On the current distribution and population size of the nonnative *Claytonia sibirica* (*Montiaceae*) in Bulgaria

Antoaneta Petrova¹, Diana Venkova¹, Boris Assyov² & Rossen Vassilev³

- ² Institute of Biodiversity and Ecosystem Research, Bulgarian Academy of Sciences,
 2 Gagarin Str., 1113 Sofia, Bulgaria
- ³ Bulgarian Biodiversity Foundation, 6 Triaditza Str., 1000 Sofia, Bulgaria Received: December 22, 2023 ⊳ Accepted: April 29, 2024
- **Abstract.** *Claytonia sibirica* has native distribution in the Komandorskie Islands and Western North America. As an introduced plant, it is found in some countries in Europe and New Zealand. It has been reported for Bulgaria in 1951. Recent observations in the Rila Mts and other available data on the distribution, habitats and population of the species are presented in this work. Locally, it is very abundant, with high population density and heterogeneous age structure. *Claytonia sibirica* is a naturalized alien species in Bulgaria, most likely deliberately introduced. Considering the long period of time since the species has been getting established in the country and its current distribution, it can be concluded that this non-native plant is spreading at a low rate by means of short-and mid-distance dispersion.
- Key words: alien species, Claytonia, established non-native plant
- Citation: Petrova, A., Venkova, D., Assyov, B. & Vassilev, R. 2024. On the current distribution and population size of non-native *Claytonia sibirica (Montiaceae)* in Bulgaria. Phytologia Balcanica, 30(1): 95-102. ISSN 1310-7771 (print), 1314-0027 (online).

Introduction

The natural range of *Claytonia sibirica* encompasses the Komandorskie Islands, Alaska, British Columbia (Canada), and the US states of Washington, Idaho, Oregon, Montana, and California (Miller 2004; POWO 2023). Its natural habitats are mainly shady moist woodlands and wet streambanks. The species is quite tolerant to soil types, pH values and shadiness (Miller 2004, Douglas & al. 2023, etc.). As an introduced plant, it has been found in some countries in Europe (POWO 2023) and New Zealand (Heenan & al. 2004). In Europe, it is naturalized/introduced mostly in North and West Europe, and in isolated localities in the Czech Republic and Bulgaria (Verloove 2006; Pladias 2014-2023; Raab-Straube 2018+).

Within its natural range, *C. sibirica* is harvested for local use as food and medicinal plant. Its leaves

¹ Botanical Garden, Bulgarian Academy of Sciences, P.O. Box 664, 1000 Sofia, Bulgaria, e-mail: petrovabotgar1@abv.bg (author for correspondence)

and bulbous stem bases are edible: raw in salads, or cooked (*Plants for a Future* 2023). Although a small plant, *C. sibirica* grows abundantly in proper habitats and creates a beautiful cover with ample pink and white flowers. It is also used as an ornamental ground-cover plant in the parks in Europe (Huxley 1992). With its abundant seed production and high germination rate, the species easily escapes from its original locations and settles in suitable habitats. It is dispersed naturally mainly at small distances by ants and weak water currents (Collings & al. 2019).

Data for Bulgaria are very scarce. Stefanov (1951) reported *C. sibirica* from the Rila Mts, near river Bistritsa, in the area of the Borovets Mountain Resort. The deposited voucher material (SOM 16668) was collected in August 1950. The author indicated the place of its intentional introduction as the Tsarska Bistritsa Estate of the former royal family of Bulgaria, and assessed the species as naturalized. After that first report, the species was listed in the national *Floras* (Georgiev 1966; Anchev 1992; Delipavlov 2003; Stoyanov & al. 2021; etc.), without any specific data.

Materials and methods

Data from visual observations in 2019 and 2020 (Petrova & Venkova), 2020 (B. Assyov) and 2023 (Petrova, Assyov & Vassilev) in the Borovets area of the Rila Mts were summarized. The field survey covered a wide area around the species' place of initial introduction (Tsarska Bistritsa Estate): Borovets Resort area; along river Bistritsa up to the town of Samokov; and in suitable habitats in the direction of Raduil and Beli Iskar villages. GPS coordinates were taken (Garmin eTrex 30) and data on the phenology and population were collected. Also, data were added from the Bulgarian herbaria and international databases derived from the (GBIF 2024).

Voucher specimens have been collected and deposited in the Herbarium of the Institute of Biodiversity and Ecosystem Research of the Bulgarian Academy of Sciences in Sofia (SOM). Morphometric data are mostly from the Bulgarian population, compared with data from relevant literature (Kuzeneva 1936; Miller 2004; etc.).

Results and discussion

Claytonia sibirica L., Sp. Pl. 1: 204. 1753.

[Syn. Montia sibirica (L.) Howell] (Fig. 1)

Annual or perennial plant, rhizomatous, producing bulblets or stolons. Base of stems caudiciform, stems 5–30 cm. Basal rosette leaves with 3–20 cm long petioles, blade linear, lanceolate to elliptic, $1-3\times1-3$ cm; cauline leaves 2, opposite, sessile, blade lanceolate to ovate, 1–3 cm. Inflorescences racemose, branched or not, bracts leaf-like, 5–20 mm. Flowers numerous, developing consistently throughout the growing season, 8–20 mm in diam., sepals 3–5 mm; petals white, candy-striped, or pinkish, 8–14 mm; ovules 3. Seeds 1(3), 2–3 mm, shiny and smooth, with elaiosome.

Phenology. Flowering from June to September, fruiting from August until October (November). The species has a long term of flowering and fruiting, therefore, a long period of disseminating too.

With the exception of Stefanov's 1950 collection, there is only one other material in SOM, of M.F. & S.G. Gardner: Forest around Borovec, 1250 m, 42°20'N, 23°45'E, margins of damp *Picea abies* and *Abies alba* woodlands, with well-developed undergrowth, 29.07.1965 (SOM 49302).

Data from the authors' observations, as well as other data on the distribution of the species and localities are presented in Table 1 and on a map (Fig. 2). Personal observations show a 4 km long strip of distribution of the species along river Bistritsa, from Tsarska Bistritsa in the direction of Samokov town. The width of the occupied strip varies from 1–2 to 20 and more meters. The elevation range is between 1170 and 1490 m. The main habitat (Fig. 3a) is a mixed forest dominated by conifers (*Picea abies, Abies alba, Pinus sylvestris*), with presence of *Salix* sp. in places close to the river, and of *Fagus sylvatica* at lower altitudes. The second forest floor is uneven, with *Rubus idaeus* and *Lonicera xylosteum* developed better in the more open places,



Fig. 1. Claytonia sibirica (photo by A. Petrova).

along the river and the forest roads. There is a third floor with Vaccinium sp., Lusula sp., Poa nemoralis, and herbs (Lactuca muralis, Geranium robertianus, Trifolium medium, etc.). Predominant soils are relatively shallow dystric cambrisols, sandy near the river. In the area with a low inclination (central coordinates 42.275037° 23.596382°, point 4 on the map), C. sibirica is locally very abundant, with high population density and heterogeneous age structure. Flowering is long-lasting, seed production is abundant. In the lowest places near the town of Samokov, the species is found only in microhabitats near the river; for example, on small sandy spills (Fig. 3b). There are probably more places along the river where C. sibirica occurs, but the strip around the current is heavily overgrown and only partially accessible.

Two visits were done at the place of introduction, Tsarska Bistritsa Estate (13.08.2020 & 06.09.2023). *Claytonia sibirica* was abundant there; it was found in all suitable wet habitats starting from the entrance area to the riverside below the small historical hydroelectric power plant. Comparing the observations in 2020 and 2023, the species was more abundant in 2023. That could be also attributed to the climatic features of the particular year, as well as to the later date of observation.

A small subpopulation got established near the estate, in a suitable wet microhabitat by the road to Beli Iskar village (point 8 on the map). One of the subpopulations the authors have identified was located at a higher altitude than the original source (central coordinates 42.257424° 23.592013°, point 9 on the map,



Fig. 2. Distribution of *Claytonia sibirica* in Bulgaria.



Fig. 3. Habitats of *Claytonia sibirica* along river Bistritsa (photos by A. Petrova): **a**, app. 42.275037° 23.596382° (point 4 on the map); **b**, app. 42.289686° 23.574753° (point 6 on the map).

Table 1. Data on the distribution of C. sibirica in Bulgaria.

Area/ locality	Point number on the map	GPS coordinates (date; collector/s*)	Population or source and other notes	
Deposits in the herbaria in Bulgaria				
Borovets, Rila Mts, along river Bistritsa		08. 1950, B. Stefanov	SOM 16668 (also Stefanov, 1951)	
Rila Mts. Forest around Borovets, 1250 m.		42° 20' N, 23° 45' E; 29.07.1985, M.F. & S.G. Gardner	SOM 49302 (sub <i>Montia sibirica</i> (L.) Howell). Margins of damp <i>Picea abies</i> and <i>Abies alba</i> woodlands, with well- developed undergrowth. Herbarium M.F. & S.G. Gardner, 3221	
Authors' observations in Tsarska Bistrica Estate – the place of deliberated introduction				
Tsarska Bistrica Estate, a lawn near the Electric Power Plant.	1	42.260038° N 23.595770° E; 13.08.2020, AP & DV	These are selected points in the Estate, where the species is found. It is common in the lower part of the forest park, eastwards of the river. The population structure is uneven, with spots of high density, but also with scattered groups.	
Tsarska Bistrica Estate, shady woody park area near the entrance.	2	42.259287° N 23.598318° E; 06.09.2023, AP, BA, RV		
Tsarska Bistrica Estate, around a weir on river Bistritsa.	3	42.258970° N 23.596526° E; 06.09.2023, AP, BA, RV		

Area/ locality	Point number on the map	GPS coordinates (date; collector/s*)	Population or source and other notes	
Authors' observations outside Tsarska Bistritsa Estate				
Along river Bistrica, downstream, about 1.5 km after the Tsarska Bistrica Estate.	4	42.275037° N 23.596382° E, 13.08.2020, AP & DV (observed also on 09.08. 2019 & 06.09.2023)	A relatively flat section of the river valley. The population is abundant, with uneven space and age structure. Hundreds of plants per square meter are found locally, especially along a forest dirt road.	
Along river Bistrica, downstream.	5	42.274988° N 23.596416° E, 13.08.2020, AP & DV (observed also on 09.08. 2019)	River valley narrows, forest vegetation is dense and very shady. The population declines in numbers, plants are found in more open spots.	
Along river Bistrica, downstream, near the fish ponds.	6	42.289686° N 23.574753° E, 13.08.2020, AP & DV	Riverbed is narrow, with slightly raised banks. <i>C. sibirica</i> is found in small sandy spills, close to the river course in groups of plants.	
Along river Bistrica, downstream.	7	42.280421° 23.589475°, 09.2020, BA	Mixed forest with abundant undergrowth. Scattered patches of dozens of plants of <i>C. sibirica</i> .	
Along the road Borovets – Beli Iskar village.	8	42.258454° N 23.596186° E, 06.09.2023, AP, BA, RV	A small flat stripe with seeping water and loose herbal vegetation. Single individuals and small groups of <i>C. sibirica</i> .	
On a mountain slope, on and around a ski track.	9	42.257748° N 23.591893°E, 06.09.2023, AP, BA, RV	Diverse vegetation on a wet slope: grassy on the route of the track; coniferous forest between the forks and with large shrubs at forest edges along the track. Population of the species is large, numerous, with a patchy distribution.	
Other data and observations from Bulgaria, included in the Global Biodiversity Information Facility (GBIF 2024)				
Borovets Resort	10	42.265278° N 23.6025° E (coordinate values rounded), 8.07.2019, observation of user zmei in plantnet.org	https://identify.plantnet.org/the-plant-list/ observations/1004372728 & https://identify.plantnet.org/ the-plant-list/observations/1004372884	
Bulgarien, Rila- Gebirge, am Wanderweg von Borovec zur Musala hut, bei der Brücke über die Bistrica; Alt. 1725 m	11	42.24306° N 23.60278° E, 29.05.2007, Det./rev./ conf./assigned: R. Karl	"Habitat Granit, <i>Picea abies-Abies alba-Pinus peuce</i> -Wald" Natural History Museum, Vienna - Herbarium W: Herbarium # 2015-0016713 & University of Graz, Institute of Plant Sciences - Herbarium GZU: Herbarium # GZU 000282919	
Montes Rila		20.07.1993, A.R. Burgaz, M.A. Carrasco & C. J. Martín-Blanc	Herbarium MACB - Herbario de la Facultad de Ciencias Biológicas de la Universidad Complutense de Madrid (MACB); A.R. Burgaz, M.A. Carrasco & C. J. Martín- Blanco; 63227-1, sub <i>Montia sibirica</i> (L.) Howell Herbarium MA - Real Jardin Botanico Madrid; MA-01- 00592011; leg. M.A.Carrasco & al., sub <i>Claytonia alsinoides</i> Sims.	

Table 1. Continuation

*The authors' observations are initialed.

about 100 m higher than the Estate). The occupied area was about 0.2 ha, but spatial distribution was very uneven. There, the species was found along with another species once cultivated in the royal estate and now naturalized in the area: *Campanula lactiflora* M. Bieb. (Vassilev & al. 2023).

The Global Biodiversity Information Facility (GBIF 2024) contains data on some localities of the species in Bulgaria. Records that indicate the Borovets region in the Rila Mts are for two localities (Table 1). One of them is close to the lower mountain lift station in the Borovets Resort (point 10 on the map), observation of user **zmei** in plantnet.org 8.07.2019. The second one is at a higher altitude (1725 m), along the hiking trail from Borovets to Musala chalet, near the bridge over river Bistrica (point 11 on the map). It is based on the collections of R. Karl on 29.05.2007 deposited in the herbaria of Wienna and Graz (W & GZU).

More data from the Rila Mts were deposited in the herbarium in Madrid, Spain (MA, MACB) and also included in GBIF (2024). As it could be seen from Table 1, the samples were collected on 20.07.1993. At that time (18th-30th July 1993), the VII OPTIMA Meeting took place in Borovets (Bulgaria), with participation of botanists from many countries. Thus, it would be logical to assume that these deposits were also from the Borovets region in the Rila Mountains.

Conclusion

Claytonia sibirica is a naturalized alien species in Bulgaria. Although such an assumption is speculative, most likely it has been deliberately introduced in the Tsarska Bistritsa Estate in the Rila Mts between 1925-1935, when the Estate's park area was landscaped and completed. Currently, there have been records of its occurrence along a stretch about 7 km long of the valley of river Bistrica, which runs through the estate. Relative to the place of the species' initial introduction (about 1400 m a.s.l.), locations have been explored both downstream (to about 1100 m) and at higher altitudes (to 1725 m). Considering the long period of establishment of the species in the country and its current distribution, it can be concluded that it spreads at a low rate, mainly by shortand mid-distance distribution. The dispersal vectors are ants, human activity and water courses. "Long jumps" prompted by human activity (forestry, transport, tourism) are also possible.

Acknowledgements. The authors are grateful to Valeri Georgiev for the preparing of the map. Thanks also to the anonymous reviewer for his thorough review and notes.

References

- Anchev, M. 1992. Portulacaceae. In: Kozhuharov, S. (ed.). 1992. Field Guide to the Vascular Plants in Bulgaria, pp. 638-639. Nauka & Izkustvo, Sofia (in Bulgarian).
- Collings, M., Bussey, L., Aylott, L. & Morris, N. 2019. Pink-Purslane. *Claytonia sisbirica*. https://cinng.org.uk/wp-content/uploads/2019/10/Pink-Purslane-Final.pdf
- **Delipavlov. D.** 2003. *Portulacaceae.* In: **Delipavlov, D. & Cheshmedzhiev, I.** (eds), Key to the Plants of Bulgaria, p. 65. Agrar. Univ. Acad. Press, Plovdiv (in Bulgarian).
- **Douglas, G.W., Meidinger, D. & Pojar J.** 2023. *Claytonia sibirica* L. – In: **Klinkenberg, B.** (ed.). 2020. E-Flora BC: Electronic Atlas of the Plants of British Columbia [eflora. bc.ca]. Univ.of British Columbia, Vancouver. (Accessed 03.10.2023)
- **GBIF.2024. Global Biodiversity Information Facility.** Claytonia sibirica L. Bulgaria. https://www.gbif.org/occurrence/sear ch?advanced=false&geometry=POLYGON((23.36841%20 4 1.98482, 23.93166%2041.98482, 23.93166%20 42.4746, 23.36841%2041.98482))&has_coordinate=true&locale=en&taxon_key=3084742 (Accessed 27.03.2024)
- Georgiev, T. 1966. Portulacaceae. In: Jordanov, D. (ed.) Flora Reipublicae Popularis Bulgaricae. Vol. 3, pp. 269-271. In Aedibus Acad. Sci. Bulgaricae, Serdicae (in Bulgarian).
- Heenan, P.B., de Lange, P.J., Cameron, E.K., Ogle, C.C. & Champion, P.D. 2004. Checklist of dicotyledons, gymnosperms, and pteridophytes naturalised or casual in New Zealand: additional records 2001–2003. – New Zealand J. Bot., 42: 797-814.
- Huxley, A. 1992. The New Royal Horticultural Society Dictionary of Gardening. Stockton Press, New York.
- Kuzeneva, O. 1936. Portulacaceae Lindl. In: Komarov, L.V. (ed.), Flora URSS. Vol. 6, pp. 376-386. Editio Acad. Sci. URSS, Moscow, Leningrad (in Russian).
- Miller, J.M. 2004. Claytonia L. In: Flora of North America. Vol. 4, pp. 457, 458, 465. http://www.efloras.org/florataxon. aspx?flora_id=1&taxon_id=107275 (Accessed 02.10.2023)
- Pladias. 2014-2023. Database of the Czech Flora and Vegetation. https://pladias.cz/en/taxon/overview/Claytonia%20sibirica (Accessed 03.10.2023)

- Plants for a Future. 2023. *Claytonia sibirica* L. https://pfaf.org/ user/plant.aspx?LatinName=Claytonia+sibirica (Accessed 05.10.2023)
- **POWO.** 2023. Plants of the World Online. Facilitated by the Royal Bot. Gard., Kew. http://www.plantsoftheworldonline.org/" *Claytonia sibirica* L. (Accessed 01.10.2023).
- Raab-Straube, E. von (2018+). *Montiaceae*. In: Euro+Med Plantbase - the information resource for Euro-Mediterranean plant diversity. https://europlusmed.org/cdm_dataportal/ taxon/2d4bacf3-73e9-4d9d-bee6-464e660a7dc5 (Accessed 23.11.2023)
- Stefanov, B. 1951. Floristic reports. Izv. Bot. Inst. (Sofia), 2: 270 (in Bulgarian).

- Stoyanov, K., Raycheva, Ts. & Cheschmedzhiev, I. 2021. Key to the Native and Foreign Vascular Plants in Bulgaria. Agric. Univ. Plovdiv Acad. Press (in Bulgarian).
- Vassilev, R., Petrova, A., Assyov, B. & Tanev, A. 2023. Ornamental escapes and citizen science the example of *Campanula lactiflora*. In: Trichkova, T. & al. (eds), Joint ESENIAS and DIAS Scientifi c Conference 2023 and 12th ESENIAS Workshop 'Globalisation and invasive alien species in the Black Sea and Mediterranean regions management challenges and regional cooperation', 11–14 October 2023, Varna, Bulgaria. Book of Abstracts, p. 136. IBER-BAS, ESENIAS, DIAS.
- Verloove, P. 2006. Catalogue of neophytes in Belgium (1800-2005). Scripta Bot. Belg., **39**:1-89.