

Reports of some ornamental plants as aliens for the Bulgarian flora

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Abstract. The aim of the paper is to report data about the distribution, habitat preferences and naturalisation success of three ornamental taxa cultivated in Bulgaria. *Hemerocallis fulva* (*Asphodelaceae*), a native species to temperate Asia, has been recorded as an established alien in eight floristic regions in the country. *Oxalis articulata* (*Oxalidaceae*), native to temperate South America, has been recorded as a casual species in three floristic regions. *Phalaris arundinacea* var. *picta* (*Poaceae*) has white variegated leaves and is a popular garden cultivar of a native to Bulgaria species. It has been recorded as an established alien in three floristic regions. Although *H. fulva* and *Ph. arundinacea* var. *picta* may form relatively wide, monodominant stands through vegetative reproduction, at this stage the two taxa do not show invasive behaviour in the Bulgarian flora. Photographs and distribution maps of the species are provided.

Key words: alien plants, flora of Bulgaria, *Hemerocallis fulva*, ornamental escapes, *Oxalis articulata*, *Phalaris arundinacea* var. *picta*.

Introduction

Introduced ornamental species are a major source of naturalised alien plants (e.g. Lambdon & al. 2008). The registration of such species is important for many reasons such as monitoring of their distribution, impact and risk assessments. Although many traditionally used ornamentals are included or mentioned as such in the Floras and guides to vascular plants in Bulgaria (e.g. Jordanov 1963–1979, Kozhuharov 1992, Delipavlov & Cheshmedzhiev 2011), as a rule, no information about the naturalization success and distribution of these species is provided. Some ornamental species have been reported during the past decade, both woody and herbaceous: *Koelreuteria paniculata* (Vladimirov 2009), *Larix decidua* (Petrova & Gerasimova 2017), *Parthenocissus inserta* (Zieliński & al. 2012), *Lupinus*

polyphyllus (Vassilev & Pedashenko 2009), *Oenothera glazioviana* (Kalníková & Palpurina 2015), *Sedum sarmentosum* (Petrova 2017a), *Sternbergia lutea* (Vladimirov & al. 2016), *Tagetes patula* (Petrova 2017b), *Tulipa agenensis* (Stoyanov & Raicheva 2018), etc. Nevertheless, many ornamental plants which escaped from cultivation have not been reported for the Bulgarian flora yet. This concerns both long-used and only recently introduced species.

Material and methods

Materials have been collected during field studies across the country for more than 10 years. Data about the size of the escaped localities and habitats of the species were noted in the field. Repeated observations

were done whenever possible. Analysis of the pathways of introduction and of the alien and invasive status of the species in the Bulgarian flora are based on the authors' personal observations in the field, as well as on relevant literature sources (e.g. Richardson & al. 2000; Harrower & al. 2018; for references about the particular species, see below).

A concise description of each species is provided, with notes on the general native and alien distribution range. The collected herbarium specimens have been deposited in the herbarium (SOM) of the Institute of Biodiversity and Ecosystem Research.

The species are presented in an alphabetical order.

Results and discussion

Hemerocallis fulva (L.) L. Sp. Pl., ed. 2, 462. 1762 (*Asphodelaceae*)

Herbaceous perennial, to 150 cm tall, clump-forming. The base of the stems shortened, swollen, with tuberous roots and stolons. Leaves in basal fans, linear, 50–90 × 1.0–2.8 cm. Inflorescences erect. Flowers 2–10, funnel-shaped, large, to 12 cm across, with 6 tepals, orange-red (Fig. 1), lasting for one-day – opening in the morning and closing in the evening (hence the English name 'day-lily'). Anthers 6. Fruit an ellipsoid capsule.

Native to Asia, from the Caucasus to the Himalaya, China, Japan, Korean peninsula (Chernyakovskaya 1935; Chen Xinqi & al. 2000). In Asia, it is used as edible, medicinal and ornamental plant. The horticultural use in Western Europe dates back to XVI century (POWO 2019). Nowadays, it is grown as ornamental in many parts of the world.

An important character of the cultivated *H. fulva* plants is that they are sterile. Studies revealed that the cultivars used for a long time in Europe, USA, and other regions are infertile triploids whereas the native populations are usually diploid, rarely with triploid plants (Stout 1932, etc.). Cultivars are well adapted to propagation only by vegetative means (Pütz 1998), and they spread as naturalised aliens in many countries in Asia, Australia, Europe and North America. In Europe, it has been recorded as an alien in at least 18 countries (DAISIE 2017), in some of which (e.g. Austria, Italy, Switzerland, etc.) it is considered established (Essl & Rabitsch 2002; Wittenberg 2005; Celesti-Grappo & al. 2009, etc.). In the USA, it is con-

sidered an invasive species in many states (Straley & Utech 2002; Swearingen & Barger 2016).

In Bulgaria, the species is widely cultivated (Delipavlov & Cheshmedzhiev 2011). As an attractive, soil and drought tolerant plant, which can survive without or with very limited gardener's care, it is often planted in graveyards, summer-houses and villas' areas as well. When it overgrows the place designed for it, people most often discard the surplus plants to semi-natural or natural habitats. Such plants can survive and once established outside the controlled urban areas, they expand their localities.

During the past decade, the species has been recorded as an escaped alien in many localities in eight floristic regions in Bulgaria (Fig. 2): **Northeast Bulgaria:** Varna district, along the road Varna – Burgas, north of Haramiyata locality, NH67, 43.131043°N, 27.814566°E, 05.07.2013, A. Petrova obs.; along the road between the villages Izgrev and Kalimantsi, Varna district, NH59, ca. 43.284839°N, 27.712207°E, 2011–2015, A. Petrova obs.; **Forebalkan (Eastern):** along the right bank of river Kalnik, near a bridge above the river, ca. 5–6 km above Balgarski Izvor



Fig. 1. *Hemerocallis fulva*: habit and flowers, Valley of River Mesta, between Mesta and Gospodintsi villages (photos V. Vladimirov).

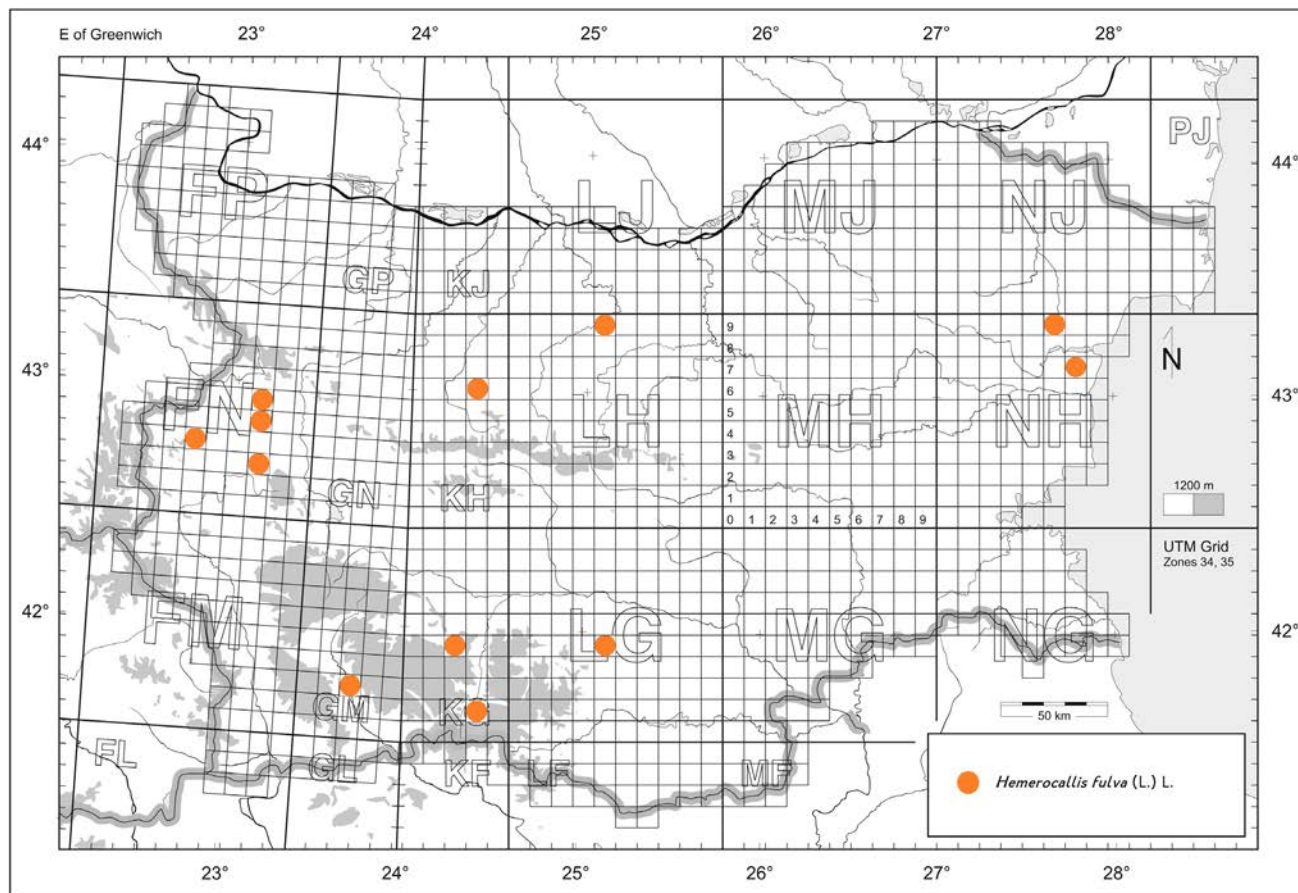


Fig. 2. UTM-distribution map of *Hemerocallis fulva*.

village (after the fork to Kirchevo village), ca. 290 m a.s.l., KH86, 43.03496°N, 24.35184°E, 28.06.2012, V. Vladimirov obs.; by the road from Krushuna to Chavdartsii villages, ca. 110 m a.s.l., LH49, 43.25383°N, 25.00944°E, 27.06.2012, V. Vladimirov obs. (Fig. 3); **Znepole region:** wet meadows near Paramun village, FN43, 42.793971°N, 22.755491°E, 15.07.2010, coll. A. Petrova (SOM 166117); **Sofia region:** along the road between Bogovtshi village and Belidie Han, FN74, 42.880851°N, 23.150547°E, 20.06.2009, coll. A. Petrova (SOM 165222); wet place along a small river in Belidie Han settlement, FN75, 42.890119°N, 23.165953°E, 10.06.2018, coll. A. Petrova (SOM 176406); **Vitosha region:** Lyulin Mt., along the road to Pernik, near Cherniya Kos locality, FN72, ca. 42.647883°N, 23.210089°E, 02.07.2011, A. Petrova obs.; **Valley of River Mesta:** by the road from Mesta



Fig. 3. *Hemerocallis fulva*, by the road from Krushuna to Chavdartsii villages (photo V. Vladimirov).

to Gospodintsi villages, ca. 625 m a.s.l., GM22, 41.724683°N, 23.691521°E, 27.06.2013, V. Vladimirov obs.; **Rhodopi Mts (Western)**: grassland vegetation along the road near the Borovo forest station, KG74, 41.917171°N, 24.253330°E, 01.08.2010, coll. A. Petrova (SOM 166108); **Rhodopi Mts (Central)**: Trigrad Gorge, by the road from Devin town to Trigrad village, ca. 1080 m a.s.l., KG81, 41.62006°N, 24.37913°E, 13.07.2019, V. Vladimirov obs. (Fig. 4); **Thracian Lowland**: moist depressions in pastures near Iskra village, LG44, 41.92912°N, 25.12560°E, 14.06.2012, A. Petrova obs.

The observed populations consist of one to few dense spots that cover areas from one to more than 100 m². They grow usually in ruderal or semi-natural habitats like roadsides and pastures. The vertical range is from almost sea level (near Varna town) to about 1500 m (Borovo forest station in Western Rhodopi Mts). The largest and the most thriving among the observed populations is the one near Paramun vilage in Western Bulgaria. Obviously thrown out as a garden waste at the edge of a higr- to mesophylous meadow from the nearby villas, now the established population covers about 200 m² and consists of a mo-



Fig. 4. *Hemerocallis fulva*, Trigrad Gorge (photo V. Vladimirov).

saic of very dense spots. The population at Beledie Han inhabits humid places near a small river and also is a thriving one, although it is a smaller one.

It is worth mentioning, that some of the localities of the species become very spectacular during flowering. This often attracts plant-lovers and gardeners to dig-up plants from the naturalised stands and transfer them to private gardens for cultivation. In fact, this practice should be encouraged since it is a mean to control or fully eradicate this alien to the Bulgarian flora species from some localities.

Oxalis articulata Savigny Lam. Encycl. 4: 686. 1798
(*Oxalidaceae*)

Caespitose rhizomatous herbaceous perennial. Rhizomes segmented, thick, 5–10(15) cm long, 1–2 cm in diameter, woody, with thick remains of leaf-bases. Leaves in rosettes. Petioles 5–30 cm (in Bulgaria up to 20 cm); leaflets 3, gray-green, obcordate, deeply emarginate. Inflorescence a corymbose cyme, 3–10-flowered; sepals lanceolate, petals 10–15 mm, pink (Fig. 5A). Capsule 10 mm, cylindrical-ovoid. It is native to the temperate parts of South America – Argentina, Brazil, Paraguay and Uruguay (Young 1968; Nesom 2017).

Oxalis articulata was introduced as an ornamental plant in many part of the world, mostly with temperate or Mediterranean type of climate. Consequently, it naturalised in Europe, Australia, North America (USA), Africa, Asia (GBIF 2019). In Europe, it is recorded as alien in at least 10 countries (Henning & Raab-Straube 2016), in some of which (Great Britain, Italy, Spain, Slovenia, etc.) it is considered established.

In Bulgaria, it is infrequently grown as a pot or balcony plant – outside during the warmer seasons and inside during the winter. Only recently it has been sometimes planted as an ornamental in open areas with milder climate, e.g. in the southern parts of the valley of River Struma or in the Black Sea coastal region.

So far, the species has been recorded in three floristic regions (Fig. 6): **Black Sea Coast (Northern)**: Varna city, grassy area in the Central Graveyards, NH78, 43.218917°N, 27.890640°E, 23.09.2018, coll. A. Petrova (SOM); **Sofia region**: Sofia city, residential area Druzhba – 2, in a lawn at the northern side of block of flats no. 312, FN93, ca. 42.64793°N, 23.40692°E, 29.06.2019, coll. A. Petrova & B. Assyov (SOM 176714); **Valley of River Struma (Southern)**: Kozhuh hill, the northern part, among shrubs, FL89,



Fig. 5. *Oxalis articulata*: A. flowers, B. part of the population at Kozhuh hill (photo A. Petrova).

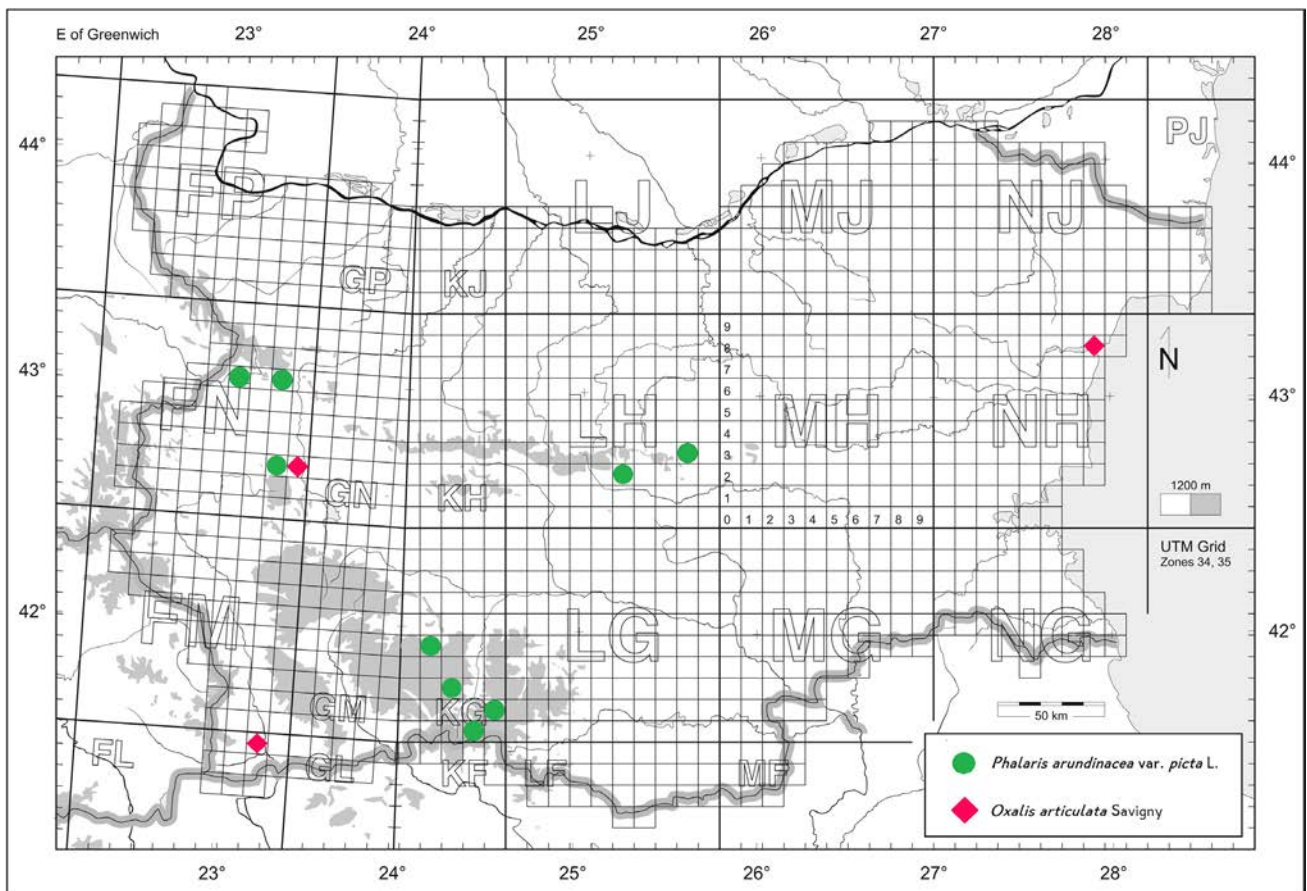


Fig. 6. UTM-distribution map of *Oxalis articulata* and *Phalaris arundinacea* var. *picta*.

41.46672°N, 23.25823°E, 21.04.2018, coll. A. Petrova, K. Bakardzhiev & R. Vassilev (SOM 176417).

The only locality in a natural habitat is that on the northern slope of Kozhuh hill in the valley of River Struma. The observed population comprised 3 groups of 3–7 plants each growing in a scrubland (Fig. 5B). It is at about 500 m distance from the Rupite locality where the plant is abundantly planted as ornamental. It is difficult to judge whether humans or animals were the vector which facilitated the escape of the species to this locality. There is information for one more locality of the species in this floristic region, on a hill near the graveyard of Kulata village (FL98, G. Kamberova, pers. communication & photo). Observed also in urban habitats in Sofia and Varna towns. In Sofia, a group of few plants with an area of occupancy about 3 m² was found in a lane around a block of flats. Apparently, in this particular site the species escaped from a balcony at the 4th floor of the block. In Varna, a small group of plants flowers in a public green stripe in the Central Graveyard. Most likely, it originates from discarded plant remains at the disposal site that is at about 20 m distance. Dispersal of the seeds by ants or other animals is also possible.

***Phalaris arundinacea* var. *picta* L., Sp. Pl. 55. 1753.
(Poaceae)**

Perennial rhizomatous grass. Stems to 200 cm, erect. Leaves linear, acute, 10–35 × 0.6–1.8 cm, sheaths smooth, ligules 6–10 mm. Panicles to 30 cm, lanceolate to oblong, patent at anthesis. Spikelets 5–6 mm, green, sometimes streaked with purple (Tutin 1980). The species has a large distribution range in the Eurasia, North America and Northern Africa (Baldini 1995). The natural habitats are river banks, lake shores and wet open grasslands.

Phalaris arundinacea var. *picta* has white variegated leaves. It has been a popular garden plant for a long time. The species is very tolerant to the climatic and soil conditions as a garden plant – it can grow on wet to dry, clayed to sandy, acidic to alkaline soil. In dry conditions the species does not flower.

In Europe, *Ph. a.* var. *picta* has been registered as an alien in some countries: Austria, Belgium, Czech, France, Iceland, Slovakia, Switzerland, etc. (Essl & Rabitsch 2002; Verloove 2006; Medvecká & al. 2012; Pyšek & al. 2012, etc.). Escaped populations are usually a result of discarded plants/rhizomes or parts of them and a subsequent expansion in more or less suit-

able habitats. The status is mostly ‘casual’, ‘non-established’ or ‘unknown’. It was considered almost established in a particular region in Belgium, but then disappeared (Verloove 2019).

In Bulgaria, it is grown as ornamental in many parts of the country, mostly in small private gardens in the villages and small towns. Also, it is valued and planted in places without regular gardening like summer houses, isolated buildings, etc. As the climate of Bulgaria is rather dry, it usually does not flower as a garden plant. A common practice in the country is to discard the surplus shoots/rhizomes to natural or semi-natural environments together with the garden waste.

So far *Ph. arundinacea* var. *picta* has been recorded in three floristic regions in Bulgaria (Fig. 6): **Balkan Range (Western)**: Godech town, at several locations by the river in the town, ca. 600 m a.s.l., FN66, 43.01564°N, 23.04592°E, 13.08.2009, V. Vladimirov obs. (Fig. 7); between Chibaovtsi and Tsarichina villages, forbs vegetation along a river, FN86, 20.06.2009, coll. A. Petrova (SOM 165336); **Balkan Range (Central)**: Balgarka Nature Park, wet places near an abandoned building (a former holiday station of a weapons factory), near the Izvora Hut, LH83, ca. 42.759249°N, 25.515313°E, 24.07.2008, coll. A. Petrova (SOM 165335); wet meadow near Golyamo Dryanovo village, LH52, 42.667344°N, 25.254435°E, 15.09.2012, coll. A. Petrova (SOM 169077); **Sofia region**: along Okolovrasten Pat road, residential area Kinotsentar – 2, FN82, 42.648286°N, 23.295367°E, repeated observations by A. Petrova between 2001–2007; **Rhodopi Mts (Western)**: by river Borinska between Borino and



Fig. 7. *Phalaris arundinacea* var. *picta* in the river in Godech town (photo V. Vladimirov).

Chala villages, ca. 1130 m a.s.l., KG72, 41.66539°N, 24.30015°E, 13.07.2019 (Fig. 8), coll. V. Vladimirov (SOM); Tsigov Chark resort area, south of Batak dam, near Uytut villas, KG64, 41.94357°N, 24.151928°E, 03.08.2018, coll. A. Petrova (SOM 176709); **Rhodopi Mts (Central)**: along river Trigradska between Trigrad and Zhrebevo villages, ca. 1230 m a.s.l., KG80, 41.57022°N, 24.40697°E, 13.07.2019, coll. V. Vladimirov (SOM); Shiroka Laka village, along the river, KG91, 41.678856°N, 24.581807°E, repeatedly observed by both authors since 2003.

Obviously, the taxon escaped mostly in mountainous regions where the precipitation is higher. It grows better in places with more or less wet soils, reaching a height of more than 1.5 m and flowering abundantly. *Phalaris arundinacea* var. *picta* usually makes monodominant spots of a few to several tens m². The population along the river in Shiroka Laka in Rhodopi Mts persists for already more than 20 years and forms a linear stand of about 100 m along the river bank.

Taking into account the terminology suggested by Richardson & al. (2000) and the observed occurrences



Fig. 8 *Phalaris arundinacea* var. *picta* along river Borinska at Western Rhodopi Mts (photo V. Vladimirov).

of the three species in the Bulgarian flora, it can be inferred that *Hemerocallis fulva* and *Phalaris arundinacea* var. *picta* are established aliens whereas *Oxalis articulata* is a casual species. The former two taxa escape to natural or semi-natural environments with discarded garden waste containing viable propagules of the species and consequent local expansion of the stands by vegetative reproduction. Although they may form relatively wide monodominant stands, at this stage the two species do not show invasive behaviour in the Bulgarian flora.

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