The bryophyte flora of Loven Park in the city of Sofia, Bulgaria

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Abstract. This study reveals the bryophyte diversity in Loven Park, one of the largest parks in Sofia, Bulgaria. This is the first investigation of the bryophyte flora of the Park. Thirty-one species of mosses and five species of liverworts have been recorded. Of these, two are of conservation importance. One of the species is new to the Sofia floristic region. In spite of its relatively long history as a forested area (more than 100 years), the bryophyte diversity of Loven Park is low. The main reasons are the air and soil pollution, a relatively uniform landscape and microrelief, few microhabitats, a very dense understory layer of shrubs and saplings, and invasion of ivy (*Hedera helix*) on soil and tree trunks.

Key words: bryophytes, city of Sofia, Loven Park, urban bryophytes

Introduction

Bryophyte flora in the Bulgarian urban areas is poorly known. Sporadic data about bryophytes growing in some parks in Sofia city can be found in Podpéra (1911), Arnaudoff (1909), Stefanoff & Petrov (1962), Ganeva (2004), and Natcheva & Ganeva (2005). The first detailed study of the bryophyte flora of a park in Sofia was carried out by Gospodinov et al. (2018). It showed that, as part of the urban flora, bryophytes are an important component of the urban ecosystems. The bryophyte layer creates favorable conditions for seed germination of tree and herb species by preserving moisture and decreasing temperature fluctuations. Bryophytes are pioneers on open substrates that are typical for the urban landscape, e.g. bare soil, concrete, and asphalt. These plants are also aesthetically important. Their green carpets could be used as elements in park landscaping, along with the flowering plants, small shrubs and in-between rocks in rock gardens.

The aims of this study are: 1) to reveal the diversity of bryophytes of Loven Park, 2) to evaluate the state of their habitats.

Material and methods

Loven Park is situated on ca. 3.7 km SSW from the city center. It covers an area of 243.04 ha. The mean elevation is 570 m, relief is relatively level, with soil characteristics of chromic luvisols (FAO, ISSS, ISRIC 1994, Doichinova & al. 2006). River Dragalevska runs across the Park with some smaller rivulet. The Park was started in 1915 as part of a large-scale project for a forest ring around Sofia in the period 1889-1940 (Ganev 1942). Prior to 1915, the Park area was a grassland used for pasture. At present, the Park is covered by a mixed deciduous forest dominated by *Quercus rubra* L. and *Pinus nigra* Arn., with some *Acer pseudoplatanus* L., *Acer tataricum* L., *Betula pendula* Roth, *Fraxinus excelsior* L., *Ulmus minor* Mill., *Quercus robur* L. and *Tilia tomentosa* Moench. The shrub layer is dominated by *Clematis vitalba* L., *Crataegus monogyna* Jacq., *Hedera helix* L. and *Ligustrum vulgare* L. The grass layer consists of typical ruderal species, such as *Dactylis glomerata* L., *Rumex dentatus* L., *Geum urbanum* L., *Taraxacum officinale* Webber and *Bellis perennis* L.

The area of the Park was visited late in the winter of 2018 and the summer of 2019. In order to cover all types of habitats and substrates, the transect method was used. Vouchers of all collected species were deposited at SOM.

The nomenclature follows Hodgetts (2015). The conservation status is according to Natcheva et al. (2006).

Results and discussion

Thirty-six bryophyte species were recorded during the present study (Table 1). Of these, 31 were mosses and five were liverworts. Nine of the mosses were pleurocarpous and 22 were acrocarpous. The 1:2.4 ratio between pleuro- and acrocarps is a typical ratio for ruderal ecosystems (1:2.3, Zarnowiec 1996).

Two species were of conservation importance. *Fissidens exilis* Hedw. was included in the Bulgarian Bryophyte Red List as Data Deficient (Natcheva et al. 2006). In the Loven Park, it was found in a single place with abundant sporophytes. It is also known from the Forebalkan, in the Managed Nature Reserve Uchilishna Gora (Natcheva & Gyosheva 2016) and Vrachanski Balkan Nature Park. *Orthotrichum pumilum* was red-listed as Near Threatened. However, since its evaluation in 2006, the species has proven to be fairly widespread, including in several places in the Loven Park during the present study.

The poor bryophyte flora of the Park may be due to the Park's history (it was planted relatively recently on grasslands) and the lack of diversity of habitats within the Park area. There are few and small open areas. Prevalence of American oak (*Quercus rubra*) is another factor that hinders bryophyte diversity, as oak litter does not support rich bryophyte ground layer. This is in contrast to the situation in Vrana Park, where diversity of the various habitats and tree species in the forested areas, favorable disturbance regime, and incorporation of semi-natural vegetation types all support a fairly rich and interesting bryophyte flora (Gospodinov *et al*. 2018).

Absence of epiphytic bryophytes on deciduous trees and shrubs is explained by insufficient air humidity and polluted atmosphere of the city. Furthermore, tree trunks are overgrown by ivy that severely reduces the availability of suitable substrates for epiphytes.

Thus, the present study supports the importance of bryophytes for urban biodiversity and highlights some important factors with a negative effect for it.

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Table 1. List of bryophytes collected in the Loven Park, city of Sofia, with data on their substrates. The red-listed species are marked with an asterisk (*) and their conservation status is shown in parentheses: NT – Near Threatened, DD – Data Deficient.

Nr.	Taxon	Substrate
	Marchantiophyta	
1.	*Frullania dilatata* (L.) Dumort.	bark
2.	*Lophocolea heterophylla* (Schrad.) Dumort.	decaying wood
3.	*Marchantia polymorpha* L. subsp. *polymorpha*	soil
4.	*Porella platyphylla* (L.) Pfeiff.	bark
5.	*Radula complanata* (L.) Dumort.	bark
	Bryophyta	
1.	*Amblystegium serpens* (Hedw.) Schimp.	bark, concrete
2.	*Anomodon viticulosus* (Hedw.) Hook. & Taylor	bark
3.	*Atrichum undulatum* (Hedw.) P.Beauv.	soil
4.	*Barbula unguiculata* Hedw.	soil
5.	*Brachytheciastrum velutinum* (Hedw.) Ignatov & Huttunen	bark, decaying wood
6.	*Brachythecium albicans* (Hedw.) Schimp.	soil
7.	*Brachythecium rutabulum* (Hedw.) Schimp.	soil, decaying wood
8.	*Brachythecium salebrosum* (Hoffm. ex F.Weber & D.Mohr) Schimp.	soil
9.	*Bryum argenteum* Hedw.	soil
10.	*Bryum dichotomum* Hedw.	soil
11.	*Ceratodon purpureus* (Hedw.) Brid.	soil, concrete
12.	*Dicraum tauricum* Sapjegin	bark
13.	*Didymodon vinealis* (Brid.) R.H.Zander	soil
14.	*Fissidens bryoides* Hedw.	soil
15.	* *Fissidens exilis* Hedw. (DD)	soil
16.	*Fissidens taxifolius* Hedw.	soil
17.	*Hypnum cupressiforme* Hedw.	bark, concrete, dead wood
18.	*Leskea polycarpa* Hedw.	bark
19.	*Orthotrichum affine* Schrad. ex Brid.	bark
20.	*Orthotrichum diaphanum* Schrad. ex Brid.	bark
21.	* *Orthotrichum pumilum* Sw. ex anon. (NT)	bark
22.	*Oxyrrhynchium hians* (Hedw.) Loeske	soil
23.	*Plagiomnium affine* (Blandow ex Funck) T.J.Kop.	soil
24.	*Plagiomnium undulatum* (Hedw.) T.J.Kop.	soil
25.	*Pseudoleskeella nervosa* (Brid.) Nyholm	bark, concrete
26.	*Ptychostomum imbricatulum* (Müll.Hal.) Holyoak & N.Pedersen	soil
27.	*Ptychostomum moravicum* (Podp.) Ros & Mazimpaka	bark
28.	*Pylaisia polyantha* (Hedw.) Schimp.	bark
29.	*Schistidium apocarpum* (Hedw.) Bruch & Schimp.	concrete
30.	*Tortula muralis* Hedw.	concrete
31.	*Tortula subulata* Hedw.	soil

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