

The serpentrophytae of the brdjani gorge

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Abstract: The Brdjani gorge is located along the Ibarska highway between Gornji Milanovac and Cacak. It is characterised by the serpentine earth and by a specific steppe flora with an abundance of endemic species. The habitat of these natural rarities has largely been impaired by the existing dunghill of Gornji Milanovac and by the nearness of the extremely busy highway, too.

The objective of the paper was to monitor the flora of the Brdjani gorge as well as to find out to what extent its plants had been damaged on behalf of the existing dunghill and the highway.

Key words: Gorge, serpentine, flora, endemic, dunghill.

Introduction

Serpentrophytae embrace plant species settling down the areas of serpentine and geological substratum. Serpentine and the soils formed onto it are highly specific for their physico-chemical properties. Further, serpentine rocks are extremely unsuitable habitats due to their predominantly dark coloration, then they easily get hot are waterproof and composed of a shallow soil largely imparted by the lowly fertile rocks [8]. The serpentines are mostly spread over Europe and North America, but may be encountered in Australia, New Zealand, New Caledonia, Japan, Cuba and in Africa, too.

As for Serbia, the largest rock masses are situated on the Mts. Zlatibor, Maljen, Suvobor, Troglav, Kopaonik, Avala and Deli Jovan. The surface split from the rocks resulted in the soils rich in magnesium, chromium and nickel, but poor in calcium, nitrogen and phosphorous [3].

The serpentine flora is highly specific, of xerophytic character featured with a range of the serpentine-morphoses (nanisam, purpurescence, etc.) and by the occurrence of an endemite relic.

Serpentine substratum has got a range of specific properties which has made it an intriguing topic of the numerous researchers [1,2,4,5,6,8,11,13,14]. The Brdjani gorge has long been known as a plentiful serpentine flora locality developed on its serpentine substratum. Thus, Josif Pancic wrote down in the preface of "The Flora of Serbia Principedom". In the year of 1858 at the beginning of my holiday, I set off for Brdjani situated within Rudnik district to study all I needed to supplement my book about the serpentine flora which was nearly to come out". That is the evidence how the Brdjani gorge was mentioned in some later studies as the location with an abundance of the serpentine species.

The Brdjani gorge is located high among the Mount Vujan skylines and Ilijak hill. It is 5m long, 5km away from Gornji Milanovac, with northern-southern direction of its stretch passing through Ibarska highway as the busiest one in Serbia. The gorge had been cut in by the Western Morava's III rank tributary, Despotovica of an extremely polluted watercourse. The gorge's sides are askew at an angle of 45-70°, of an altitude around 300m.



Photo 1 The Brdjani Gorge

Geologically, the gorge is mostly consisted of the serpentine habsburtit – serpentinite. Serpentine content of the Brdjanska gorge is made up of MgO – 38.7%, SiO_2 – 35.12%, Fe_2O_3 – 7.71% and Al_2O_3 – 2.24%, respectively. Rock destruction caused formation of pedological layer, i.e. skeletoid soil of rhendzina type made up of serpentine and humus silicate brown soil spread over the serpentine. These are rather shallow soils of low fertility and of abundantly inherently present rock particles (78.26% sand, 4.80% colloid clay, 4.40%

powder etc). Humus amount accounts for 3.41%, with eroded and from mildly alkaline to neutral reaction soil [8].

In the 90's of the twentieth century, the disposal of the waste matter of Gornji Milanovac began. Burning was used as a measure of reducing waste amounts, but it had a highly detrimental impact on the living world.

Therefore, the objective of the paper was to get to know the flora of the gorge which is of paramount importance to the biodiversity of Serbia which has, unfortunately, been heavily imperiled by human activities.

Materials and Method

The terrain was surveyed over the vegetation period (April-May) 2004, implying its monitoring, recording and collecting all the plant species necessary to get to know the Brdjani gorge flora, as identified by means of the plant determination tool [2,4,7,12]. Additionally, rudiment and alternative serpentinophytæ were singled out with particular attention paid to the relic and endemic species. The data about relief geological substratum and areal soil were also collected.

Results and discussion

The plant world of the gorge is likely to have been caused by a highly specific serpentine substratum, the environmental factors and relief as well as by the human impact. Having taken place after thermo-phyllous forest degradation, the relics of these and pine forest formed upon forestation made up grass vegetation characteristic of steppe.

In the Brdjani gorge flora, 71 species, falling under 28 families [13] were evidenced. A slight number of the species is due to the unsuitable geological substratum – serpentine. Of the species found, their larger number comprised cosmopolite (euryvalent) and a lower number of some rarer ones. Therefore, serpentine is characterised by serpentinophytæ - an ecological type of plants determining this type of substratum.

Among the serpentinophytæ, rudiment (solely growing on the serpentine) and alternative species (growing more on the serpentine than elsewhere) could be differed.

Rudiment serpentinophytæ

In the Brdjani gorge, 7 rudiment serpentinophytæ: *Halacsya sendtneri*, *Alyssum markgrafi*, *Notholaena marantae*, *Silene longiflora*, *Sclerantus serpentini*, *Scrophularia trsistis* and *Scabiosa fumarioides*, were recorded. The previous researches had also revealed the presence of endemic species *Thymus adamovici* which is worth mentioning [2]. Interestingly, this species had been recorded to inhabit the Brdjani gorge before, but was, unfortunately, not identified among the collected representatives of the strain *Thymus* over the current studies.

Hallascya sendtneri - “cvakija”, “halacija” (fam. *Boraginaceae*) is a rare plant growing on the serpentine rocks. Perennial, bushy with a vigorous root system and numerous upward undeveloped stems of yellow-coloured blossoms forming enveloped floescence, blooming in May. Being the endemite of Serbia, Bosna and Herzegovina and Albania, this plant is of international importance, falling under the Europe “Red list” of the vulnerable species [9] and being a tertiary relic.



Photo 2. *Halascya sendtneri*

Alyssum markgrafi (fam. *Brassicaceae*) grows vertically over the cut in sides of the Brdjani gorge. It is a perennial standing plant with a larger number of stems. Its small yellow-coloured flowers are clustered in rosette floescence, representing an ancestor of the completely unfavourable substrata, taken physico-chemically (ex. fallow parts due to asbestos exploitation in Stragari where this species has remained as the only one dominating in these biologically barren parts). It is the endemite of the Balkan Peninsula.

Northolaena marantae – “pljevika” (fam. *Polypodiaceae*) is a fern with horizontal rhizome with standing pinnate leaves 10-35 cm by size as the only representative of the strain *Notholanea* in the flora of Serbia [2] encountered in the crevasses of the Brdjani gorge rocks being a tertiary serpentine relic.

Silene longiflora (fam. *Caryophyllaceae*) is a perennial herbacious plant which may reach 1m of height. The stem is sticky in its upper portion covered

with large white-coloured flowers. This plant may grow on the shallow soil among the rocks. Several authors reckon its being a serpentine endemite of Serbia and Monte Negro [10].

Scleranthus serpentinei – serpentine, i.e. “treskavica” (fam. *Caryophyllaceae*) is a perennial plant of the dichotomously branched stem with rigid protruding leaves without crown, whereas the calyx leaves over fruiting are of a star-like elongated shape. It is encountered in the stone substratum within the plant communities characteristic of serpentine.

Schrophularia tristis – “zalosni stupnik” (fam. *Schrophulariaceae*) is the biennial plant with a larger number of stems and of a thin root. All the vegetative parts are red-purple coloured. Grows on the soft rocks on those spots with an expressed substratum fragmentation, is an outstanding example of the serpentinephytae and was evidenced as an endemite of the ex-Yugoslavia.

Scabiosa fumarioides (fam. *Dipsacaceae*) is a biennial plant with an upward well- branched stem with double and triple pinnate severed leaves, light-yellow coloured flowers clustered in acme racemes. Grows on scanty soils located between serpentine rocks and was registered as an endemite in ex-Yugoslavia (eastern Bosnia, western and southern-western Serbia and Macedonia). As its most inherent species is considered *Scabiosa achaeta* deemed to have disappeared from the world gene fund of the flora [10] and met only in Trnava near Raska [7].

Alternative serpentinophytae

The group embraces *Bromus fibrosus*, *Veronica jacquini*, *Polygala supina*, *Potentilla arenaria*, *Statice collina*, *Rumex acetosella*, *Stachys recta* and *Sesleria rigida* species.

Bromus fibrosus – ‘klasaca’ (fam. *Poaceae*) is a perennial plant met in the serpentine soil of the Brdjani gorge representing the Balkan endemite.

Veronica jacquini (fam. *Scrophulariaceae*) is a perennial plant with pinnate detached leaves, common on the serpentine, but scarce on the lime rock.

Polygala supina – ‘kostunac’ (fam. *Polygalaceae*) is a perennial semi-bushy plant with blue-coloured flowers clustered in raceme, the top branchlets being flowerless. Rarely seen on the lime rock.

Potentilla arenaria – ‘celasica tiny’ (fam. *Rosaceae*) a perennial plant of a laid down stem with clusters of the fertile and infertile shoots and large yellow-coloured flowers and small gray-white-coloured leaves covered with hairs.

Statice collina – ‘vrazemil’ (fam. *Plumbaginaceae*) a perennial species, with a vigorous spindle-shaped and a deep root system. Its leaves are in the form

of rosette, with a well-branched stem bearing tiny whitish-coloured flowers. It is seldom found in the Brdjani gorge.

Rumex acetosella – ‘small dock’ (fam. *Polygonaceae*) an euryvalent species, of lanced-shaped leaves and of an expressed purple coloration.

Stachys recta (fam. *Lamiaceae*) - a perennial plant species, the bottom leaves of its stem are rounded or narrowed at the base, the upper being elongated and horizontal. The flowers are of yellowish colour.

Sesleria rigida (fam. *Poaceae*) - a perennial bushy plant, of elongated, needle-like leaves. The raceme is ovate or semi-cylindrical. It has been found to inhabit the northern-western prominent slopes of the gorge being depicted.

The dunghill of the G. Milanovac occupies a comparatively spacious stretch inhabited by the species growing on the serpentine rocks. A constant burning of the waste and overloading the dunghill with litter has enlarged it to such an extent that it is constantly threatening plants to continue to exist. This fact is necessary to take into account over designing a rubbish pit, particularly when setting up its bounds to make sure it is outside the area of these highly valuable plant species.

Conclusion

The serpentine geological substratum is considered highly specific, both in light of its chemical composition and physical properties. The serpentine flora of the Brdjanska gorge is characterised by the presence of rudiment serpentinophytae characteristic of the serpentine geological substratum: *Alyssum markgrafii*, *Silene longiflora*, *Halacsya sendtneri*, *Notholaenna marantae*, *Scrophularia tristis*, *Asplenium adulterinum*, *Bromus fibrosum*, *Polygala supina*, *Potentilla arenaria*, *Scabiosa funarrioides*, *Statice solina* and others most of which are endemic. A high endemism percentage is responsible for the isolation of the flora from the remaining areas meaning that over its evolution the flora has grown independently of that growing on the non-serpentine land.

The species of serpentine flora of the region under way are considered significant members of the floristic composition of the various biocenoses imparting the steppe vegetation of the gorge under consideration.

Being so, the Brdjanska gorge represents a drastically damaged area. While certain steps have been taken for amending the aquatic, none of it has been done so far improving the land ecosystem, which is even being exposed to an utter devastation. Therefore, the existence of the town dunghill of Gornji Milanovac in this region literally means snatching the living space from the autochthonous plant species.

An outstandingly significant value of the area is its plant stretch. The presence of a larger number of endemic (7) and relic species and presence of specific steppe communities in the gorge even more emphasizes on an unavoidable need of protecting this highly valuable space for biodiversity of

Serbia. Having in mind that in developed countries the locating of such a dunghill in the vicinity of natural values is literally unthinkable, this problem gains in interest even more.

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SERPENTINOFITE BRĐANSKE KLISURE

- originalni naučni rad -

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Gimnazija Gornji Milanovac

Rezime

Brdanska klisura je locirana uz Ibarsku magistralu između G. Milanovca i Čačka. Karakteristična je po serpentinskoj podlozi i specifičnoj stepskoj flori u kojoj se nalazi veći broj endemičnih vrsta. Stanište ovih prirodnih retkosti je ugroženo prisustvom gradske deponije G. Milanovca i blizine prometne saobraćajnice. Cilj rada je bio da se prouči flora Brđanske klisure, kao i to u kojoj meri prisustvo gradske deponije i saobraćajnice utiče na njen biljni svet.