results, they most probably have analysed samples of *Salix alba* and a swarm of hybrids, which should be attributed to *Salix ×fragilis*.

×*Sorbaronia mitschurinii* (A. Skvortsov et Maitul.) Sennikov (Rosaceae). The name *Aronia melanocarpa* (Michx.) Elliott is usually applied for widely cultivated and occasionally escaped and naturalized plants in Europe (STACE, 1997; GUDŽINSKAS, 2000; TYLER et al., 2007; LAIVIŠ et al., 2009; TOKARSKA-GUZIĆ et al., 2014, VINOGRADOVA et al., 2017, etc.). However, studies on cultivated plants have revealed that plants significantly differ from *Aronia melanocarpa*, which is native to North America (HARDIN, 1973; LEONARD et al., 2013). Therefore, SKVORTSOV & MAITULINA (1982) have described plants of the garden origin as a new species *Aronia mitschurinii* A. Skvortsov et Maitul. Further studies on these plants have confirmed that *Aronia mitschurinii* in fact is intergeneric hybrid originating from crosses between *Aronia melanocarpa* and *Sorbus aucuparia* L. (LEONARD et al., 2013). Although LEONARD et al. (2013) have discussed the relationships of *Aronia mitschurinii* with the genus ×*Sorbaronia* (= *Aronia* × *Sorbus*), they refused to ascribe this species to this genus formally, because it originates from backcross of the hybrid with one parental species [(*Aronia* × *Sorbus*) × *Aronia*]. The transfer of *Aronia mitschurinii* to the genus ×*Sorbaronia* has been formalized by SENNIKOV (SENNIKOV & PHIPPS, 2013). Therefore, plants from Lithuania earlier identified as *Aronia melanocarpa* (auct. non (Michx.) Elliott) in fact belong to ×*Sorbaronia mitschurinii*.

In Europe, ×*Sorbaronia mitschurinii* as escaped from cultivation has been reported in Estonia, Lithuania and Russia, including Kaliningrad Region (KURTTO et al., 2013). Considering quite extensive cultivation of this species in gardens and plantations, particularly in Central and East Europe, its records

in other regions are highly probable. In Lithuania, escaped ×*Sorbaronia mitschurinii* has been recorded in several localities and some of these have been revealed in quite a distance from places of cultivation, i.e. in raised bogs and peatlands (GUDŽINSKAS, 2000; GUDŽINSKAS et al., 2014). During the last decade, this species has been increasingly found escaped in various habitats, but most of new records have been made in pine forests on sands, occasionally in swamp pine forests. Fruit-eating birds are, probably, the main vector of the spread of this species to natural and seminatural habitats. ×*Sorbaronia mitschurinii*, as it has been indicated earlier (GUDŽINSKAS, 2000), should be considered as naturalized species; however, its invasion is unlikely in Lithuania. Nevertheless, control and eradication of ×*Sorbaronia mitschurinii* in forest and bog habitats of nature conservation areas is recommended to avoid its negative impact on their structure and biodiversity.

Most of the species analysed, have been deliberately introduced to Lithuania, and escaped from cultivation (*Bellis perennis*, *Malus domestica*, *Salix euxina*, *Salix* ×*fragilis* and ×*Sorbaronia mitschurinii*), whereas *Medicago* ×*varia* and *Oenothera casimiri* most probably is a result of spontaneous hybridization between the native and introduced species or between two alien species. Two species, *Gossypium hirsutum* and *Senna obtusifolia*, in Lithuania have been introduced accidentally with imported grain, and *Leymus racemosus* has probably spread by natural means from areas of its deliberate introduction in the Kaliningrad Region of Russia. Only two accidentally with grain introduced species are casuals and their naturalization in Lithuania is unlikely, whereas all other species are naturalized in the country (Table 1).

Table 1. Time of the first record in Lithuania, frequency, naturalization and invasiveness of the analysed alien species

Species	First record	Frequency	Naturalization	Invasiveness
<i>Gossypium hirsutum</i>	1989	Very rare	Casual	Not invasive
<i>Leymus racemosus</i>	1996	Rare	Naturalized	Potentially invasive
<i>Senna obtusifolia</i>	1988	Very rare	Casual	Not invasive
<i>Bellis perennis</i>	1890	Quite frequent	Naturalized	Potentially invasive
<i>Malus domestica</i>	1979	Common	Naturalized	Potentially invasive
<i>Medicago</i> × <i>varia</i>	1884	Common	Naturalized	Invasive
<i>Oenothera casimiri</i>	1934	Quite frequent	Naturalized	Not invasive
<i>Salix euxina</i>	20th century	Quite frequent	Naturalized	Not invasive
<i>Salix</i> × <i>fragilis</i>	1791	Common	Naturalized	Potentially invasive
× <i>Sorbaronia mitschurinii</i>	1987	Quite rare	Naturalized	Potentially invasive

Analysis of the considered species distribution in Lithuania revealed that accidentally introduced species are rare or very rare, whereas other species are quite frequent or common (Table 1). Similar frequency was revealed for hybrids, which had formed spontaneously in Lithuania.

Studies on the dynamics of distribution of the analysed species revealed that *Medicago ×varia* has spread most drastically during the last decades and it should be treated as invasive species, which threatens genetic stability of the populations of native *Medicago falcata*. Other five species show signs of invasiveness and their spread should be controlled at least in the protected or important habitat areas. Further studies on the spread, impact on populations of native species, plant communities and habitats as well as research on certain biological properties are required for *Leymus racemosus*, *Bellis perennis*, *Medicago ×varia*, *Salix euxina* and *Salix ×fragilis*.

REFERENCES

- ABROMEIT J., JENTZSCH A., VOGEL G., 1898: Flora von Ost- und Westpreussen. 1. Hälfte. – Berlin.
- ANDERSSON N.J., 1868: *Salix*. – In: DE CANDOLLE A.P. (ed.), *Prodromus systematis naturalis regni vegetabilis*, 16(2): 190–323. – Genève.
- APG, 2016: An update of the Angiosperm Phylogeny Group classification for the orders and families of flowering plants. APG IV. – *Botanical Journal of the Linnean Society*, 181: 1–20.
- APPLEQUIST W.L., 2017: Report of the Nomenclature Committee for Vascular Plants: 69. – *Taxon*, 66(2): 500–513.
- ARGUS G.W., 2010: *Salix* Linnaeus. – In: Flora of North America north of Mexico. Magnoliophyta: Salicaceae to Brassicaceae, 7: 23–164. – New York–Oxford.
- BELYAEVA I., 2009: Nomenclature of *Salix fragilis* L. and a new species, *S. euxina* (Salicaceae). – *Taxon*, 58(4): 1344–1348.
- BLAIR A.C., HUFBAUER R.A., 2010: Hybridization and invasion: one of North America's most devastating invasive plants shows evidence for a history of interspecific hybridization. – *Evolutionary Applications*, 3: 40–51.
- CHRISTENSEN K.I., JONSELL B., 2005: Proposal to conserve the name *Salix fragilis* with the conserved type (Salicaceae). – *Taxon*, 54(2): 555–556.
- CINOVSKIS R., KRALL H., BUTKUS V., 1996: *Malus* Mill. – In: KUUSK V., TABAKA L., JANKEVIČIENĖ R. (eds), *Flora of the Baltic Countries*, 2: 98–99. – Tartu.
- CRONK Q., RUZZIER E., BELYAEVA I., PERCY D., 2015: *Salix* transect of Europe: latitudinal patterns in willow diversity from Greece to arctic Norway. – *Biodiversity Data Journal*, 3: e6258. doi: 10.3897/BDJ.3.e6258.
- FRYXELL P.A., 1992: A revised taxonomic interpretation of *Gossypium* L. (Malvaceae). – *Rhedeia*, 2: 108–165.
- FRYXELL P.A., HILL S.R., 2015: *Gossypium* Linnaeus. – In: Flora of North America north of Mexico. Magnoliophyta: Cucurbitaceae to Droseraceae, 6: 263–264. – New York–Oxford.
- GEDERAAS L., MOEN T.L., SKJELSETH S., LARSEN L.K. (eds), 2012: Alien species in Norway with the Norwegian Black List 2012. – Trondheim.
- GUBAREVA I.J., 2017: Rare and protected plant species of the flora of National Park “Kurshskaya Kosa”. – Kaliningrad.
- GUDŽINSKAS Z., 1989: The new for the Lithuanian flora adventive plant species. – *Botaničeskij Žurnal*, 74(10): 1499–1504.
- GUDŽINSKAS Z., 1993: *Commelina communis* L. (Commelinaceae) – naujas adventyvinis augalas Lietuvos floroje. – *Ekologija (Vilnius)*, 3: 3–5.
- GUDŽINSKAS Z., 1994: Alien species of Lithuania. – Vilnius.
- GUDŽINSKAS Z., 1997a: Conspectus of alien plant species of Lithuania. 1. Liliopsida (excluding Poaceae). – *Botanica Lithuanica*, 3(1): 3–23.
- GUDŽINSKAS Z., 1997b: The dilemma: native or naturalized alien? – *Botanica Lithuanica*, Suppl. 1: 29–40.
- GUDŽINSKAS Z., 1997c: Conspectus of alien plant species of Lithuania. 4. Asteraceae. – *Botanica Lithuanica*, 3(4): 335–366.
- GUDŽINSKAS Z., 2000: Conspectus of alien plant species of Lithuania. 16. Rosaceae. – *Botanica Lithuanica*, 6(4): 345–364.
- GUDŽINSKAS Z., PETRULAITIS L., 2014: *Helianthus grosseserratus*, a new alien plant species in Lithuania. – *Botanica Lithuanica*, 20(2): 173–176.

- GUDŽINSKAS Z., PETRULAITIS L., ARLIKEVIČIŪTĖ L., 2014: *Vaccinium macrocarpon* – a new alien plant species in Lithuania. – *Botanica Lithuanica*, 20(1): 41–45.
- GUDŽINSKAS Z., PETRULAITIS L., ŽALNERAVIČIUS E., 2017: New woody alien plant species recorded in Lithuania. – *Botanica Lithuanica*, 23(2): 153–168.
- GUO Q., 2014: Plant hybridization: the role of human disturbance and biological invasion. – *Diversity and Distributions*, 20: 1345–1354.
- HARDIN J.W., 1973: The enigmatic chokeberries. – *Bulleten of the Torrey Botanical Club*, 100: 178–184.
- HOLM L., DOLL J., HOLM E., PANCHO J., HERBERGER J., 1997: *World Weeds. Natural Histories and Distribution*. – New York.
- HRYNIEWIECKI B., 1933: *Tentamen florae Lithuaniae*. – Warszawa.
- JANKEVIČIENĖ R., LEKAVIČIUS A., TUČIENĖ A., VENCUS Z., 1979: *Anykščių šilelis*. – Vilnius.
- JUNDZILL B.S., 1791: *Opisanie roślin w prowincji W. X. Litewskiego naturalnie rosnących według układu Linneusza*. – Wilno.
- JUNDZILL B.S., 1811: *Opisanie roślin litewskich według układu Linneusza*. – Wilno.
- JUNDZILL J., 1830: *Opisanie roślin w Litwie, na Wołyniu, Podolu i Ukrainie dziko rosnących jako i oswojonych*. – Wilno.
- KALJUND K., 2013: Genetic Diversity, Genotypic Structure and Vulnerability of Native Populations of Sickle Medic (*Medicago sativa* ssp. *falcata*) in Estonia. – Tartu.
- KALJUND K., LEHT M., 2013: Extensive introgressive hybridization between cultivated lucerne and the native sickle medic (*Medicago sativa* ssp. *falcata*) in Estonia. – *Annales Botanici Fennici*, 50: 23–31.
- KIK C., KORPELAINEN H., VÖGEL R., ASDAL Å., ELIÁŠ P., DRAPER D., MAGOS BREHM J., 2011: *Malus sylvestris*. – The IUCN Red List of Threatened Species: e.T172170A6841688. <http://dx.doi.org/10.2305/IUCN.UK.2011-1.RLTS.T172170A6841688.en>.
- KRALL H., TABAKA L., BALEVIČIENĖ J., 2003: *Leymus Hochst.* – In: KUUSK V., TABAKA L., JANKEVIČIENĖ R. (eds), *Flora of the Baltic Countries*, 3: 257. – Tartu.
- KURTTO A., SENNIKOV A.N., LAMPINEN R. (eds), 2013: *Atlas Florae Europaeae. Distribution of Vascular Plants in Europe. Rosaceae (Cydonia to Prunus, excl. Sorbus)*, 16: 1–168. – Helsinki.
- LAIVIŅŠ M., KRAMPIS I., BICE M., KNAPE D., ŠULCS V., 2009: *Atlas of Latvian Woody Plants*. – Rīga.
- LAZDAUSKAITĖ Ž., 1980: *Astereae Cass.* – In: NATKEVIČAITĖ-IVANAUSKIENĖ M., JANKEVIČIENĖ R., LEKAVIČIUS A. (eds), *Lietuvos TSR flora*, 6: 33–46. – Vilnius.
- LAZDAUSKAITĖ Ž., LEHT M., TABAKA L., 2003: *Bellis L.* – In: KUUSK V., TABAKA L., JANKEVIČIENĖ R. (eds), *Flora of the Baltic Countries*, 3: 157. – Tartu.
- LEKAVIČIUS A., 1989: *Vadovas augalams pažinti*. – Vilnius.
- LEONARD P.J., BRAND M.H., CONNOLLY B.A., OBAE S.G., 2013: Investigation of the origin of *Aronia mitschurinii* using amplified fragment length polymorphism analysis. – *HortScience*, 48(5): 520–524.
- LORENZI H.J., JEFFERY L.S. (eds), 1987: *Weeds of the United States and their control*. – New York.
- MARTINS S.V., RIBEIRO G.A., DA SILVA W.M., NAPPO M.E., 2002: Regeneração pós-fogo em um fragmento de floresta estacional semidecidual no Município de Viçosa. – *Ciência Florestal*, 12: 11–19.
- MENEGHETTI S., BARCACCIA G., PAIERO P., LUCCHIN M., 2007: Genetic characterization of *Salix alba* L. and *Salix fragilis* L. by means of different PCR-derived marker systems. – *Plant Biosystems*, 141(3): 283–291.
- NATKEVIČAITĖ M., 1951: *Lietuvos TSR adventyvinė flora*. – *Biologijos instituto darbai*, 1: 44–123.
- NATKEVIČAITĖ-IVANAUSKIENĖ M., 1980: *Onagraceae*. – In: NATKEVIČAITĖ-IVANAUSKIENĖ M., JANKEVIČIENĖ R., LEKAVIČIUS A. (eds), *Lietuvos TSR flora*, 6: 302–303. – Vilnius.
- PLISZKO A., ZALEWSKA-GAŁOZ J., 2016: Molecular evidence for hybridization between invasive *Solidago canadensis* and native *S. virgaurea*. – *Biological Invasions*, 18: 3103–3108.
- PYŠEK P., RICHARDSON D.M., REJMÁNEK M., WEBSTER G., WILLIAMSON M., KIRSCHNER J., 2004: Alien plants in checklists and floras: towards better communication between taxonomists and ecologists. – *Taxon*, 53: 131–143.
- QUIAN G.-Z., LIU K.-F., TANG G.-G., 2010: 1933

- Proposal to conserve the name *Malus domestica* against *M. pumila*, *M. communis*, *M. frutescens*, and *Pyrus dioica* (Rosaceae). – *Taxon*, 59(2): 650–652.
- RECASENS J., CONESA J.A., 1995: New adventitious weeds in the irrigated crops of Catalonia. – Proceedings of the 1995 Congress of the Spanish Weed Science Society, Huesca, Spain: 59–65. – Madrid.
- RICHARDSON D.M., PYŠEK P., 2006: Plant invasions – merging the concepts of species invasiveness and community invasibility. – *Progress in Physical Geography*, 30: 409–431.
- ROSTAŃSKI K., 2004: Part 1. General considerations. – In: The genus *Oenothera* L. in Eastern Europe: 7–71. – Kraków.
- ROSTAŃSKI K., GUDŽINSKAS Z., 2004: *Oenothera* in Lithuania. – In: The genus *Oenothera* L. in Eastern Europe: 57–64. – Kraków.
- RUNGIS D., LAIVIŠ M., GAILITE A., KORICA A., LAZDINA D., SKIPARS V., VEINBERGA I., 2017: Genetic analysis of Latvian *Salix alba* L. and hybrid populations using nuclear and chloroplast DNA markers. – *iForest. Biogeosciences and Forestry*, 10: 422–429, doi: 10.3832/ifor2004-009.
- SAVOVA D., RUFENER AL MAZYAD P., FELBER F., 1996: Cytogeography of *Medicago falcata* L. and *M. sativa* L. in Switzerland. – *Botanica Helvetica*, 106: 198–208.
- SCHNITZLER A., ARNOLD C., CORNILLE A., BACHMANN O., SCHNITZLER C., 2014: Wild European apple (*Malus sylvestris* (L.) Mill.) population dynamics: insight from genetics and ecology in the Rhine valley. Priorities for a future conservation programme. – *PLoS ONE* 9(5): e96596. doi: 10.1371/journal.pone.0096596.
- SEELANAN T., BRUBAKER C.L., STEWART J.M., CRAVEN L.A., WENDEL J.F., 1999: Molecular systematics of Australian *Gossypium* section *Grandicalyx* (Malvaceae). – *Systematic Botany*, 24: 183–208.
- SENNIKOV A.N., PHIPPS J.B., 2013: Atlas Florae Europaeae notes, 19–22. Nomenclatural changes and taxonomic adjustments in some native and introduced species of Malinae (Rosaceae) in Europe. – *Willdenowia*, 43: 33–44.
- SKVORTSOV A.K., 1973: Present distribution and probable primary range of brittle willow (*Salix fragilis* L.). – In: *Problemy biogeocenologii, geobotaniki i botaničeskoj geografii*: 263–280. – Leningrad.
- SKVORTSOV A.K., MAITULINA YU. K., 1982: On the differences between the domestic chokeberry and its wild relatives. – *Biulleten Glavnogo Botaničeskogo Sada*, 126: 35–40.
- SMALL E., 2011: *Alfalfa and Relatives: Evolution and Classification of Medicago*. – Ottawa.
- SMITH W.C., 1999: Production statistics. – In: SMITH W.C., COTHREN J.T. (eds), *Cotton: Origin, History, Technology and Production*: 435–499. – New York.
- SNARSKIS P., 1954: *Vadovas Lietuvos TSR augalams pažinti*. – Vilnius.
- STACE C., 1997: *New Flora of the British Isles* (2nd ed.). – Cambridge.
- STANCEVIČIUS A., 1971: *Liucerna – Medicago* L. – In: NATKEVIČAITĖ-IVANAUSKIENĖ M. (ed.), *Lietuvos TSR flora*, 4: 423–430. – Vilnius.
- STAPLES G.W., IMADA C.T., HERBST D.R., 2003: New Hawaiian plant records for 2001. – *Bishop Museum Occasional Papers*, 74: 7–21.
- TABAKA L., KRALL H., JANKEVIČIENĖ R., 1996: *Medicago* L. – In: KUUSK V., TABAKA L., JANKEVIČIENĖ R. (eds.), *Flora of the Baltic Countries*: 2: 141–143. – Tartu.
- TOKARSKA-GUZIŁ B., BZDEGA K., NOWAK T., LEWANDOWSKA A., GANCAREK M., FRELICH M., 2014: Alien plants in Poland: research directions and putting the results into practice. – *Biodiversity Research and Conservation*, 35: 57–74.
- TRUNG Q.L., VAN PUYVEIDE K., TRIEST L., 2008: Consensus primers of cyp73 genes discriminate willow species and hybrids (*Salix*, Salicaceae). – *Molecular Ecology Resources*, 8(2): 455–458.
- TYLER T., OLSSOM K.-A., JOHNSSON H., SONESSON M., 2007: *Floran i Skåne*. – Lund.
- TZVELEV N.N., 1976: *Poaceae URSS*. – Leningrad.
- VERLOOVE F., 2006: *Catalogue of the neophytes in Belgium (1800–2005)*. – *Scripta Botanica Belgica*, 39: 1–89.
- VILÁ M., WEBER E., D'ANTONIO C., 2000: Conservation implications of invasion by plant hybridization. – *Biological Invasions*, 2: 207–217.
- VINOGRADOVA Y., MAITULINA O.G., VERGUN O., BRINDZA J., 2017: Morphological characteristics for fruits of *Aronia mitschurinii* A.K. Skvortsov & Maitul. – *Potravinarstvo Slovak Journal of Food Sciences*, 11(1): 754–760.

- VYŠNIAUSKIENĖ R., NAUGŽEMYS D., PATAMSYTĖ J., RANČELIENĖ V., ČESNIENĖ T., ŽVINGILA D., 2015: ISSR and chloroplast DNA analyses indicate frequent hybridization of alien *Medicago sativa* subsp. *sativa* and native *M. sativa* subsp. *falcatata*. – Plant Systematics and Evolution, 301(10): 2341–2350.
- WAGNER I., MAURER W.D., LEMMEN P., SCHMITT H.P., WAGNER M., BINDER M., PATZAK P., 2014: Hybridization and genetic diversity in wild apple (*Malus sylvestris* (L.) Mill.) from various regions in Germany and from Luxembourg. – Silvae Genetica, 63(3): 81–94.
- WEI Z., VINCENT M.A., 2010: *Medicago* Linnaeus. – In: Flora of China, 10: 553–557. – Beijing–St. Louis.
- ZELENCOV A.O., 1890: Očerok klimata i flory Vilenskoj gubernii. – Scripta Botanica Petropolitana, 3(2): 227–412.

LIETUVOS SVETIMŽEMIŲ AUGALŲ RŪŠIŲ SĄRAŠO PAPILDYMAI IR PAKEITIMAI

Zigmantas GUDŽINSKAS

Santrauka

Straipsnyje aprašytos trys svetimžemės rūšys, kurios surastos prieš kelis dešimtmečius, bet ilgą laiką buvo neapibūdintos: *Gossypium hirsutum*, *Leymus racemosus* ir *Senna obtusifolia*. *Gossypium hirsutum* ir *Senna obtusifolia* į Lietuvą pateko atsitiktinai su importuojamais grūdais, yra atsitiktinės rūšys ir šalies gamtinės sąlygos jų natūralizacijai yra nepalankios. *Leymus racemosus* į Lietuvą tikriausiai pateko savaime iš Kaliningrado sričiai (Rusijos Federacija) priklausančios Kuršių nerijos dalies, kurioje šie augalai buvo įveisti dirbtinai. Lietuvoje *Leymus racemosus* yra natūralizavusi rūšis ir yra didelė tikimybė, kad gali toliau plisti ir turėti neigiamą poveikį pajūrio kopų buveinėms ir jų biologinei įvairovei.

Kitos straipsnyje aprašomos septynios rūšys Lietuvoje aptinkamos gana seniai ir įvairiais laikotarpiais buvo aprašytos botaninėje literatūroje. Dėl kai kurių iš jų statuso (pvz., *Bellis perennis*) buvo įvairių nuomonių, o kitų rūšių (pvz., *Malus domestica*, *Medicago ×varia*, *Oenothera casimiri*, *Salix ×fragilis*)

statusas buvo neįvertintas arba jos laikytos savaiminėmis rūšimis. Laikantis šiuolaikinio požiūrio, hibridai, susidarę dėl vietinių ir svetimžemių rūšių kryžminimosi, yra laikytini svetimžemiais augalais.

Per kelis paskutinius dešimtmečius įvairių autorių atliktų taksonominių tyrimų rezultatai parodė, kad anksčiau *Salix fragilis* laikyti augalai iš tikrųjų priklauso dviem skirtingoms rūšims – *Salix euxina* ir jos hibridui su vietine rūšimi *Salix alba*, kuris turi būti vadinamas *Salix ×fragilis*. Taip pat nustatyta, kad anksčiau *Aronia melanocarpa* vadinti augalai yra ne tapatūs Šiaurės Amerikoje paplitusiai rūšiai ir yra sudėtingi dviejų genčių augalų – *Aronia* ir *Sorbus* – hibridai. Dėl to kultūriniai ir sulaukėję augalai, anksčiau vadinti *Aronia melanocarpa*, turi būti vadinami *×Sorbaronia mitschurinii*.

Straipsnyje pateikiama informacija apie nagrinėjamų rūšių introdukcijos istoriją, dabartinį paplitimą, natūralizaciją, žinomą ir tikėtiną poveikį vietinių rūšių populiacijoms, bendrijoms ir buveinėms.