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Data on Some Parasitic and Semi-parasitic Plant Species from Serpentines of Kosovo

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Abstract. From the richness of the vascular flora of Kosovo, the flowering plants predominate. Within this group of plants, most of them are typical autotrophic plants. In contrast, a very small group of plants consists of parasitic and semi-parasitic life. Semi-parasitic plants are able to perform the process of photosynthesis throughout their life cycle and mainly take up water and mineral salts dissolved by the host plant. In our study, we focus on the presence of certain confirmed parasitic and semi-parasitic plant species in the serpentines of Kosovo, with additional evidence of their occurrence in other parts of the country as well. Here, as a result of intensive two-year field work, we provide details on the presence of the following four species, two of them semi-parasitic: *Arceuthobium oxycedri* (DC.) M. Bieb. and *Loranthus europaeus* Jacq., and two parasitic: *Lathraea squamaria* L. and *Orobanche alba* Willd. For each species, the host plant(s), status as parasitic or semi-parasitic, and data on distribution in the region studied are given, along with a broad discussion of distribution at the state level.

Key words: natural ecosystems, serpentine flora, parasitic plants, Kosovo.

Introduction

Kosovo is located in the central part of the Balkan Peninsula. Its geographical location is defined as the country of Western Balkans, SE Europe (Pllana, 2015). Based on the geological data of Kosovo (Korolija et al., 1976), all the serpentine areas of the country (e.g. the regions of Brezovica, Gjakova, Golesh, Koznicë, Gubavc, Strofc, Rahovec, etc.) belong to the Jurassic ophiolitic complexes, which makes them characterized by their diversity and specific flora. Within the territory of Kosovo, based on its geomorphology, there is a considerable area of serpentine substrates (Pavičevič et al., 1974). Serpentine substrates of Kosovo represent dry and rather slightly warmed soils with additional alkaline reaction. They

are particularly poor in potassium and sodium content, and deficient in nitrates, phosphates, chlorides and sulfates. These soils are also poor in terms of water capacity, although there are some exceptions. In terms of altitude and horizontal extent, serpentine substrates in Kosovo are present within mountain massifs, ranging in altitude from about 300 - 2000 m. Based on various studies conducted by other authors (Słomka et al., 2016) in these substrates have been shown to be habitats with high floristic diversity and with increased presence of endemic plant taxa (Rexhepi, 1979; Millaku et al., 2008; Millaku, 2013; Berisha et al., 2014; Krasniqi et al., 2015; 2019; Prodanović et al., 2020) and very diverse and interesting vegetation composition (Rexhepi, 1994; Krasniqi & Millaku, 2007; Millaku et al., 2011; 2017; Shuka et al., 2012; 2020; Stevanovic et al., 2003; Shuka, 2008).

On the territory of the Republic of Kosovo there are significant areas covered with serpentine substrate. They are located in the northern part of Kosovo (Kopaonik, the banks of the river Ibër), Malësia e Gjakovës (sector-Qafë e Morinë-Qafë e Prush), Badovc (near the capital Prishtina), Gurana (near Hani i Elezit), Golesh Mt., Sharr Mts. (Peak of Pashallarëve, or Peak of Ostrovica), Mushtisht district, some small fragments in Albanian Alps of Kosovo ("Bjeshkët e Nemuna" National Park), Koznik Mountains (Rahovec and Mirusha sector), Koznica, some fragments in Drenica Mt., (Llapushnik-Carralevë sector) as well as some other smaller fragments (Fig. 1).

Kosovo is characterized by a typical continental climate, with an annual average temperature of 10^{o}C and an average annual rainfall of 784.7 mm (Çavolli, 1997; Pllana, 2015). In terms of flora and vegetation, the serpentine substrates of Kosovo are covered with forests, shrubs, pastures and dry rocky grasslands with a rather rich floristic diversity. Deciduous forests and shrub formations are dominated by oaks and above 800 m by beech forests. The typical grasslands are dry due to the serpentine substrate characteristics. The pastures and rocky grasslands are rich in plant species, some of which are characteristic of serpentine substrates.

Although the influence of the anthropogenic factor is evident, there are also a considerable number of endemic plant taxa in these areas and those that are also protected by law and evaluated accordingly, in accordance with IUCN rules and criteria (Millaku, 2013). Within the richness of the vascular flora of these substrates, there are also some parasitic and semi-parasitic species, confirmed both during field surveys and from literature sources, which are the subject of study in this paper. In particular, we studied the parasitic species during field observations in 2018-2020. Here we will present the results of two semi-parasitic plant species from the family *Loranthaceae* [*Arceuthobium oxycedri* (DC.) M. Bieb. and *Loranthus europaeus* Jacq.] and those of two parasitic plant species from the family *Orobanchaceae* [*Lathraea squamaria* L. and *Orobanche alba* Willd].

Material and Methods

The floristic material was collected during research conducted mainly in the period 2018-2020. In order to expand the knowledge about parasitic and semi-parasitic plant species in serpentine substrates of Kosovo, research expeditions were carried out in other areas with serpentine substrates in Kosovo. For this purpose, about 56 research expeditions were conducted during these two years. All studied plant taxa were photographed, data on habitat types, floristic composition and plant communities, threats and human impacts were recorded. Samples were dried and herbarised according to known standards (Bridson & Forman, 1998) and their habitat and GPS data collected. For the parasitic and semi-parasitic plant species, their presence was confirmed in some other serpentine localities of Kosovo.

For taxonomic identification of plant species, we relied on the Flora Europaea

volumes (Tutin et al., 1964; 1972), and in addition, local and regional floras and taxonomic keys were also consulted for certain taxa (Pajazitaj, 2017; Qosja et al., 1996; Paparisto et al., 1988; Demiri, 1983; Josifovic et al., 1970 - 1977). The taxa nomenclature was updated accordingly, based on the Euro-Med Plant Database (Euro+Med, 2006-2021).

Results and Discussion

As part of our study, mainly in the period 2018-2020, we conducted research expeditions in the serpentines of Malësia e Gjakovës, specifically in the sector Qafë e Morinës-Qafë e Prushit (on the territory of Kosovo). This research has led to the identification and documentation of plant species of the vascular flora, including parasitic and semi-parasitic species. The parasitic and semi-parasitic plant species enrich the floristic diversity of the space studied in this case, but also the flora and vegetation of Kosovo in general. From parasitic and semi-parasitic plants we present in this paper the results for these species: *Arceuthobium oxycedri* (DC.) M. Bieb., *Loranthus europaeus* Jacq., *Lathraea squamaria* L. and *Orobanche alba* Willd. The presence of these plant species has been confirmed in some additional serpentine localities of Kosovo (Table 1).

Fam. Loranthaceae Juss.

Arceuthobium oxycedri (DC.) M. Bieb.

Small shrub up to 20 cm, green to yellow. Articulated, often dichotomous stem. Semiparasitic plant, usually on *Prickly Juniper* (*Juniperus oxycedrus*). I-VII. Figure 2 – 1. (Pajazitaj, 2017; Tutin et al., 1964). From the syntaxonomic point of view, the species was recorded on plant communities belonging to the Association: *Astero-Juniperetum oxycedri* Rexhepi 1990, respectivelly within the Alliance: *Pruno tenellae-Syringion* Jov 1979, Order: *Quercetalia pubescentis* Br. Bl. 1932 and Class: *Querco-Fagetea* Br. Bl. et Vlieger 1937. (Rexhepi, 1994).

Table 1. Some parasitic and semi-parasitic plant species in the serpentine terrains of the Republic of Kosovo.

Nr.	Family / Plant species	Habitat	Host plants	Parasitic / Semi-parasitic	Locality
	Loranthaceae				
1.	*Arceuthobium oxycedri* (DC.) M. Bieb.	Rocky habitats, nearby the bushes	*Juniperus oxycedrus* L.	Semi-parasitic	Malësia e Gjakovës, Rajoni i Mirushës, Mali Drenicë, Zatriq-Koznik, Mushtisht
2.	*Loranthus europaeus* Jacq.	Oak forests	*Quercus petraea* (Matt.) Liebl.	Semi-parasitic	Malësia e Gjakovës
	Orobanchaceae				
3.	*Lathraea squamaria* Jacq.	Beech forest	*Fagus sylvatica* L.	Parasitic	Malësia e Gjakovës Zatriq-Koznik, Rajoni i Mirushës, Mali Drenicë
4.	*Orobanche alba* Wild.	Grasslands and rocky places	*Lamiaceae (Thymus sp.)*	Parasitic	Malësia e Gjakovës, Guriq, Golesh

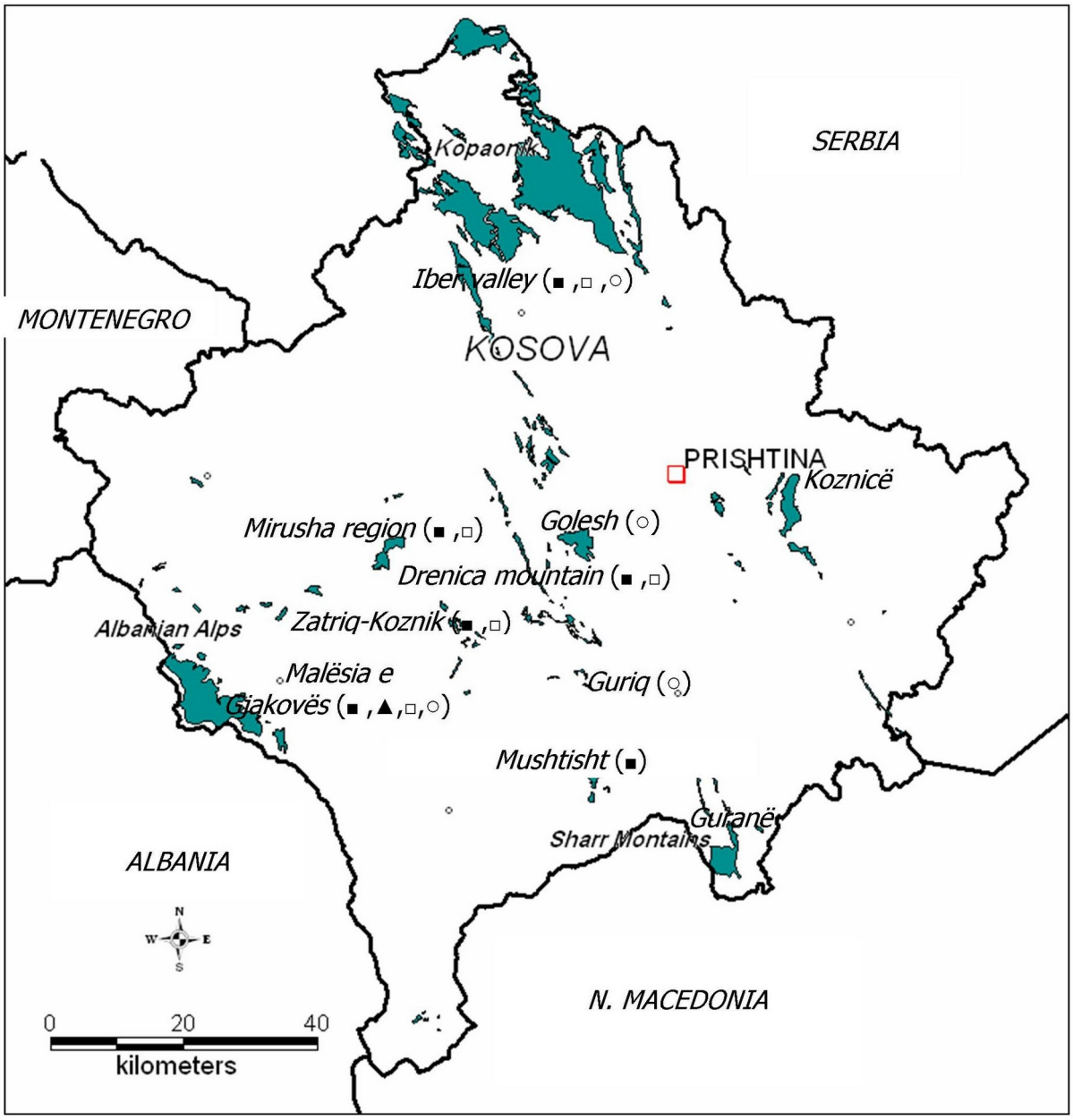

Fig. 1. Plant species localities on the map of Kosovo serpentines. Serpentine areas (colored in green). *Arceuthobium oxycedri* (DC.) M. Bieb. [■], *Loranthus europaeus* Jacq. [▲], *Lathraea squamaria* Jacq. [□] and *Orobanche alba* Wild. [○].

Loranthus europaeus Jacq.

Small shrub, 5-15 (-50) cm, leaves obovate-oblong, obtuse, dull green, 1-5 cm. Stamen 4-6, embedded in the base of the petals. Semiparasitic plant on *Oak*, *Chestnut*, *Pine* etc. V-VI. Figure 2 – 2. (Pajazitaj, 2017; Tutin et al., 1964). From the syntaxonomic point of view, the species was recorded on plant communities belonging to the Association: *Erico-Quercetum petraeae serpentinicum* Rexhepi 1988, respectivelly within the Alliance: *Orno-Ostryon* Tomazic 1940, Order: *Erico-Pinetalia* Oberd. 1949 emend. Ht. 1959 and Class: *Erico-Pinetea* Ht. 1959 (Rexhepi, 1994).

Fig. 2. Habitus of four surveyed plant species. 1. *Arceuthobium oxycedri* (DC.) M. Bieb., 2. *Loranthus europaeus* Jacq., 3. *Lathraea squamaria* Jacq. and 4. *Orobanche alba* Wild.

Fam. Orobanchaceae Vent.

Lathraea squamaria L.

The common toothwort (*L. squamaria*) have been wrongly included in the *Scrophulariaceae* family by various authors (Tutin et al., 1972; Weber, 1976). Perennial plant, 10-25 cm, with fleshy steam, reddish to pink color. Flowers in dense unilateral clusters, with red upper lip, the lower lip is white. In moist forests, as parasites on beech and oak trunks. IV-V. Fig. 2 – 3. (Pajazitaj, 2017; Tutin et al., 1972). From the syntaxonomic point of view, the species was recorded on plant communities belonging to the Association: *Fagetum moesiacae montanum* Blec. et Lakusic 1970, respectivelly within the Alliance: *Fagion moesiacae* Blec. et Lakusic 1970, Order: *Fagetalia sylvaticae* Pawl. 1928 and Class: *Querco-Fagetea* Br. Bl. et Vlieger 1937. (Rexhepi, 1994).

Orobanche alba Wild.

The upper edge of the corona is full, lower lip glandular ciliate. The edges of the stamens at the base with dense hairs, 35-70 cm. The species parasites in the roots of *Lamiaceae* species. VI-VII. Figure 2 – 4. (Pajazitaj, 2017; Tutin et al., 1972). From the syntaxonomic point of view, the species was recorded on plant communities belonging to the Association: *Polygalo-Genistetum hassertianae* Blec. et al. (1969), respectivelly within the Alliance: *Centaureo-Bromion fibrosi* Blec. et al. 1969, Order: *Halacsyetalia sendtneri* H. Ritter-Studnicka 1970 and Class: *Festuco vaginatae* Soo'1968 emend. Vicherek 1972.

Conclusions

In the research that we conducted in the vascular flora of Malësia e Gjakovës (territories between Qafë Morinë to Qafë e

Prushit), as well as in some other serpentine substrates on the territory of the Republic of Kosovo, we identified parasitic and semi-parasitic plant species among many plant species. From 2018 until now, we have identified and documented 4 plant species from this group of plants, grouped in two families of vascular plants. For these plant species, their occurrence was confirmed in some other serpentine localities in Kosovo, such as in Mirusha Region, Drenica Mountain, Zatriq-Koznik, Guriq, Mushtisht and Golesh. From the family *Loranthaceae*, we identified the semi-parasitic species *A. oxycedrus* occurring on Prickly Juniper (*J. oxycedrus*) and *L. europaeus* occurring on Sessile Oak (*Q. petraea*). From the family *Orobanchaceae*, we identified the parasitic species *L. squamaria*, which parasitizes on beech trunks (*F. sylvatica*) and *Orobanche alba*, which parasitizes mainly on plant roots of species belonging to the family *Lamiaceae*. For each plant species, we have also provided its phytosociological data and vegetation classification. The presence of these plant species not only enriches the floristic diversity of the studied area, but also contributes to the general knowledge about the flora of Kosovo.

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