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RESEARCH ARTICLE

## *Lobelia urens* (Campanulaceae), a new naturalized alien species in the flora of seaside Adjara (SW Georgia / Sakartvelo)

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**Abstract.** The article reports a new alien plant species found in Georgia / Sakartvelo, *Lobelia urens* (Campanulaceae: Lobelioideae), first recorded in 2012 in the floristic district of Adjara. Data on its distribution and ecological and cenotic interactions with local native and alien species under new environmental conditions are provided.

**Keywords:** Adjara, *Lobelia urens*, new alien plant species

### Introduction

*Lobelia urens* L. (Campanulaceae, subfamily Lobelioideae) is a plant species of the diverse and widespread genus *Lobelia* L. (see below). The subfamily Lobelioideae (now included in Campanulaceae but earlier often recognized as a separate family Lobeliaceae) includes about 30 genera with at least 1200 species (Knox et al., 2008). Morphologically they are characterized by resupinate flowers with zygomorphic corollas and connate anthers (Lammers, 2011 and references therein). Representatives of the subfamily are widespread throughout the world, except the Middle East, the Arctic, and some parts of

Eurasia (e.g., Eastern Europe and the Central Asian region). Approximately half of them are of South American origin, and thus South America is considered as one of the most important centers of diversification of that group (Kagame et al., 2021).

The genus *Lobelia* is one of the largest genera in the subfamily Lobelioideae. It was subdivided by Wimmer (1948) into three subgenera, subg. *Lagotis* F. Wimmer (which should be called *Lobelia* subg. *Lobelia* because it contains the type of the genus), subg. *Mezleria* (Presl.) F. Wimmer, and subg. *Tupa* (G. Don) F. Wimmer and numerous groups of subordinate ranks (Wimmer, 1948), while Lammers (2011) recently recognized 18 sections and no subgenera.

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The genus *Lobelia* includes from 415 (Lammers, 2011) to more than 440 species (POWO, 2022–onward), with subcosmopolitan distribution; its diversity centers are mainly located in the tropics and subtropics (Spaulding, Barger, 2016). It is also rather widespread in warm temperate regions. In cold temperate regions, they are less common and their distribution there decreases as compared to that in tropical and subtropical areas.

The name of the genus, *Lobelia*, was coined in 1703 by the French botanist and explorer Charles Plumier, who discovered a new plant in the West Indies and named it *Lobelia* after the Flemish physicist and botanist Matthias de l'Obel, Latinized as Lobelius (Lloyd, Lloyd, 1909; Spaulding, Barger, 2016). Linnaeus (1753) kept the name of the genus proposed by Plumier in the polynomial form, and validated the binomial name *Lobelia plumieri* L. that commemorated Plumier (Lammers, 2011). *Lobelia* includes annual and perennial herbaceous and shrubby plants.

Until now, 75 species of 5 genera of the family *Campanulaceae* have been reported in Georgia (Gagnidze, 2005; GBD, 2007–onward). *Lobelia urens* is a new alien species discovered in Georgia.

The aim of the present research was to study distribution characteristics and species composition of the plant communities with *Lobelia urens* in its dispersal areas in Georgia.

## Materials and Methods

Traditional botanical expeditions and field research involved plant descriptions, photography, plant sampling, herbarium preparation, and identification. Appropriate scientific literature and online sources were used for plant identification (GBIF, 2022–onward; Dmitrieva, 1990a, b; Averis, 2013; Spaulding, Barger, 2016; Beentje, 2016; POWO, 2022–onward; Fischer et al., 2018; Pell, Angel, 2021; <https://www.brc.ac.uk/plantatlas/plant/lobelia-urens>).

Our studies were conducted in 2014–2021 with the aim of clarifying the biomorphological characteristics of *Lobelia urens* and the species composition in its distribution area in Georgia. In 2017–2020, we used transects as the primary survey method for the study of *Lobelia urens* and its accompanying and associated species in the study area. During the field surveys, six transects were selected (1 m wide × 280 m long). In each transect, 20 marked sample plots/squares (1 × 1 m) were used to determine the density, frequency, and projective

coverage of *Lobelia urens*. Monitoring was conducted twice during the vegetation period in the plots/squares, at the beginning of the vegetation period and at the flowering-fruiting phase. A total of 240 entries were made every year. Based on these data, the mean values were calculated.

Nomenclature of the plant species mostly follows the *Plants of the World Online* database (POWO, 2022–onward). Field information for mapping was collected with a Garmin GPS MAP 64st handheld GPS. The maps were compiled using the geographic information systems (GIS) software Esri ArcGIS ArcMap. Maps are made in UTM WGS 1984 Zone 37N coordinate system.

## Results and Discussion

*Lobelia urens* L., Sp. Pl. 2: 931 (1753).

*Lobelia urens* is a perennial rhizomatous herbaceous plant. Rosettes consist of 5–15 cm long, inverted ovate, sometimes more elongated, and irregularly toothed leaves. An erect stem or several stems, 10–100 cm tall, develop from each rosette. The leaves on the stem are narrower and shorter than the rosette leaves. Flowers bisexual, zygomorphic, and inverted (representatives of *Campanulaceae* subfam. *Lobelioideae* usually have three petals above and two below, while *Lobelia* has the opposite — two petals above and three petals below). Corolla five-lobed; flowers entomophilous (insect-pollinated), sometimes self-pollinating. Calyx tube cylindrical, petals bilobed, 10–15 mm long, light purple. The upper lobe consists of two sharply divided lips, while the lower lobe has three lips. All lips end in a pointed, backward-curved tip (Fig. 1).

Stamen filaments free, attached to the corolla by antheridium. Stamens black, covered with white hairs. Stigma cephalic, weakly glandular, style thin. Pistil bilocular, with many ovules. About 200 light brown seeds less than 1 mm long develop in a fruit. Ripening and dispersal of seeds occur parallel to flowering. Flowering begins at the end of May / early June and lasts until the end of October, and in some specimens flowers were also observed in November. After the end of flowering in late autumn, the aboveground parts dry up, and new rosettes form (Fig. 2).

We recorded *Lobelia urens* in Kobuleti (Adjara, Georgia), on wet secondary disturbed areas, between 10 and 30 m above sea level. The monitoring area of *L. urens*, according to the provided map, was approximately 25 ha (Fig. 3).



Fig. 1. *Lobelia urens*, a blooming plant and flowers



Fig. 2. *Lobelia urens*, vegetative (by rhizomes) and generative (by seeds) propagated plants

The exposure is flat, soil is poorly developed. In the 1920s, in the mentioned areas when canals (waterways) were constructed, local species, represented mainly by beech (*Fagus orientalis* Lipsky), hornbeam (*Carpinus caucasica* Grossh. [= *Carpinus betulus* L.]), Strandzha oak / Hartwiss oak (*Quercus hartwissiana* Steven), rhododendrons (*Rhododendron ponticum* L., *R. luteum* Sweet) were cut down, and species of eucalyptus (*Eucalyptus cinerea* F. Muell. ex Benth., *E. globulus*

Labill., *E. viminalis* Labill.), cryptomeria (sugi, *Cryptomeria japonica* (Thunb. ex L. f.) D. Don), and cinnamomum (*Cinnamomum glanduliferum* (Wall.) Meisn.) were planted. At the end of the 1980s, the plantations grown in these territories almost disappeared. In the degraded, empty and abandoned sections, under conditions of competitive relationship between species of local and alien origin, certain cenotic groups (more or less established plant communities) gradually formed.

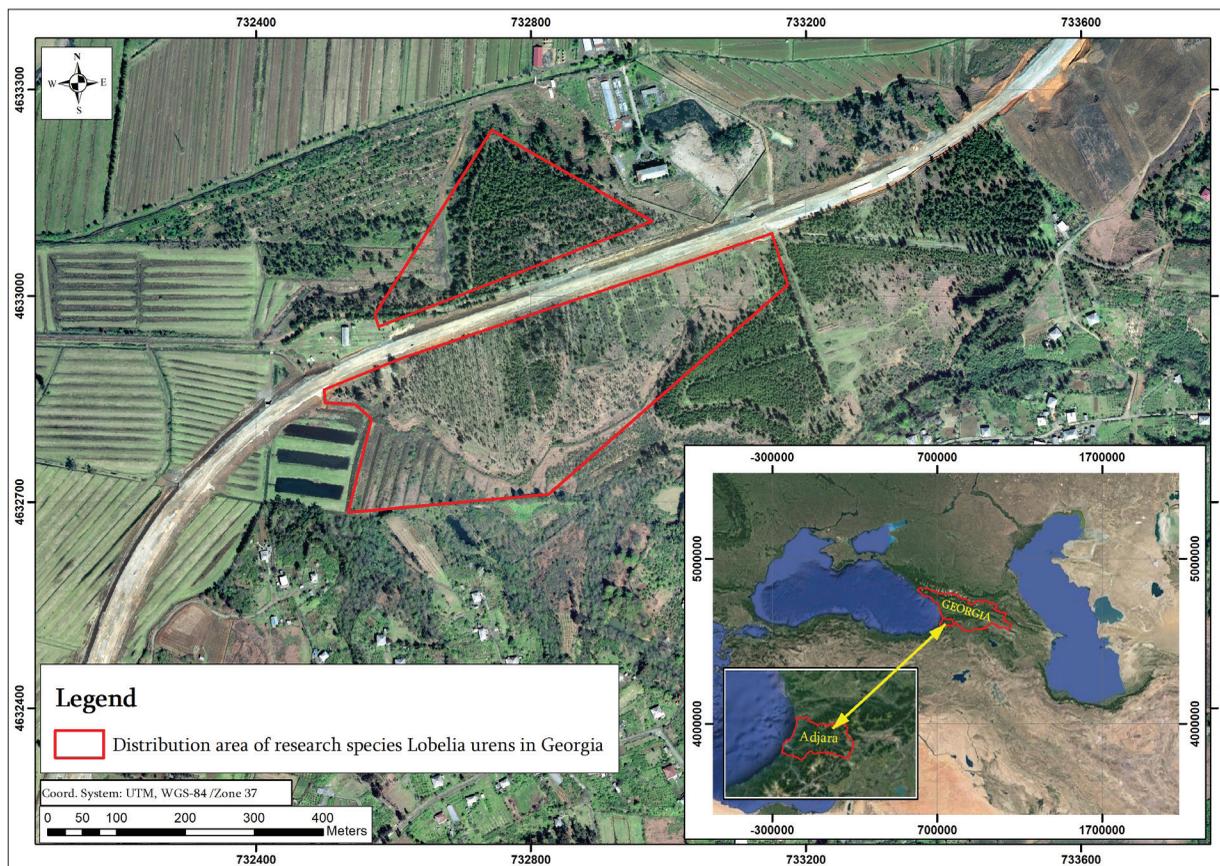


Fig. 3. Geographic location of the studied populations of *Lobelia urens* (study area)

In 2012, the construction of the Kobuleti bypass road started in this territory. In parallel with the construction of the road, the introduction of different types of plants intensified. Among them, a new species of foreign origin, heath lobelia — *L. urens*, appeared and started to spread.

As our observations demonstrated, the first registered specimens of *Lobelia* appeared in the research area in 2012. In each subsequent vegetation period, the area and frequency of distribution increased, therefore from 2017–2020, we carried out a study of density, frequency, and coverage using the method of squares.

In 2017, the maximum number of specimens recorded in a sample plot was six units, and the average number in a transect — 728 units; density — 2.6, frequency — 70%, and coverage — 12%.

According to our research in 2018, all these values increased. The maximum number of specimens in a sample plot was eight units, and the average number in a transect was 980 individuals,

density — 3.5, frequency — 80%, and coverage — 15%.

In 2019, the data increased slightly compared to the results of 2018. The maximum number of specimens in the sample plot was eight units, and the average number in a transect — 1092 individuals, density — 3.9, frequency — 95%, and coverage — 17%.

From the received data, the meeting indicators are especially important. In 2017 the frequency value was 70% and in 2019 it increased to 95%. The plant was spotted in 95% of the sampled transects.

Over the following years (2020–2021), the distribution area of *Lobelia* expanded. However, its density is low, the plant does not yet create economic, ecological and health problems, and it is unnecessary to consider its potential invasiveness at this stage. It adapts particularly well to moist soils and is widely spread along canal edges. In the distribution sites, accompanying species were registered, forming communities of specific structure and species composition. The following 81 plant species have

been recorded in the distribution area of *Lobelia urens* in Adjara: *Acalypha australis* L., *Aira elegans* Willd. ex Roem. & Schult., *Alnus barbata* C.A. Mey. (= *Alnus glutinosa* subsp. *barbata* (C.A. Mey.) Yalt.), *Bellis perennis* L., *Blechnum spicant* (L.) Roth (*Struthiopteris spicant* (L.) Weiss), *Calliargonella cuspidata* (Hedw.) Loeske, *Capsella bursa-pastoris* (L.) Medik., *Cichorium intybus* L., *Cardamine hirsuta* L., *Carex riparia* Curtis, *Centaureum tenuiflorum* (Hoffmanns. & Link) Fritsch., *Cinnamomum glanduliferum* (Wall.) Meisn., *C. japonicum* Siebold ex Nakai., *Commelina communis* L., *Corylus avellana* L., *Cryptomeria japonica* (Thunb. ex L. f.) D. Don., *Cyperus esculentus* L., *C. longus* L., *Erigeron annuus* (L.) Desf., *Eucalyptus cinerea* F. Muell. ex Benth., *E. globulus* Labill., *E. viminalis* Labill., *Euphorbia falcata* L., *E. pepus* L., *E. stricta* L., *Fragaria vesca* L., *Filago arvensis* L., *Frangula alnus* Mill., *Hydrocotyle ramiflora* Maxim., *H. vulgaris* L., *Hypericum androsaemum* L., *Juncus effusus* L., *J. tenuis* Willd., *Kummerowia striata* (Thunb.) Schindl., *Kyllinga gracillima* Miq., *Leontodon hispidus* L., *Lespedeza bicolor* Turcz., *Logfia gallica* (L.) Coss. & Germ. (*Filago gallica* L.), *Lonicera japonica* Thunb., *Lolium perenne* L., *L. rigidum* Gaudin, *Lysimachia japonica* Thunb., *Lythrum salicaria* L., *Mentha aquatica* L., *M. pulegium* L., *Microstegium japonicum* (Miq.) Koidz., *M. vimineum* (Trin.) A. Camus, *Miscanthus sinensis* Andersson, *Odontoschisma denudatum* (Nees) Dumort., *Osmunda regalis* L., *Oxalis corniculata* L., *Paspalum distichum* L., *P. thunbergii* Kunth, *Persicaria hydropiper* (L.) Delarbre (= *Polygonum hydropiper* L.), *P. thunbergii* (Siebold & Zucc.) H. Gross (= *Polygonum thunbergii* Siebold & Zucc.), *Phytolacca americana* L., *Plantago major* L., *Poa annua* L., *P. compressa* L., *Polytrichum strictum* Menzies ex Bridel., *Prunella vulgaris* L., *Pteridium aquilinum* (L.) Kuhn (incl. *P. tauricum* V.I. Krecz. ex Grossh.), *Pteris cretica* L., *Rubus caesius* L., *R. serpens* Weihe ex Lej. & Courtois., *Rumex acetosella* L., *Senecio sylvaticus* L., *S. vulgaris* L., *Setaria faberi* R.A.W. Herrm., *S. intermedia* Roem. et Schult., *Smilax excelsa* L., *Sphagnum cuspidatum* Ehrh. ex Hoffm., *Spiraea japonica* L. f., *Thelypteris limbosperma* (All.) H.P. Fuchs (*Oreopteris limbosperma* (All.) Holub), *Trifolium diffusum* Ehrh., *T. echinatum* M. Bieb., *Vaccinium arctostaphylos* L., *Verbascum blattaria* L., *Viola prionantha* Bunge, *V. reichenbachiana* Jord. ex Boreau, *Verbena brasiliensis* Vell.

Among them, 39 species are native, while the remaining 42 taxa are alien in our area. Among

aliens, 20 taxa are of East Asian origin, 8 taxa originated from the Mediterranean region, 7 taxa from Europe, 3 taxa from North America, 3 taxa from Australia, and one species originated from South America (Dmitrieva, 1990a, 1990b; Davitadze, 2001; Kikodze et al., 2010; Mikeladze et al., 2017).

The plants of foreign origin began to spread in Georgia since the ancient times, and their introduction and spread continue today. Many of alien species have become so established in local plant communities (biocenoses) and ecosystems that it is difficult to distinguish them ecologically from native species (Davitadze, 2001; Mikeladze et al., 2018). Their spread is mainly related to the geographical location and climatic conditions of Georgia. The non-native species are especially abundant in the coastal zone. One example of this is the appearance of singular specimens of *Lobelia urens* in 2012, which today can be considered as naturalized species for coastal Adjara, judging from the density, frequency, coverage, flowering, and fruiting indicators that we studied.

According to references, *L. urens* has a Lusitanian pattern of distribution in Europe and North Africa that extends from Morocco, Madeira, and the Azores, in the south along the Atlantic coast through Portugal, Spain, and France, as far northward as Belgium (Dinsdale, 1996). In France it grows in the plains, in Spain it occurs in high valleys (up to 830 m above sea level), in Madeira the plant is mainly found between 600–915 m, and in Portugal it is present in the coastal plain, going inland up the valleys of the wetter northern provinces to 800 m (Brightmore, 1968). In the Azores it is found above 300 m in grazed pastures. In Britain *Lobelia urens* is a lowland species common only on the southern coasts, with an altitudinal range from 25 m up to 210 m. It is characterized by a rare distribution and is included in the *Red Data Book of Britain* as a Vulnerable species (Perring, Farrell, 1977; Dinsdale et al., 2003). In our research, in the study area in Georgia (Adjara) *L. urens* was found mainly between 15 and 35 m above sea level.

The focus of our research was monitoring of the new alien species. Since *Lobelia* is considered a Vulnerable species in Britain, we studied its distribution in the research area (Georgia, Adjara) by the method of squares in order to determine the peculiarities of its naturalization. Along with *Lobelia*, we studied accompanying species in the distribution. It is the first-time research in this direction that has

been carried out on that species. In the next stages of the research, monitoring and study of the dynamics of the species spread will continue.

## Conclusions

*Lobelia urens* (*Campanulaceae*), a herbaceous perennial species, originally of the Lusitanian area in Europe and North Africa, is found for the first time in the floristic region of Adjara in SW Georgia in 2012. This is the first record of this alien species, and also a new genus record, for the flora of Georgia / Sakartvelo. During 2014–2020, its distribution and bioecological features were studied. The distribution area was increasing every year, which indicates a high degree of adaptation of the plant to new environmental conditions. The plants bloom abundantly and produce numerous fruits and viable seeds. The species competes with different other species

in its distribution area in Adjara. In total, 81 taxa of vascular plants and mosses have been recorded as co-occurring in plant communities with *L. urens*.

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## Ethics Declaration

The authors declare no conflict of interest.

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***Lobelia urens* (*Campanulaceae*), новий натуралізований чужорідний вид з приморської території Аджари (південно-західна Грузія / Сакартвело)**

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**Реферат.** У статті повідомляється про новий чужорідний (адвентивний) вид для Грузії / Сакартвело, *Lobelia urens* (*Campanulaceae: Lobelioideae*), уперше знайдений у 2012 р. у флористичному регіоні Аджара. Наведено відомості про особливості його поширення і ценотичні зв'язки з аборигенними та іншими чужорідними видами рослин у нових природних умовах.

**Ключові слова:** *Lobelia urens*, Аджара, новий чужорідний вид рослин