

Communication

Lotus maritimus L. (Fabaceae), alien species new to Lithuania

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Abstract

Petrulaitis L., 2022: *Lotus maritimus* L. (Fabaceae), alien species new to Lithuania. – *Botanica*, 28(1): 39–45. <https://doi.org/10.35513/Botlit.2022.1.5>

Information about the first record of alien species *Lotus maritimus* L. (Fabaceae) in Lithuania is provided. This species was found in disturbed grassland along the railway line in Panevėžys district (northern part of Central Lithuania), Berčiūnai village in June 2021. It is supposed that seeds of this species have been accidentally introduced with rock material used to maintain railway embankment. Species composition of the habitat in *Lotus maritimus* locality is presented. The recorded population consists of a large number of generative individuals. This species could also grow in other parts of Lithuania, as the plants produce viable seeds and might spread to new areas. Currently, *Lotus maritimus* is considered as a casual species in Lithuania; however, it may naturalise locally in the future.

Keywords: casual alien, community, distribution, population density, railway, seed set.

INTRODUCTION

An increasing number of alien plant species is a worldwide phenomenon, affecting many ecosystems in various ways (Parker et al., 1999; Hejda et al., 2010). Native plant communities are mainly affected by changes in species diversity and suppression of dominant plant species (Hejda et al., 2010). Alien plant species that overcome geographic barriers and establish themselves in different environments are interesting subjects for ecologists because of novel interactions with the native species, probable impact or potential invasiveness (Lachmuth et al., 2010; Kapitzka et al., 2020). Anthropogenic pressure causes severe disturbances to natural and seminatural habitats, where non-native species penetrate and establish self-sustaining populations (Hansen & Clevenger, 2005).

Disturbances caused along transportation routes such as railways and motorways often harbour many non-native plant species, as vehicles and transported commodities act as a vector of propagules (Wrzesień & Denisow, 2017). The results of studies in Lithuania also confirm that railways and other transport networks have been, and continue to be, a significant immigration route for alien species (Gudžinskas, 1993, 1999 b, 2017). Some studies have shown that alien plant species introduced and occurring near the railways, after a certain period, tend to penetrate other habitats, and railways become corridors for the internal migration of alien species (Hansen & Clevenger, 2005; Lachmuth et al., 2010). In the vicinity of the railways, due to higher levels of disturbance, better lighting and warming of the embankment slopes and other locally-specific environmental conditions, the

northern regions provide more favourable conditions for alien species to establish and pass the first stages of their establishment (Rutkovska et al., 2013).

During field research in June 2021, a population of unknown species of the genus *Lotus* in grassland near a railway line was found. After the literature analysis, this plant was identified as *Lotus maritimus* L. The genus *Lotus* L. comprises about 130 species, and some of these share resemblances with closely related genera; therefore, its taxonomy is complicated and still disputed (Degtjareva et al., 2006, 2008; Kramina et al., 2021).

The genus *Lotus* in Lithuania had previously been represented by three native species: *Lotus corniculatus* L., *Lotus tenuis* Kit. and *L. uliginosus* Schkuhr. (Stancevičius, 1971). *Lotus corniculatus* is a common species widespread throughout the country, and the latter two species are quite rare, especially *Lotus tenuis*. *Lotus uliginosus* is common in the western part of the country, especially in coastal areas (Stancevičius, 1971). Subspecies or varieties of *Lotus corniculatus* are considered by some authors at the species rank (Eglīte et al., 1996), e.g. *Lotus arvensis* Pers. (= *Lotus corniculatus* var. *arvensis* (Pers.) Ser.), *Lotus balticus* Min. (= *Lotus corniculatus* var. *carnosus* Hartm.), *Lotus ambiguus* Bess. ex Spreng. (= *Lotus corniculatus* subsp. *hirsutus* (Koch) Rothm.). Recent studies have shown that most of the infraspecific taxa belong to the *Lotus corniculatus* complex (Degtjareva et al., 2008). Some studies have revealed that even *Lotus corniculatus* and *Lotus tenuis* are closely related species, and the latter is perhaps the maternal ancestor of *Lotus corniculatus* (Gauthier et al., 1997).

Lotus maritimus is a European species distributed mainly in coastal regions of Europe and the inland areas (Domínguez & Galiano, 1979). However, in some databases (POWO, 2021; Euro+Med, 2021), it is stated that *Lotus maritimus* is an alien species in the Baltic States. In Estonia, this species is native and distributed in coastal parts (Krall, 1996; Kuuk, 1999; Kull et al., 2002). However, there are no data from Latvia and Lithuania confirming the previous existence of this species in both countries (Gudžinskas, 1999 a, b; Prieditis, 2014). Thus, this paper, reporting the occurrence of the alien species *Lotus maritimus* in Lithuania, partly fulfils the gap. Furthermore, species composition of the newly discovered stand

is described, and notes on *Lotus maritimus* possible establishment in Lithuania. The species' ecological requirements are also shortly discussed.

MATERIALS AND METHODS

The field research was performed in July 2021. Eight phytosociological relevés of 1 × 1 m were recorded according to the Braun-Blanquet method (1964) to determine the species composition. In the same plots, the number of generative individuals was counted. Thirty pods were randomly collected (1–2 pods from one individual) at the studied site to evaluate the number of developed seeds per pod.

A distribution map was compiled using a system of grid cells, which were arranged according to geographical coordinates with sides of 6' of latitude and 10' of longitude (Gudžinskas, 1993). The collected herbarium specimen of *Lotus maritimus* is deposited at the Herbarium of the Nature Research Centre (BI-LAS). Nomenclature of taxa follows Plants of the World Online (POWO, 2021).

RESULTS AND DISCUSSION

***Lotus maritimus* L., Sp. Pl.: 773. 1753. – *Tetragonolobus maritimus* (L.) Roth, Tent. Fl. Germ., 1: 323. 1788; Krall in Fl. Baltic Countr., 2: 138. 1996.**

Lotus maritimus is a perennial rhizomatous plant with ascending or suberect stems reaching 50 cm. Flowers are usually solitary, occasionally two, corolla from pale yellow to yellow, 25–30 mm, keel with a curved obtuse beak. Bracts in groups of three, 10–20 mm, calyx tubular, 14–18 mm, with teeth shorter than the tube. Pods quadrangular, 40–60 mm long and 2.5–4 mm wide, with wings 0.5–1 mm, each pod has about 20–30 seeds that are 1.5–2 mm, subspherical or ellipsoid, from brown to mottled black (Domínguez & Galiano, 1979; Valdés, 2000). *Lotus maritimus* belongs to *Lotus* sect. *Tetragonolobus* (Scop.) Benth. et Hook.f. It is very distinct from the native members of the genus *Lotus* in Lithuania by its large flowers and quadrangular pods (Fig. 1.)

Lotus maritimus L. is a nitrogen-fixing species native to South and Central Europe (Domínguez & Galiano, 1979). Furthermore, this species is rare and listed as vulnerable (VU) or near threatened (NT) in the Red Lists of the Czech Republic, Po-

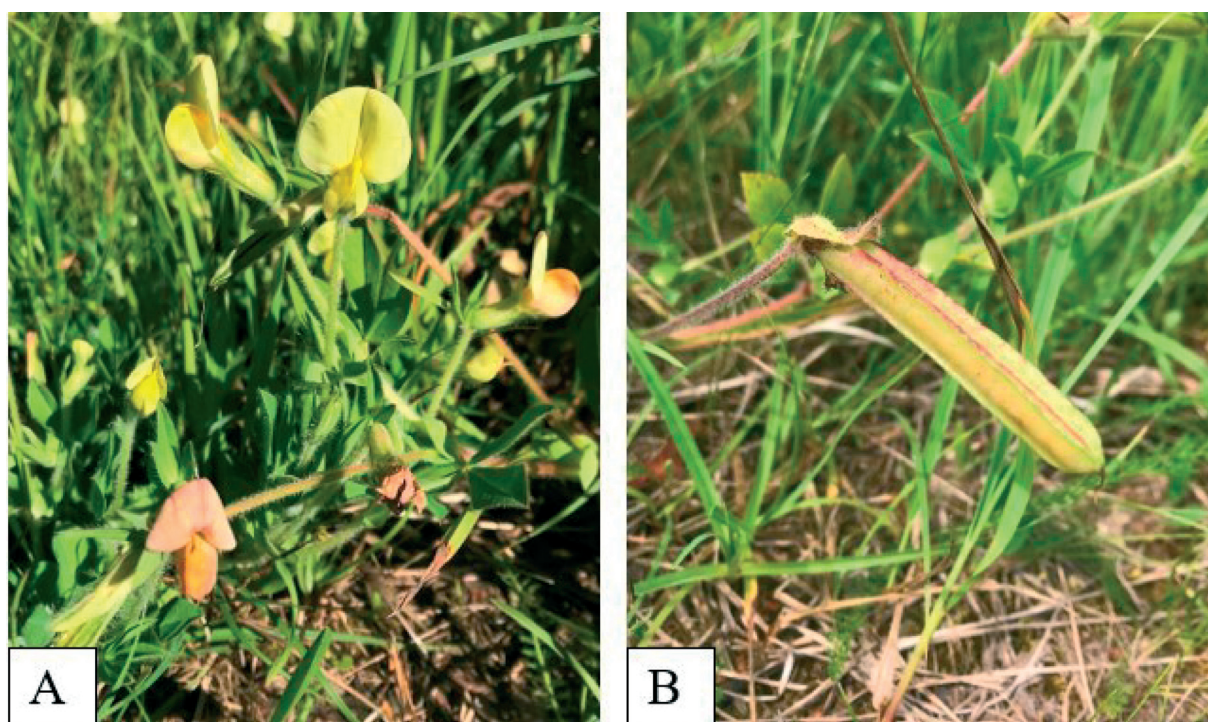


Fig. 1. *Lotus maritimus* in the locality at Berčiūnai village (Panevėžys district): a flowering individual (A) and a mature pod (B)

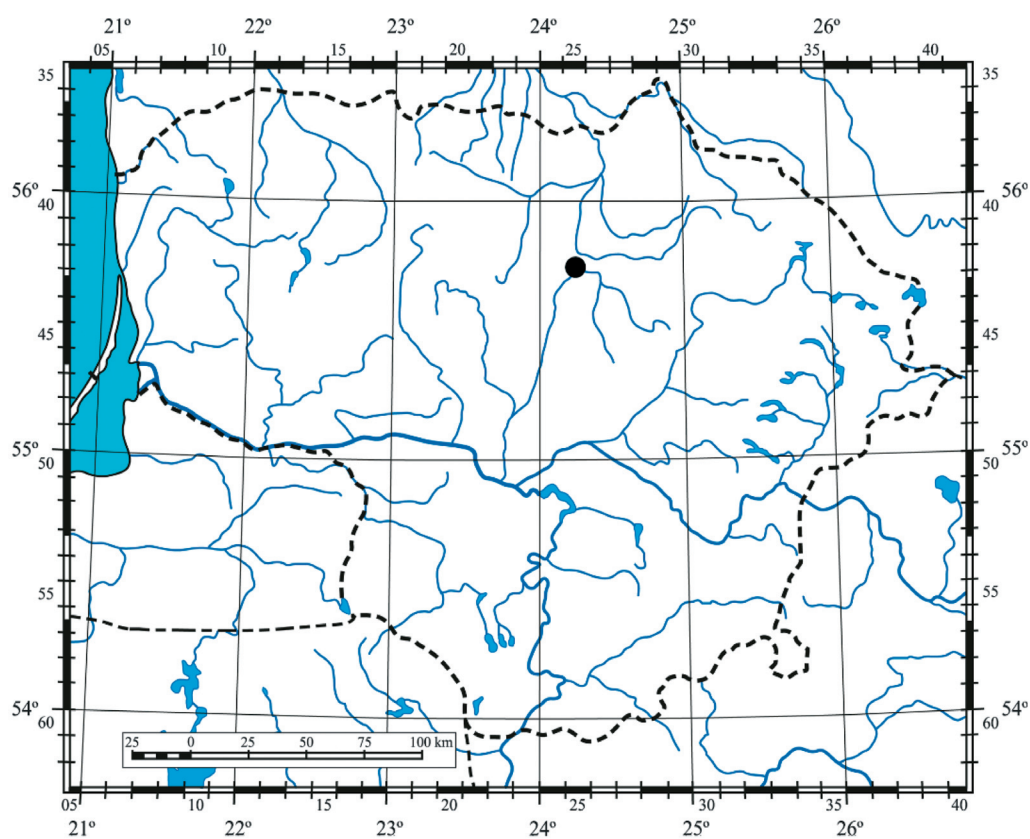


Fig. 2. The locality of *Lotus maritimus* in Lithuania

land, the Carpathian part of Slovakia and Slovenia (Danihelka et al., 2012; Kocjan, 2014; Turis et al., 2014; Kaźmierczakowa, 2016). It is also native to the Scandinavian Peninsula, where it occurs on seashore grasslands in the southern Baltic and becomes rare in calcareous fens further inland (Karlsson, 2015). Finally, this species is native to the northwestern shores of Estonia, where it occurs in dry and coastal grasslands, also in bushes and along forest margins (Krall, 1996; Kull et al., 2002).

The species was recorded in Berčiūnai village (specimen collected on 17 June 2021; 55.74068 °N, 24.22436 °E), Panevėžys district, 6 km west of Panevėžys city (Fig. 2). The individuals of *Lotus maritimus* were distributed over 30 m long and 3 m width in disturbed thermophilous grassland, about 20 meters from the railway line. The number of generative individuals in the studied plots ranged from 5 to 17 (mean density was 9.8 ± 3.9 individuals per square meter). Analysis of 30 pods collected during field studies revealed that the number of ovules ranged from 14 to 36 (mean \pm standard deviation; 22.6 ± 6.3) per pod. The number of developed seeds ranged from 10 to 34 (19.3 ± 6.6), whereas undeveloped seeds ranged from 0 to 11 (3.3 ± 2.9) per pod.

The mean number of species per plot was 15 (from 10 to 20 species), mainly grassland species occurring in dry calcareous soils, such as *Briza media* L., *Carex flacca* Schreb., *Linum catharticum* L. prevailed (Table 1).

Occurrence of some species (*Pastinaca sativa* L., *Plantago media* L., *Taraxacum officinale* F.H. Wigg.) indicates that this grassland has been disturbed and probably favoured successful establishment and spread of *Lotus maritimus*. In this anthropogenic habitat, species characteristic of the *Molinio-Arrhenatheretea* R. Tx. 1937 class (e.g. *Achillea millefolium* L., *Anthyllis vulneraria* L., *Trifolium montanum* L.) prevailed. However, some species representing the *Festuco-Brometea* Br. Bl. et R. Tx. 1943 class (e.g. *Briza media* L., *Calamagrostis epigejos* (L.) Roth, *Polygala comosa* Schkuhr) also were abundant.

In the native range in Poland, *Lotus maritimus* forms communities with *Carex flacca* on wet calcareous soils (Głazek & Łuszyńska, 1994; Matuszkiewicz, 2001). The species composition at the studied site in Lithuania is similar to that described at some

southern Poland sites (environs of Podkamieniec in Jaworzno city and Zagaje village). This is because the studied plots contained many species found in dry calcareous soils (e.g. *Carex flacca* L., *Briza media* L., *Linum catharticum* L., *Pimpinella saxifraga* L., *Trifolium montanum* L.). Habitat from another site in central Poland (Nowa Wieś Dolna, Poznań neighbourhood) also has a similar species composition compared to the site in Lithuania by the low number of grassland species in the communities (e.g. *Achillea millefolium* L., *Dactylis glomerata* L., *Poa pratensis* L., *Taraxacum officinale* F. H. Wigg.). However, in Poland, *Lotus maritimus* occurs in a more humid habitat with abundant wet grassland species (*Angelica sylvestris* L., *Cirsium oleraceum* (L.) Scop., *Silene flos-cucculi* (L.) Greuter & Burdet) (Janyszek & Janyszek, 2005). In Slovenia, *Lotus maritimus* occurs in contrasting ecological conditions, i.e. mineral-rich fens and rocky grasslands (Kocjan, 2014). *Lotus maritimus* grows in its native range in open habitats of varying humidity. As a result, this species accidentally introduced into a favourable grassland habitat in Lithuania currently forms a dense population and reproduces successfully by seed.

The emergence of alien species in habitats along railway lines is a well-documented and ongoing process, as railways are an important corridor for introducing and spreading alien species (Hansen & Clevenger, 2005; Galera et al., 2012; Wrzesień & Denisow, 2017). Most of the alien species records are closely related to frequently disturbed habitats and the intensity of railway usage. In contrast, along abandoned railway lines, alien species decrease (Galera et al., 2012). Thermophilous species also often occur along railway lines, as slopes of railway embankments are usually exposed to full sun and material for railway maintenance, such as rocks, creates a warmer environment. For example, species naturally found in the south of Europe (*Tribullus terrestris* L., *Sideritis montana* L.) were found in Lithuania several decades ago, along railway lines (Gudžinskas, 2017).

In Lithuania, rock material for railway ballast is mainly imported from Belarus and Ukraine (Ramūnas et al., 2014). Imported rock material from Zhytomyr Region (North Ukraine) may have contained seeds of *Lotus maritimus*, where this species is present (Prokudin et al., 1987). Thus, it is possible that its

Table 1. Species composition of the communities with *Lotus maritimus*

Number of relevé	1	2	3	4	5	6	7	8	Frequency (%)
Cover of herb layer (%)	80	60	70	90	70	90	50	40	
Cover of bare ground per plot	5	70	20	20	30	10	40	20	
Cover of <i>L. maritimus</i>	10	40	80	80	80	85	30	70	
Density of generative individuals per plot	5	8	7	14	10	17	8	9	
Number of species per plot	18	14	16	18	20	10	15	11	
<i>Lotus maritimus</i> L.	2	3	4	4	4	4	2	3	100
<i>Trifolium montanum</i> L.	+	1	1		+	+	+	+	87.5
<i>Anthyllis vulneraria</i> L.	2	1		+	+	1	2		75
<i>Briza media</i> L.	4	2	2	2			2	3	75
<i>Carex flacca</i> Schreb.	2	2	1	1	+		4		75
<i>Achillea millefolium</i> L.		+	1	2	1			1	62.5
<i>Calamagrostis epigejos</i> (L.) Roth		+	+	+	+			1	62.5
<i>Dactylis glomerata</i> L.		+	1	1	1	1			62.5
<i>Linum catharticum</i> L.	2	2		2	1			1	62.5
<i>Pimpinella saxifraga</i> L.	+		2		+		1	1	62.5
<i>Polygala comosa</i> Schkuhr	1	1	+	+	1				62.5
<i>Avenula pubescens</i> (Huds.) Dumort.	2	1		2		2			50
<i>Knautia arvensis</i> (L.) Coult.			+	2		1		1	50
<i>Ranunculus acris</i> L.		+		+	+		+		50
<i>Centaurea scabiosa</i> L.				1	+		2		37.5
<i>Galium album</i> Mill.			2	1		1			37.5
<i>Pastinaca sativa</i> L.					1	1	+		37.5
<i>Agrimonia eupatoria</i> L.	+						1		25
<i>Centaurea jacea</i> L.	+				1		+		25
<i>Daucus carota</i> L.	+		1						25
<i>Festuca arundinacea</i> Schreb.	+				2				25
<i>Leontodon hispidus</i> Cav.	+		+						25
<i>Scorzoneroidea autumnalis</i> (L.) Moench	+				1			+	25
<i>Lotus corniculatus</i> L.			+		1				25
<i>Medicago falcata</i> L.							1	1	25
<i>Plantago media</i> L.	1	1							25
<i>Poa pratensis</i> L.				+		+			25
<i>Polygala vulgaris</i> L.			1	+					25
<i>Potentilla reptans</i> L.					1			1	25
<i>Taraxacum officinale</i> F. H. Wigg.				+	+				25
<i>Thymus pulegioides</i> L.			+	1					25

Sporadic species. *Cichorium intybus* L. – 2 (+); *Equisetum arvense* L. – 5 (2); *Galium boreale* L. – 6 (+); *Galium verum* L. – 1 (+); *Inula salicina* L. – 7 (+); *Leucanthemum vulgare* Lam. – 7 (+); *Medicago lupulina* L. – 7 (+); *Vicia craca* L. – 1 (+)

seeds were introduced with rock material and plants germinated when favourable conditions occurred.

Considering the size and vigorousness of *Lotus maritimus* population at Berčiūnai site, this population may survive as long as the habitat is suitable for its persistence because this species is reproducing and spreading by seeds. Therefore, the naturalisation of this species is possible in the country. However, considering that this species is quite rare in some

countries of its native range, the probability of its invasion in Lithuania is very low.

ACKNOWLEDGEMENTS

I express my gratitude to Dr Zigmantas Gudžinskas (Institute of Botany of the Nature Research Centre) and the reviewers for their valuable comments on the manuscript.

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