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SYMPATRIC AREA OF THE SIBLING AND ENDEMO–RELICT SPECIES RAMONDA SERBICA PANČ. AND R. NATHALIAE PANČ. ET PETROV. (GESNERIACEAE) IN SOUTHEAST SERBIA (YUGOSLAVIA)

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The distribution and the ecology of *R. serbica* and *R. nathaliae* were studied in the wider surroundings of the Suva planina mountain and Niš in order to establish in more detail the habitats of these sibling species. We report for the first time existence of two meeting points of *R. serbica* and *R. nathaliae* areas where these plants grow in sympatry: the limestone rock of Radovanski kamen above the village of Jelašnica and the Oblik in the Sićevačka klisura gorge. The behaviour and distribution of the plants in the symphatric zones is analyzed in terms of their ecology and reproduction and the sympatry is discussed with respect to the origin and the chorological differentiation of these endemo–relict plants.

Key words: sympatry, sibling species, endemo–relict species, overlapping areas.
Ključne reči: simpatrija, sestrinske vrste, endemo–reliktne vrste, preklapajući areali.

INTRODUCTION

The discovery of the *Ramonda serbica* and the *Ramonda nathaliae* species (P a n č i ć, 1874; P a n č i ć et P e t r o v i ć, 1882) was met with great interest among the european botanists of the time. The interest was understandable enough, as the

discovery concerned the typical relict plants of the family of *Gesneriaceae* and the only european representatives of the family known at that time were *Haberlea rhodopensis* Friv., *Ramonda pyrenaica* Rich. and *Jankaea heldreichii* (Boiss.) Boiss. The Pančić and Petrović observations had, however, the geographical boundaries of the Dukedom of Serbia; consequently, the only knowledge of the areas of Ramondae was at the time confined to that territory. It was only later, with the works of the yugoslav, as well as, the european botanists researching the flora of Yugoslavia and the Balkan Peninsula that the numerous localities and the areas of distrubution of these species were brought to light. Košanin (1922) in his well known work „The Geography of Balkan Ramondae" was the first to draw attention to the fact that the *R. serbica* and the *R. nathaliae* inhabit different areas. Chorological differentiation together with morphological and ecological differences were for Košanin (1922) among the main arguments proving that the *R. serbica* and the *R. nathaliae* were two „separate types", i.e. they are, as taxonomy points it out, valid species. The argumentation in favour of Ramondae as valid species had its additional reasons in answering the opinion voiced by some european botanists (Velenovsky, 1898; Vandas, 1909; Doflein, 1921) that these were not two separate species and that the *R. nathaliae* was only a variety of the *R. serbica*. The fact remains that these two species are morphologically and ecologically very close and that they belong to the group of sibling species. This might have made it difficult for the botanists who were not familiar with them and never saw in the field to accept them as independent species. Košanin settled this dispute in the best way.

Our research of ecology and distribution of the *R. serbica* and the *R. nathaliae* encompasses the wider surroundings of the Suva planina mountain and the gorge Sićevačka klisura. Since the time of Pančić and Petrović both Ramondae species were known to inhabit this territory; moreover, their respective localities in this region are known to be close to each other. The scope of our research was, among other things, to investigate whether the two species are consistently microgeographically separated and to look for the possible existence of the overlapping areas, i.e. the true zones of sympatry.

RESULTS AND DISCUSION

As it is pointed out, the wider region of the Suva planina mountain represents the territory of the possible overlapping of the areas of the *R. serbica* and the *R. nathaliae*. Petrović (1885) speaks about it indirectly: „.....*R. serbica* grows on the limestone rocks ..... and on the rock near Jelašnica, and the *R. nathaliae* grows on the limestone rocks in Jelašnica and on the Suva planina mountain". Jelašnica is, in a sense, mentioned as the habitat of both species. However, in „The flora of the surroundings of Niš" Petrović (1882) says: „....*R. nathaliae* grows on the rocky slopes above Jelašnica ....". Košanin (1922) mentiones this locality only for the *R. nathaliae*, whereas he speaks about the Suva planina mountain, which is in the close vicinity of Jelašnica, as of the common habitat for both species; this, in its immediate meaning, would signify the sympatry of the two species. Later on, however, Košanin (1939) gives a contradictory opinion: „.... their areas of distribution have almost no place of overlapping, not even in the foothills of the Suva planina mountain. There, their areas only border on each other, since the *R. serbica* is limited only to the shady banks of the Nišava river in the gorge of Sićevačka klisura, where the *R. nathaliae* is not found, while this other one grows in the other places of the Suva planina mountain, where, again, the

R. serbica is not to be found . . . . ". This contradiction is all the more conspicuous since in his first work K o š a n i n (1922) gave the localities of both *Ramonda* species in the wider region of the Suva planina mountain and provided a contour map of their areas, albeit a rather sketchy one where he showed the two areas as overlapping.

Our investigations of the distribution of the *R. serbica* and the *R. nathaliae* carried out in the wider region of the Suva planina and Niš show real nature of the contiguous areas and establish, for the first time, the sympatry of these sibling species. In addition to the already known localities of Pančić and Petrović, which were subsequently quoted by K o š a n i n (1922), M i c e v s k i (1956) and J o v a n o v i ć – D u n j i ć (1974), considerable number of new localities for both species were found in this region. Two localities where both species grow in sympatry are of particular interest.

The first locality is situated above the Jelašnica village, on a limestone rock locally known as the Radovanski Kamen (Fig. 1). The Radovanski Kamen has the altitude of 450–500 m and its steep side faces north–northeast. The south–southwest side of the rock has a gentle slope which gradually descends to the Jelašnica gorge. It is of interest to note that this locality corresponds well to what Petrović states, that „ . . . . *R. nathaliae* grows on the rocks above Jelašnica . . . . ". Ramondae inhabit the steep, northern side of the Radovanski Kamen. The precipitous limestone cliffs, which in some places reach 30 m, gradually turn into rocky crops and then into a steep slope covered with a dense and shrubby forest of the Oriental Hornbeam *(Carpinus orientalis).* Ramondae are found both on the rocky cliffs and in the Oriental Hornbeam forest below the cliffs, on the smaller rocky crops and on the blocks of rocks.

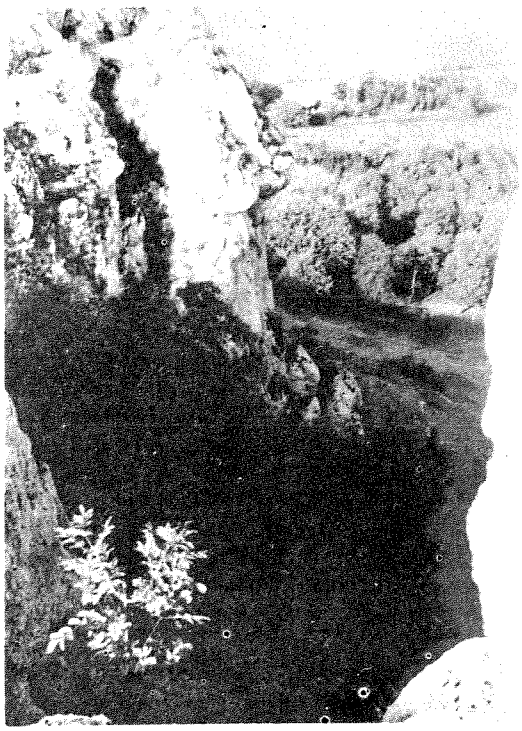

Fig. 1. – The limestone rock of Radovanski kamen above the village Jelašnica.

The zone of sympatry are found along the entire crag, but those toward the cliff foothill as well as those on the rocks in the forest show the greatest abundance of the plants (Fig. 2). In the mixt populations the *R. nathaliae* prevails over the *R. serbica.*

Fig. 2. — The species *Ramonda serbica* (A) and *R. nathaliae* (B) at the sympatry place on Radovanski kamen.

Although the habitat faces north, this does not compensate for the general ecological conditions of the Radovanski Kamen, governed mainly by the fact that it lays open and with poor protection from the surrounding forest vegetation. These features appear altogether more favourable to the *R. nathaliae,* the more xerophyllic of the two *Ramonda* species. This may be taken as one of the reasons for domination of the *R. nathaliae* in this habitat. For instance, the pure populations of the *R. nathaliae* grow on the steep cliffs, that is in the places where the xerothermic conditions are most pronounced. In contrast, the pure populations of the *R. serbica* stay in the sheltered places, as are the rocks in the deep shadow of the Oriental Hornbeam forest, or the bigger crevices in the rocks of the cliffs. This arrangement of the pure populations is one of the good indicators of the ecological differences between the two species. Of course, the „behaviour" in sympatry is also of great importance in percieving the differences and similarities of these sibling species. In this respect, a detailed population research of these plants in sympatric and allopatric conditions is in progress and it will be the topic of a separate work.

The other locality where the speices *R. serbica* and *R. nathaliae* grow in sympatry is found in the gorge Sićevačka klisura, on the northern side of the Oblik, on the left bank of river Nišava, at the altitude of 350—700 m (Fig. 3). The Ramondae habitats are

in the almost inaccessible places in the steep gorges and the rocks in the polydominant forest of the Balkan Maple *(Acer intermedium),* the Oriental Hornbeam *(Carpinus orientalis),* the Turkish Hazel *(Corylus colurna)* and the beech *(Fagus moesiaca).* In contrast to the Radovanski Kamen, in the zones of sympatry found on the locality of the Oblik, the dominant species is the *R. serbica* (Fig. 4). Until now, the data on the distribution of Ramondae in the gorge Sićevačka klisura were taking into account only the species of the *R. serbica.* In this respect, the mountains of the northern part of the gorge Sićevačka klisura (right bank of river Nišava) were already known as the habitat of the *R. serbica* species. For instance, P a n č i ć (1874) mentiones this species for the Pleš. Our own investigations of the northern slopes of the mountain Svrljiške planine have shown that the *R. serbica* is present in the entire area from the Pleš to the mountain Julijanska planina. Here, it stays within the vegetation found on the rocks in the montane beech forest, at the altitude of 800–1000 m.

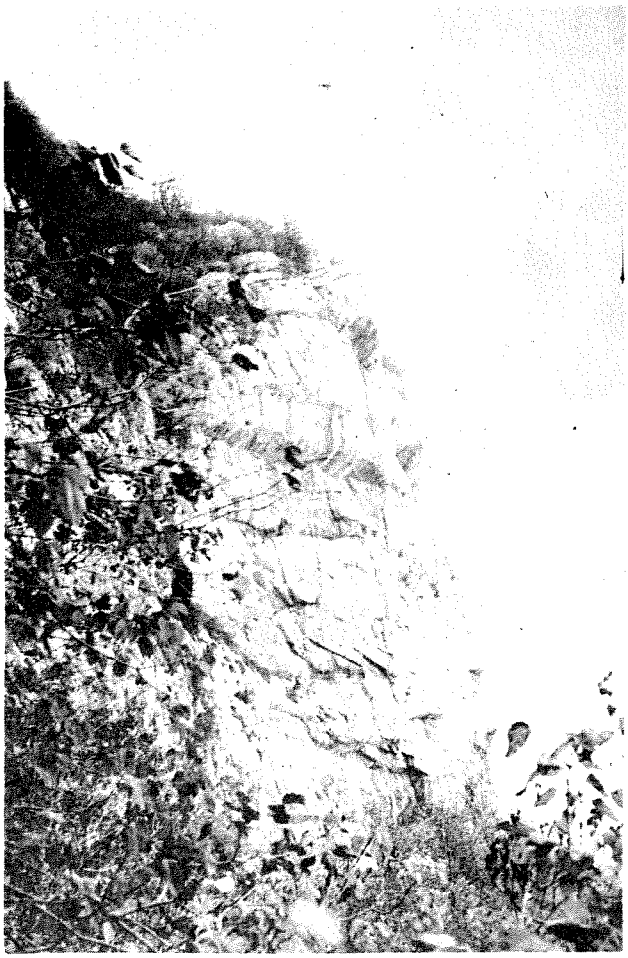

Fig. 3. – The limestone hill of Oblik in the gorge of Sićevačka klisura.

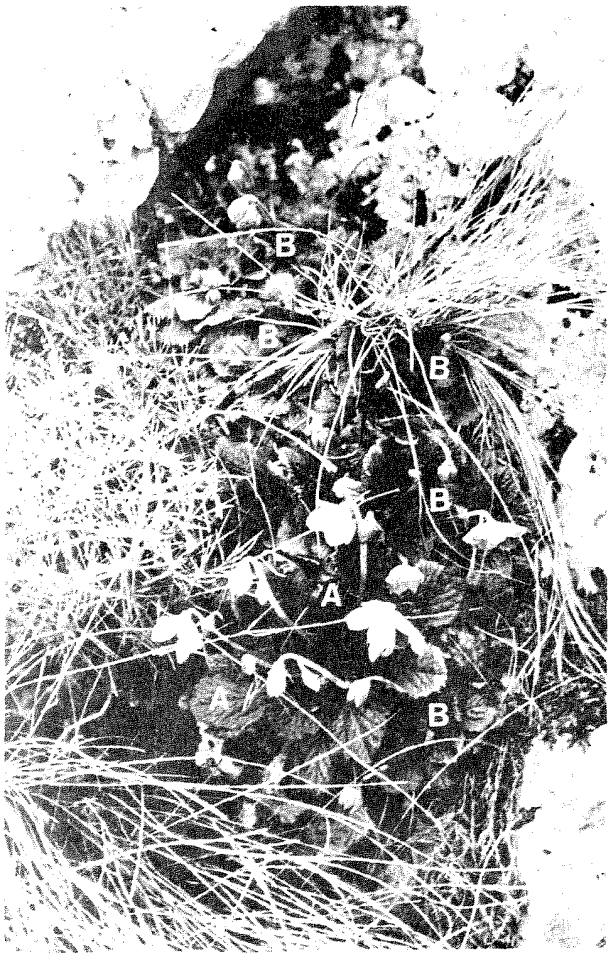

Fig. 4. – The mixed cushions of *Ramonda serbica* (A) and *R. nathaliae* (B) in the zone of sympatry on Oblik in the gorge of Sićevačka klisura.

On the basis of the literature and herbarium data as well as of the data provided by our own investigations, the distribution of the species *R. serbica* and *R. nathaliae* was established for the wider surroundings of the Suva planina mountain and Niš (Fig. 5).

The areas with only one species are confined for the *R. nathaliae* to the montane and subalpine belt of the mountain Suva planina, from the Mosor (985 m) across the Sokolov Kamen (1552 m) and the Trem (1808 m) to the Rakoš (1469 m), and for the *R. serbica* to the submontane and montane belt (700–1000 m) of the northern side of Svrljiške planine mountain from the Pleš (1273 m) across the Pernatica (1179 m) to the mountain Julijanska planina (1273 m), the gorge Sićevačka klisura above the monastery Sv. Bogorodica (250–700 m) and the gorge Jelašnička klisura (300–350 m). The areas with mixt populations – the zones of sympatry – are confined to two localities: namely, the Radovanski Kamen above the village of Jelašnica (450–500 m) and the Oblik (350–700 m) in the gorge Sićevačka klisura above the monastery Sv. Petka.

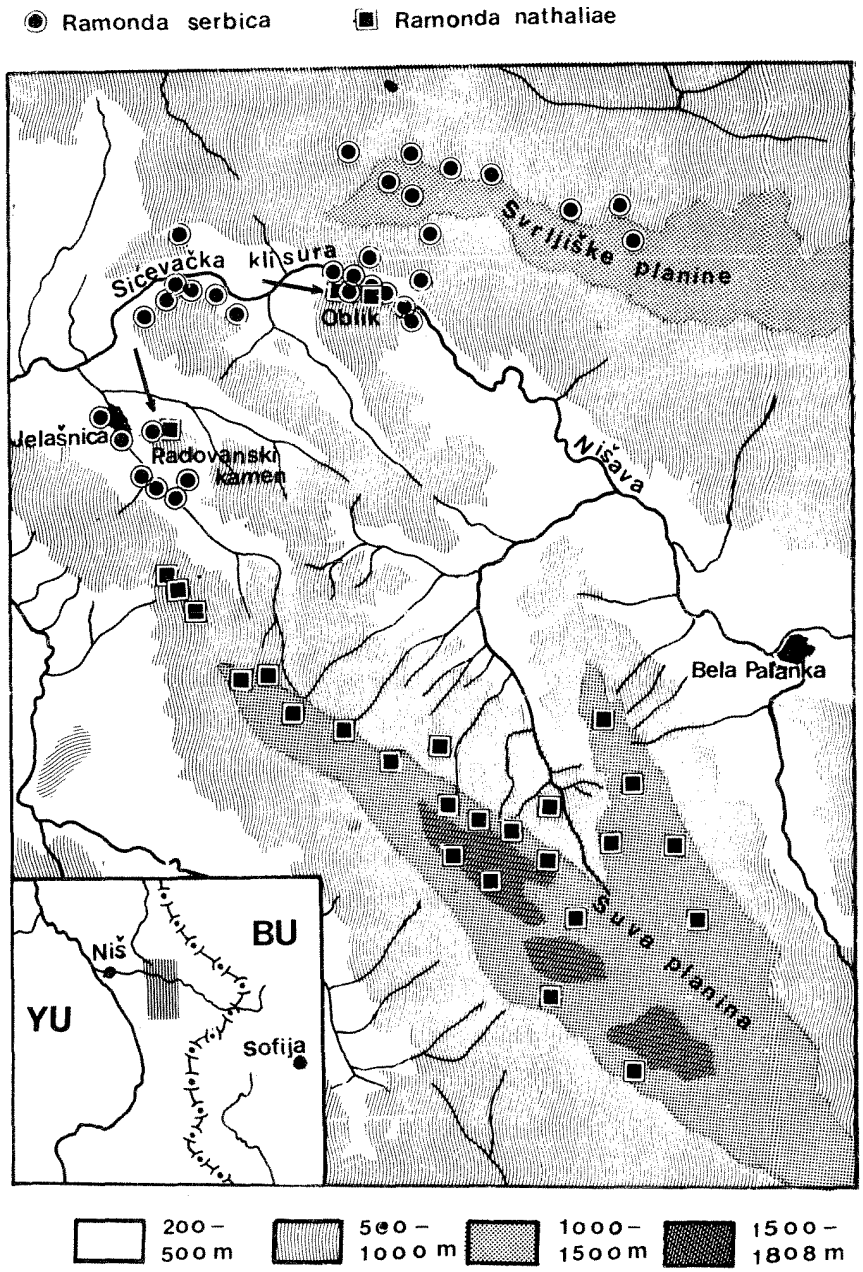

Fig. 5. – Distribution of the species *Ramonda serbica* and *R. nathaliae* in the wider surroundings of the Suva planina mountain near Niš (arrows show the zones of sympatry: 1. Radovanski kamen and 2. Oblik in the gorge of Sićevačka klisura).

In the region we investigated, in the areas where they appear in pure populations, the *R. serbica* and *R. nathaliae* species are isolated geographically and phenologically and consequently in terms of reproduction, as well. This is not the case in sympatric populations (Radovanski Kamen and Oblik), where on the average half of the plants of each species are in the full flowering period at the same time, which offers the opportunity for crossbreading. However, the hybrid forms were not found. This might be due to a genetic incompatibility (the *R. nathaliae* is a diploid and the *R. serbica* is a tetraploid plant).

Realizing the importance of the existence of both *Ramonda* species in the wider surroundings of the Suva planina mountain near Niš, K o š a n i n (1922) tried to understand its meaning. He, however, remained under the impression that the areas of the two *Ramonda* species in this region do not overlap, but only border on each other. Our own investigations have shown the contrary; the true overlapping and the existence of the zones of sympatry. The overlapping of the areas of *R. serbica* and *R. nathaliae* species presents a geobotanical problem of great interest, one which is essentialy involved in the questions of the origin, the chorology and the ecology of these endemo–relict plants.

Faced with the existence of both species in this region K o š a n i n (1922) believed that both of them were here autochtonous since the Tertiary, while the chorological differentiation of the species of the *Ramonda* genus on the Balkan Peninsula was due to the Glacial Age. The „oazis" on the Suva planina mountain near Niš was, he believed, the remnant of the sometime common area of *R. serbica* and *R. nathaliae* in the north.

We are of the opinion that the chorological and the ecological differentiation of the species *R. serbica* and *R. nathaliae* occurred much earlier, during the Tertiary. At that time, these species were widely spread in the regions of their present distribution, as the ancient elements of the mediterranean orophytic flora. During the Glacial Age their areas were reduced, following their movement from the higher parts of the mountains toward the foothills and the surrounding gorges and canyons, where they occur today.

In the explanation of the overlapping areas and the zones of sympatry we tend to believe that the two *Ramonda* species were not both autochtonous in the wider region of the Suva planina mountain since the Tartiary. Rather, the *R. nathaliae* species, as the true mediterranean orophyte, inhabited the mountain peaks of the Suva planina mountain, and there its populations are still encountered, while the *R. serbica* as a more mesophyllic species and a forest chasmophyte had its habitat more to the north of this region (the north–northeast Serbia, the northwest Bulgaria). During the Glacial Age the populations of the *R. nathaliae* species descended from the top of the Suva planina mountain toward the foothill, while the *R. serbica* populations migrated from the north toward and into the gorges in the south and this shifting of areas formed the common habitat and the zones of sympatry in this region.

CONCLUSIONS

Since the time of P a n č i ć and P e t r o v i ć (1887, 1889) the wider surroundings of the Suva planina mountain near Niš is known as a region inhabited by the both species of the genus *Ramonda* the *R. serbica* and the *R. nathaliae*. The later investigations, in the first place those by K o š a n i n (1922, 1939), who demonstrated that the areas of these sibling species were well differentiated, only confirmed the fact that the wider surroundings of the Suva planina mountain are the only known region

where the areas of the two *Ramonda* species are close to each other. Košanin (1939) believed that in this region the two Ramondae were chorologically differentiated, excluding thereby the overlapping of their areas.

Our investigations of the distribution and the ecology of Ramondae in the same region demonstrated the existance of two zones of sympatry with mixt populations of the species *R. serbica* and *R. nathaliae*. The zones of sympatry were found on the Radovanski Kamen, the limestone rock above the village Jelašnica, c. 15 km to the southeast of Niš, and on the Oblik, the northern side of the Sićevačka klisura gorge, 25 km to the east of Niš. The habitats of the Radovanski Kamen and on Oblik are reported here for the first time as the only two known meeting points of the areas of these two species and the true zones of their chorological and ecological overlapping.

In these zones of sympatry the two *Ramonda* species have opportunity for crossbreeding since their flowering periods more or less overlap. Inspite of it, the hybrid forms, pointing to the absence of reproductive isolation, were not found. The absence of hybrid forms might be due to a genetic incompatibility between the Ramondae: Ramondae are paleopolyploids, and the *R. nathaliae* is diploid, 2n – 36 (Glišić, 1924); 2n – 48 (Ratter, 1963), while the *R. serbica* is tetraploid, 2n – 72 (Glišić, 1924).

Our further investigations, which are in progress, on the distribution and on the population and physiological ecology of the sibling species *R. serbica* and *R. nathaliae* could help elucidate the complex and interesting biology of these tertiary paleoendemic plants of the Balkan flora.

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Rezime

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SIMPATRIČKI AREAL SESTRINSKIH I ENDEMO–RELIKTNIH VRSTA RAMONDA SERBICA PANČ. I R. NATHALIAE PANČ. ET PETROV. (GESNERIACEAE) U JUGOISTOČNOJ SRBIJI (JUGOSLAVIJA)

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Još od vremena Pančića i Petrovića (1874, 1882, 1884, 1885) šira okolina Suve planine kod Niša je poznata kao područje u kome su rasprostranjene obe vrste balkanskih ramonda, *R. serbica* i *R. nathaliae*. Kasnija istraživanja, na prvom mestu Košanina (1922, 1939), koja su, inače, pokazala da su ove dve sestrinske i endemo–relitne vrste dobro horološki izdiferencirane, samo su potvrdila činjenicu da se delovi areala ramonda na širem području Suve planine veoma približavaju. Košanin (1922) je smatrao Suvu planinu kao „zajedničko stanište" za obe vrste ramonda. Međutim, kasnije Košanin (1939) iznosi mišljenje da se i na ovom području areali ramonda ne preklapaju, odnosno da su na širem području Suve planine, kao i u ostalom delu areala, ove vrste dobro horološki izdiferencirane.

Našim istraživanjima rasprostranjenja i ekologije ramonda u širem području Suve planine kod Niša utvrđeno je postojanje dve zone simpatrije sa mešovitim populacijama vrsta *R. serbica* i *R. nathaliae*. Zone simpatrije su nađene na Radovanskom Kamenu, krečnjačkom grebenu, eksponiranom severu do severoistoku, iznad sela Jelašnica, i na Obliku, krečnjačkom visu na levoj obali Nišave u Sićevačkoj klisuru kod sela Ostrovica. Staništa na Radovanskom Kamenu i Obliku su do sada jedine poznate zajedničke tačke areala ovih biljaka i jedine prave zone njihovog ekološkog i horološkog preklapanja.

U pomenutim zonama simpatrije ramonde po pravilu zauzimaju slične ekološke niše, a to su pukotine krečnjačkih stena. Ipak, vrsta *R. nathaliae* uglavnom nastanjuje okomite i izloženije krečnjačke litice, dok se vrsta *R. serbica* pretežno drži zaklonjenijih mesta u sklopu šumske vegetacije i u podnožju stena. Takođe, obe vrste često rastu jedna pored druge obrazujući zajedničke busenove. Duž čitave zone simaptrije postoje mogućnosti međusobnog ukrštanja, s obzirom da se periodi cvetanja kod obe vrste manje više poklapaju. Konstatovano je da se otprilike 50% populacije jedne i druge vrste nalaze u potencijalnoj mogućnosti ukrštanja. I pored toga, hibridni oblici nisu konstatovani, što se može objasniti genetičkom inkompatibilnošću ramonda, s ozbirom da je vrsta *R. nathaliae* diploid, a vrsta *R. serbica* tetraploid.

Naša dalja istraživanja, a koja se tiču još detaljnijeg sagledavanja rasprostranjenja, populacione i fiziološke ekologije vrsta *R. serbica* i *R. nathaliae* imaju za cilj produbljenije upoznavanje sa interesantnom i složenom biologijom i ekologijom ovih tercijarnih paleoendemičnih vrsta balkanske flore.