Rapid Communication

First record of non-native woody species *Amelanchier ×lamarckii* (Rosaceae), in Lithuania

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Abstract

Amelanchier ×lamarckii F. G. Schroed., a shrub or small tree native to North America, has escaped from cultivation in Lithuania and is recorded as a new casual alien plant in Lithuanian flora. Most of the recorded young individuals have grown from seeds and spread locally through saplings. The population consists of about 50 individuals, of which approximately 10 have grown to a height of 0.5–2.5 m and are fruiting. *Amelanchier ×lamarckii* is recorded from the Kelmė district, between Panūdžiai and Palendriai villages, in a dry grassland habitat along the roadside. *Amelanchier ×lamarckii* has already been reported to have escaped to several European countries. This hybrid shares similar growth traits as its invasive congener *Amelanchier spicata* (Lam.) Koch. The naturalization and spread to natural habitats in Lithuania are highly probable. *Amelanchier ×lamarckii* has been reported from northern latitudes; therefore, the spread of this plant in Lithuania should be monitored. Planting of *A. ×lamarckii* close to dry grassland habitats as well as forest edges should be avoided, considering the possible spread by birds into these habitats.

Key words: alien plants, roadsides, shrub, invasion, naturalization

Introduction

Most alien woody species were initially introduced as ornamentals for landscape gardening and botanical collections (Hulme 2011). Despite their relatively small number compared to other alien plants, non-native woody species often pose significant problems in forestry (Jones and Grenz 2023). These species can outcompete native flora for resources, disrupt ecological balance, and lead to long-term changes in habitat structure. For instance, non-native trees and shrubs can alter soil composition, shading patterns, and nutrient cycles, which affects the entire ecosystem (Rejmánek 2014; Tyler et al. 2015). The spread of non-native woody species not only affects the environment but also, in some cases, adversely impacts human-made structures, such as historic buildings and monuments (Pliszko 2022), or even impacts human life and causes allergies (Werchan et al. 2024). The most prominent sources of new alien, potentially invasive, and invasive plant species are currently recognized as ornamental and landscape gardening, botanical gardens, and other collections of living plants (Hulme 2011, 2015;

Heywood and Sharrock 2013; Pergl et al. 2016; Evarte-Bundere et al. 2022). Private gardens also contain a large diversity of ornamentals that could potentially spread outside cultivation (Pergl et al. 2016). These sources are particularly problematic because they often involve large numbers of diverse plant species that can escape cultivation. Ornamental plants are commonly selected for their aesthetic appeal rather than their ecological performance, making them prone to becoming invasive if they are well-suited to the new environment (Pergl et al. 2016). Furthermore, the movement of plants between regions through botanical gardens and plant collections increases the likelihood of introducing species that are not only novel but also potentially invasive. Private gardens also host a diverse range of ornamentals that may escape cultivation and spread into natural environments (Dobravolskaitė and Gudžinskas 2011; Pergl et al. 2016). Gardens often contain species that are not native to the region and may have characteristics that allow them to thrive outside of controlled environments. These species can spread through seed dispersal by wind, water, or animals, and through vegetative means such as runners or root suckers. The potential for private gardens to contribute to the spread of non-native species is significant, especially as urbanization and suburban development increase the number of such gardens near natural habitats (Pergl et al. 2016).

Over 90 alien woody species have been documented in Lithuania (Gudžinskas et al. 2017; Gudžinskas 2018), with new species continually being registered (Gudžinskas et al. 2020; Petrulaitis and Gudžinskas 2020). Early detection and rapid response are crucial in managing the impact of non-native species (Hulme 2006). By identifying these species at their early stages of invasion, land managers can implement control measures before they become widespread and difficult to manage. Effective management strategies include monitoring and early eradication efforts, public awareness campaigns, and regulations to prevent further introductions. Such proactive measures are essential to mitigating the negative impacts on native ecosystems, reducing management costs, and protecting human health and infrastructure.

Among these invasive woody plants, the Rosaceae family stands out due to its significant representation in naturalized and invasive plant groups. Out of 792 species reported by Rejmánek and Richardson (2013), 92 species belong to the Rosaceae family, comprising approximately 11.6% of all invasive trees and shrubs in 15 regions of the world. In Europe, the number of alien species in the Rosaceae family reaches 443 species, making it one of the largest plant families containing such high numbers of non-native species (Kalusová et al. 2024). In Lithuania, this family contains more than 40 non-native species (Gudžinskas 2000). Other members of this family comprise a large group of taxa that have started to spread very recently in Central Europe, e.g., *Prunus cerasifera* Ehrh. (Czortek et al. 2024), ×*Sorbaronia fallax* (C.K. Schneid.) C.K. Schneid. nothosubsp. *mitschurinii* (A.K. Skvortsov & Maitul.) (Jagodziński et al. 2024), *Spiraea tomentosa* L. (Wiatrowska et al. 2023).

According to POWO (2024), the genus *Amelanchier* Medik. is represented by 24 species and three nothospecies (or interspecific hybrids). Representatives of the genus are mostly distributed in North America, with several representatives from Asia and Europe (POWO 2024), predominantly in boreal and temperate regions. Although, according to some references, the number of species within this genus may vary greatly, even reaching 110 species (Burgess et al. 2015). In Europe, several members of the genus are invasive or naturalized (e.g. *Amelanchier alnifolia* (Nutt.) Nutt. ex M. Roem., *A. confusa* Hylander, *A. ovalis* Medik., *A. spicata* (Lam.) K. Koch) (Kalusová et al. 2024). In Lithuania, this genus is currently represented by one invasive taxon, *Amelanchier spicata* (Lam.) Koch. and several other taxa cultivated for ornamental and food purposes (Navasaitis 2008; Gudžinskas et al. 2023). Plants belonging to this genus are taxonomically complex, as most of the taxa are thought to be of hybrid origin, resulting from hybridization in Europe between parental species brought from North America (Burgess et al. 2015; Stalažs 2021).

During field survey of roadside vegetation in May 2023 a plant from the genus *Amelanchier* was found growing and flowering along the roadside grassland. After closer inspection more individuals were found and afterwards were identified as *Amelanchier* ×*lamarckii*. In this paper, I present the first record of *Amelanchier* ×*lamarckii* in Lithuania, in north-western part of the country.

Materials and methods

Study taxon

Amelanchier ×*lamarckii* F. G. Schroed., Taxon 17: 633 (1968) is native to the eastern part of North America, although, in its native range, this taxon is not presently known to occur in the wild. Some authors suggest that this species is of hybrid origin, and while its precise parentage is complex, it is commonly accepted to be a natural or cultivated hybrid involving *Amelanchier laevis* Wiegand and *Amelanchier canadensis* Torr. & A. Gray (Branquart et al. 2024), while other authors state that this taxon appeared via hybridization between two introduced North American species, *A. canadensis* and *Amelanchier arborea* (F. Michx.) Fernald (Kuklina et al. 2018), or even *A. arborea* × *A. laevis* (POWO 2024).

Amelanchier ×*lamarckii* is a shrub or small tree reaching up to 10 meters in height. Twigs are thin and smooth; the bark is brown-red and grey, with a characteristic longitudinal split on thicker stems. The buds are narrowly ovoid and pointed, measuring 5–9 mm long and 1–3 mm wide. During the flowering period, the leaves reach only about half the size they attain during the fruit ripening period. They are predominantly covered with copper-red hairs, with individual whitish hairs on the surface. The inflorescence (3.5–)4–7(–8) cm in length, bearing (5–)8–10 (–16) flowers, which are obliquely erect

and slightly drooping, with a loose arrangement. The pedicels are (10–)13–24(–30) mm long. The inflorescence axis, flower peduncles, and scales are mostly copper-red, initially sparsely woolly-hairy, but mostly scaly during flowering. Flowers are 2–3 cm in size and odourless. The scape is 3–5 mm wide, with triangular-lanceolate, pointed sepals, 3–5 mm long and 1–1.5 mm wide, woolly hairy on the inside and glabrous on the outside. Sepals are weakly erect at first, bending down after flowering, and mostly erect when the fruit is ripe. Corolla petals are white, often reddish on the outside, oblong, 9–14 mm long and 2.5–5 mm wide, and glabrous. Stamens are 3–5.5 mm long; anthers are about 1.5 × 1 mm in size (Clapham et al. 1981; Lepší and Lepší 2008).

The literature often presents some confusion regarding the differences between *Amelanchier* ×*lamarckii* and *A. spicata*. The most reliable and easily distinguishable characteristic is the shape of the inflorescence (Figure 1) and the colour or cauline leaves on young twigs. During flowering time, *Amelanchier* ×*lamarckii* has copper-coloured leaves, whereas *A. spicata* has light green or somewhat olive green leaves. Morphological differences between *Amelanchier* ×*lamarckii* and *A. spicata* are shown in the Figure 1 and given in the Table 1.

Study methods

During visits at the site of newly found *Amelanchier* ×*lamarckii*, I estimated the occupied area, the number of individuals and recorded the composition and cover of all plant species in the community applying the Braun-Blanquet (1964) method. The vegetation structure was estimated in plots of 1 m^2. The percentage cover (0–100%) of shrub and herb vegetation layers was visually estimated. The plot size was based on the size of *Amelanchier* individuals growing along roadside – most of the individuals were up to 1 meter and covered small area. Also, using larger plots would fail to reflect vegetation type, as transitional habitat is not uniform. Four representative plots were selected for the assessment. The herbarium specimen of *Amelanchier* ×*lamarckii* collected by the author is deposited at the Herbarium of the Institute of Botany of the Nature Research Centre (BILAS) in Vilnius, Lithuania. Reproductive individuals were plants bearing fruit, whereas individuals without fruits were treated as vegetative. The distance from the roadside of the fruiting individuals was measured using a measuring tape.

The species was identified based on morphological characters according to Clapham et al. (1981) and Lepší and Lepší (2008).

Results

Records and population size

Amelanchier ×*lamarckii* was first recorded from the northwestern part of Lithuania (Figure 2) between Palendriai and Panūdžiai villages, in dry grassland habitat (6 May 2023, 55.7259782°N; 22.9455961°E, leg. L. Petrulaitis,

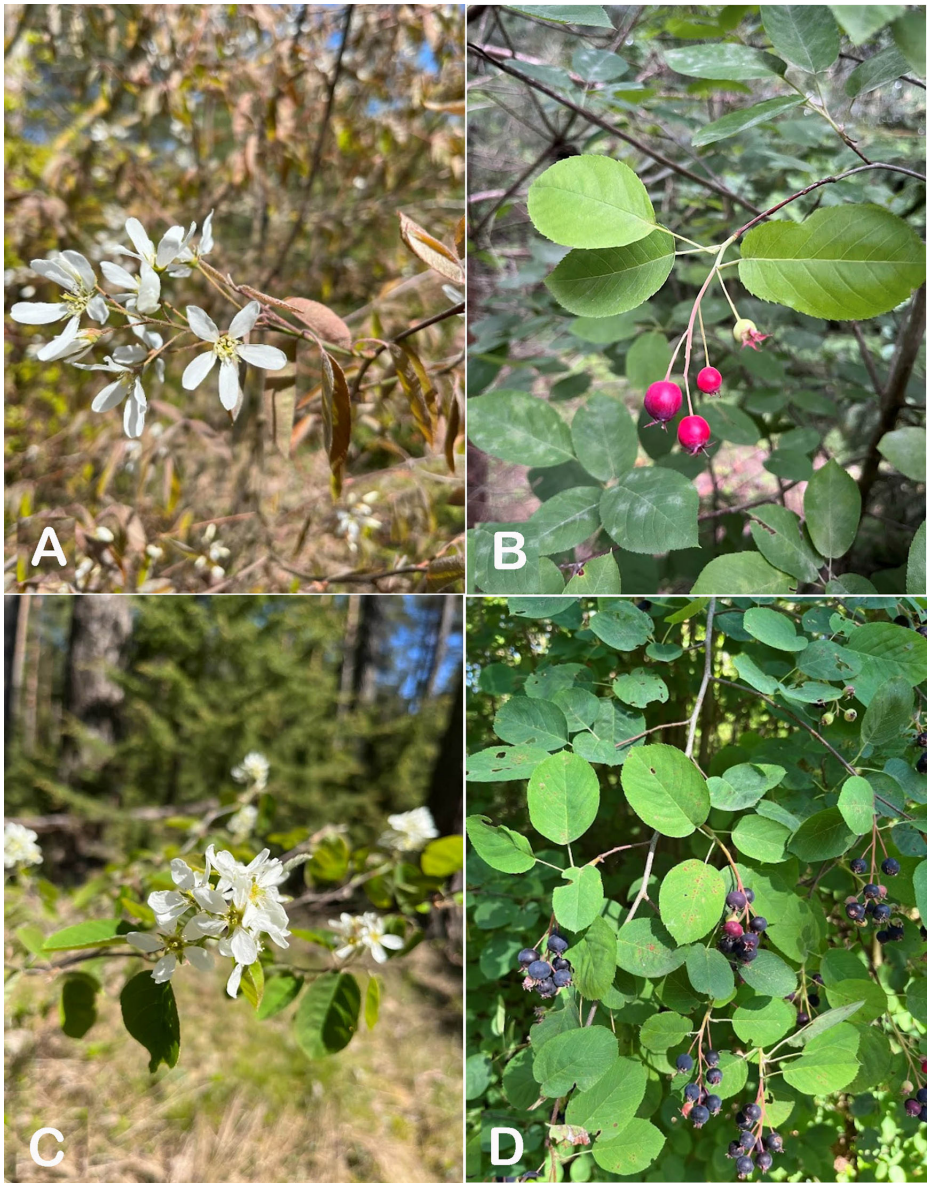

Figure 1. Flowering individual of *Amelanchier ×lamarckii* in a shrubbery, 16 May 2023 (A) and fruits on the same individual of *Amelanchier ×lamarckii* in a shrubbery, with almost ripe fruits 19 June 2024 in Kelmė distr., Panūdžiai village surroundings (B) Flowering individual of *Amelanchier spicata* along forest edge 11 May 2023 in Varėna distr., Merkinė (C) and fruits of *Amelanchier spicata* in a Scots pine forest 26 June 2024 in Molėtai distr., Pabebrusė village. Photographs by L. Petrulaitis.

Table 1. Comparison of characteristics distinguishing *Amelanchier ×lamarckii* and *A. spicata*.

Character	*Amelanchier ×lamarckii*	*Amelanchier spicata*
Life form	Small tree, shrub	Shrub, very rarely small tree
Inflorescence	Loose; (3,5–)4–7(–8) cm long	Dense; 3.5–6.5 (–7) cm long
Flowers	2–3 cm	2 cm
Leaves	4.5–8.5 cm long	3–6 (–7.5) cm long
Petals	9–14 mm, 2.5–5 mm wide, elongated	8–12 mm long, 3–5 mm wide, linear-oblong
Fruits	reddish	purple-black, glaucous

BILAS 93028). Individuals of *Amelanchier ×lamarckii* were dispersed over an area of 1300 square meters along the roadside habitats and in shrubbery close to the roadside. The population consists of 50 individuals, ranging from 0.5–2.5 meters in height. After thorough inspection, it was revealed that 10

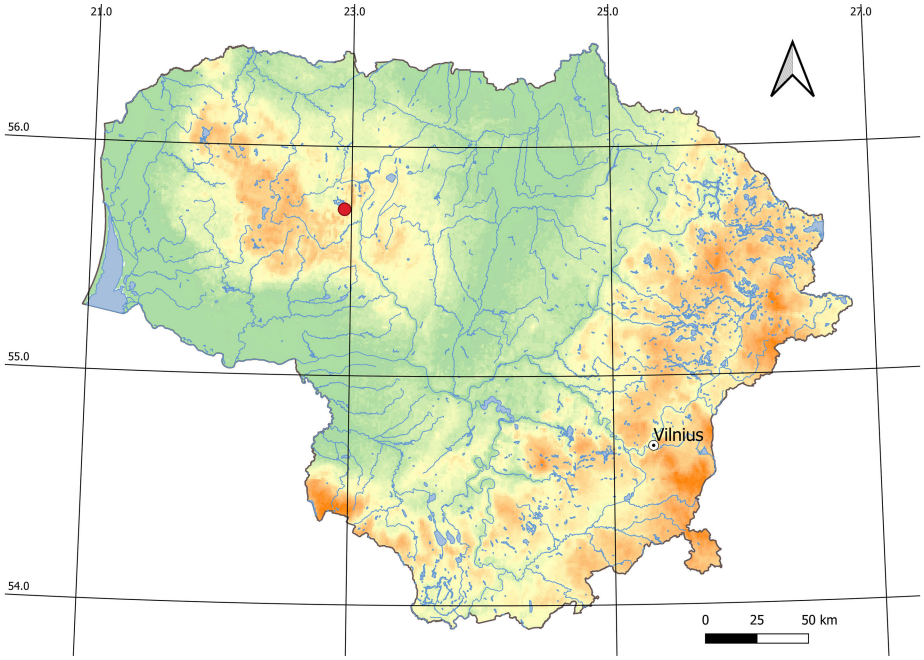

Figure 2. Map with a locality of *Amelanchier* ×*lamarckii* (dot) in Lithuania.

individuals were producing fruits. Fruiting individuals varied from 0.8 to 2.5 meters in height.

The seeds of *Amelanchier* ×*lamarckii* were thought to be brought to the habitat by birds from mature individuals growing in an enclosed area of a monastery that is located close by. The average distance from the roadside to the individuals of *Amelanchier* ×*lamarckii* was 1.57 ± 1.31 meters, with the closest proximity being 0.8 meters and the furthest being 5 meters.

Habitats and structure of communities

The studied population of *Amelanchier* ×*lamarckii* in Kelmė distr. occupied a dry grassland habitat along a gravel road. The vegetation of the habitat was composed of sparse shrub layer (cover ranging from 30% to 50 %) (Table 2).

Several non-native shrub species were recorded in the plots with *Amelanchier* ×*lamarckii* (*Cornus sanguinea* subsp. *australis*, *Prunus cerasifera*, *Rosa rugosa*); their abundance and cover were low. The herb layer was quite sparse (cover ranging from 20% to 30%) and was formed mainly by *Festuca rubra*, *Fragaria vesca* and *Galium mollugo*. The recorded *Amelanchier* ×*lamarckii* population in the Kelmė district occurs in a transitional zone between road and a shrubbery, an open dry grassland along the roadside.

Discussion

This is the first record of the *Amelanchier* ×*lamarckii* for Lithuania. In the literature this taxon is not listed as grown in Lithuania as an ornamental or food plant (Navasaitis et al. 2008). Nevertheless, *A.*×*lamarckii* is often sold in nurseries and grown in public spaces throughout the country (*pers. obs.*). In neighbouring Latvia, *A.*×*lamarckii* is listed as grown ornamental shrub

Table 2. Phytosociological relevés with occurrences of *Amelanchier ×lamarckii* in Kelmė distr., Panūdžiai village surroundings (55.7259782°N; 22.9455961°E), Lithuania.

Species	Relevé			
	1	2	3	4
Shrub layer				
Number of species per relevé	16	8	14	9
Cover of shrub layer (%)	60	20	20	30
Cover of herb layer (%)	30	50	60	40
Amelanchier ×lamarckii F. G. Schroed	**2**	**2**	**2**	**1**
Crataegus L. sp.	+		+	2
Tilia cordata Mill.	2		+	
Cornus sanguinea subsp. *australis* (C.A.Mey.) Jáv.	+			1
Pinus sylvestris L.	2			
Populus tremula L.	+			
Lonicera xylosteum Lour.	1			
Prunus cerasifera Ehrh.	+			
Quercus robur L.		+		
Frangula alnus Mill.			2	
Rosa rugosa Thunb.				+
Herb layer				
Festuca rubra L.	3	2	2	1
Galium mollugo L.	2	1	1	+
Fragaria vesca L.	2	1	+	
Pilosella caespitosa (Dumort.) P.D. Sell & C. West	+	+	+	
Solidago virgaurea L.	1	+		
Equisetum arvense L.	+		1	
Vicia tetrasperma Moris	+		+	
Poa pratensis L.		1		+
Poa compressa Schrenk ex Griseb.	1			
Vicia craca L.		+		
Taraxacum officinale F.H.Wigg.			+	
Dactylis glomerata L.			+	
Trifolium arvense L.			+	
Artemisia campestris Turcz. ex DC.			+	
Jacobaea vulgaris Gaertn.			+	
Lathyrus sylvestris L.				2
Achillea millefolium L.				+
Knautia arvensis (L.) Coult.				+
Tragopogon pratensis L.	+			

(Laiviņš et al. 2009), but not reported in the newest edition of alien woody plants of Latvia (Evarte-Bundere et al. 2022). This plant has been recorded from many European countries: Austria (Essl et al. 2011), Sweden (Tyler et al. 2015), Finland (Kurtto et al. 2019). In Great Britain *A. ×lamarckii* was recorded several decades ago (Schroeder 1970). This taxon has been listed as one of the most successful phanerophytes among neophytes in European heathland and scrub habitats (Kalusová et al. 2023), also often occurs in the coastal habitats in many Western Europe countries (Belgium, France, Netherlands, Denmark, Germany) (Adriaens et al. 2022). The occurrence of *A. ×lamarckii* along roadsides in Lithuania was not surprising, as this plant occurs in similar habitats in Netherlands (Follak et al. 2018).

Another occurrence of *A. ×lamarckii* seedlings was made in Vilnius city, 3 June 2024 in a flowerbed, near a mature individual (Figure 3). However, this kind of occurrence is very rarely long-term, as weeding and other disturbance activities take place in flowerbeds. Nevertheless, ornamental plantings of this

Figure 3. Seedlings of *Amelanchier* ×*lamarckii* in a flowerbed in Vilnius, Ceikinių Street on 3 June 2024 (A) Young fruiting individual of *A.* ×*lamarckii*. in a dry grassland in newly recorded site (B). Photographs by Lukas Petrulaitis.

taxon increase its propagule pressure and the possibility of escape. Also, this shows that planted individuals of *A.* ×*lamarckii* can contribute to spread of this taxon in urban areas.

Considering the fact, that *A.* ×*lamarckii* has already been naturalized in several European countries and the fact that this hybrid has established in northern latitudes beyond Lithuania, it is assumed that the territory of Lithuania is suitable for its expansion. In Germany, the lag phase of *A.* ×*lamarckii* lasted 98 years (Brändle and Brandl 2012). In Lithuania, this plant has been found near a monastery, that has been established between 1999 and 2001 (Butvilaitė 2008). Mature trees were observed within the monastery, suggesting that these established individuals could be the source of propagules. Therefore, the first recorded individuals of *A.* ×*lamarckii* could be the beginning of a naturalization process.

The tendency of spreading of *A.* ×*lamarckii* has been reported from Poland (Danielewicz and Wiatrowska 2014; Danielewicz et al. 2020), where this taxon is known from XIX century. Also, it should be noted that this hybrid was assessed as having the same impact on plant communities as its invasive congener *A. spicata*. Both *A.* ×*lamarckii* and *A. spicata* were classified as plants capable of transforming forest communities (Danielewicz et al. 2020). In Norway, *A.* ×*lamarckii* is listed as a taxon with severe impact to the environment, together with two congeners *A. alnifolia* and *A. spicata* (Gederaas et al. 2012). Hybrids are known to be more invasive than the parental species, therefore invasiveness and fast spread of *A. spicata* might be explained by its hybrid origin (Ellstrand and Schierenbeck 2000; Stalažs 2021). The same hypothesis can be applied to the studied species *A.* ×*lamarckii*, as

its origin is also believed to be hybridogenic. Further hybridisation potential of *A.* ×*lamarckii* is minimal as there are no close native relatives in most regions, reducing the risk of genetic integration.

According to assessment of this plant in Sweden (Tyler et al. 2015), *Amelanchier* ×*lamarckii* exhibits moderate invasiveness due to its strong competitive ability in semi-natural vegetation such as traditionally managed grasslands, where it can outcompete native species. Nevertheless, in other countries *A.* ×*lamarckii* has been found in some high conservation value habitats, but it does not form dense populations there and its negative impact on the native plants is still not clarified (Brunel et al. 2010). In Germany *A.* ×*lamarckii* was listed as expanding locally (Keil and Loos 2005). However, its realised dispersal capacity is notable, as seeds can be dispersed over long distances and become established quite frequently, which increases its ability to colonise new habitats. These factors make *A.* ×*lamarckii* a taxon of ecological concern in certain ecosystems. However, further research on the impact of this taxon to native plants and habitats is needed.

Amelanchier ×*lamarckii* is becoming widely planted ornamental shrub, nowadays often seen in public spaces and parks in Lithuania. Propagule pressure may increase in the future due to the sale and use of this species for ornamental purposes, both of which directly contribute to the spread of its propagules. The observed population of *A.* ×*lamarckii* consists of several dozens of individuals, and on part of them fructification was observed, as well as proliferation by root suckers. Because individuals in the escaped population of *A.* ×*lamarckii* recorded in Lithuania produce fruits, with viable seeds, they will provide additional propagule pressure (Křivanek et al. 2006). The spread of *A.* ×*lamarckii* seeds by birds is also very likely, as several cases of bird dispersal are reported in the literature (Schroeder 1970; Danielewicz and Wiatrowska 2014; Ries et al. 2024).

Amelanchier ×*lamarckii* demonstrates the ability to persist and establish self-sustaining populations in the environment. However, based on current data and limited spread, it should be classified as a casual alien species in Lithuania, following the categorization framework proposed by Pyšek et al. (2004).

Conclusions

Amelanchier ×*lamarckii* is a relatively common taxon in Western Europe, so its detection was expected. The further spread and naturalization of this plant in Lithuania is very likely. For now, *Amelanchier* ×*lamarckii* should be treated as casual in Lithuania. The use of this species for ornamental purposes also increases the risk of its spread, as propagule pressure increases accordingly with each planting. The naturalization and spread of *Amelanchier* ×*lamarckii* to natural habitats in Lithuania are highly probable. Therefore, the planting of *A.* ×*lamarckii* should be avoided, if possible, as for now, this

taxon is in its initial invasion stages and its eradication is the most feasible. Further research is needed to assess the possible impact on native plant communities not only in Lithuania but also in other regions, as detailed studies on its invasiveness are currently scarce.

Authors' contribution

LP collected the field data, created research conceptualization and methodology, prepared data analysis and interpretation, wrote and reviewed text.

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