



Original Contribution

THE BALKAN ENDEMICS *MOEHRINGIA JANKAE* GRISEB. EX JANKA AND *MOEHRINGIA GRISEBACHII* JANKA IN BULGARIA

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ABSTRACT

The aim of the study is to establish the current distribution of Balkan endemics *Moehringia jankae* Griseb. ex Janka and *Moehringia grisebachii* Janka in Bulgaria. The routing method was used. All areas which the species inhabit according to literary sources were visited. Established were 12 populations of *M. jankae* and 32 populations of *M. grisebachii*. All established populations of *M. jankae* were from the Eastern Balkan Range on the territory of Sinite Kamani Natural Park. Three of the registered populations of *M. grisebachii* were from North-Eastern Bulgaria (Shumen region, near village Madara). Thirteen were from Sredna Gora Mts (nine on the territory of village Rozovets, two between village Rozovets and Bratan peak, two on peak Orлите and one between peak Orлите and the megalith Popova turla, rock formation along the road from village Rozovets to the rock formation Pravite kamani, the rock formation Pravite kamani, rock formations west of the megalith Pravite kamani, and one above village Pesnopoy in the area Usoykata). Nineteen were from the Eastern Balkan Range on the territory of Sinite Kamani Natural Park. Each population was assessed and the factors with negative influence were indicated.

Key words: *Moehringia jankae*, *Moehringia grisebachii*, Bulgaria, distribution, Balkan endemics

INTRODUCTION

The Bulgarian flora is rich and diverse and includes 270 endemic Balkan species which belong to 116 genera and 35 families (1). The endemic taxa, among which are *Moehringia grisebachii* and *Moehringia jankae*, are among the most attractive components in each flora and play an important role in understanding biogeographical patterns and are often used in planning nature conservation strategies. The Balkan endemic *M. grisebachii* is included in the Red Book of Bulgaria, vol.1. Plants and fungi under category „endangered” (2). According to literary sources (2-10) in Bulgaria the species is distributed in North-Eastern Bulgaria (above the village of Madara,

Shumensko), Eastern Balkan Range (Sinite Kamani Natural Park above the town of Sliven), Sredna Gora Mts (between the village of Rozovets and Bratan peak), Thracian Plane (the surroundings of Simeonovgrad), Tundja Hilly Plain (Sakar Mountains, north of the village of Matochina, Svilengrad). Distribution in the Balkans includes Bulgaria, Romania, and Turkey.

The Balkan endemic *M. jankae* is protected by the Biological Diversity Act (11), included in the Red Book of Bulgaria, vol. 1. Plants and fungi under category „endangered” (12). It is protected by Annex I of the Bern Conservation (13) and according to the criteria of the IUCN Red Lists of Threatened Plants (14) it has been rated as „Data Deficient (DD)” on a global scale. The species is included in Annex II of Directive 92/43/EEC (15). The species is distributed in North-Eastern Bulgaria (Shumen

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region) and Eastern Balkan Range - Sinite Kamani Natural Park above the town of Sliven (6-8, 10, 12, 16). Distribution in the Balkans includes Bulgaria and Romania.

The aim of the study is to establish the current distribution of *Moehringia jankae* Griseb. Ex Janka and *Moehringia grisebachii* Janka in Bulgaria.

MATERIALS AND METHODS

The study was conducted during the vegetation periods of 2017 – 2018. The routing method was applied to establish the distribution of the species. To determine the locations and status of *M. jankae* and *M. grisebachii* in Bulgaria we visited and researched mainly on the territory of: Eastern Balkan Range (Sinite Kamani Natural Park), Sredna Gora Mts. (village Rozovets – peak Bratan – village Svejen – village Pesnopoy); Thracian Plane (Haskovo – Simeonovgrad); Tundja Hilly Plain (village Matochina – village Mihalich – village Varnik); North-Eastern Bulgaria (Shumen – village Kiyevcha – village Troica – village Madara).

A Global positioning system (GPS) was used to determine the coordinates of the sampling points. The habitats of the species are presented on the maps using Google Earth (the World Geodetic System since 1984 (WGS'84).

For taxonomic database was used Flora of PR Bulgaria (17), Field Guide to the Vascular Plants in Bulgaria (18), Key to the Plants of Bulgaria (6).

Through the use of Methodology for monitoring vascular plants in Bulgaria, we were able to determine the status of each population.

The formation in the rocks of the studied area was identified based on the Geological Map of Bulgaria scale 1:500000, Ministry of Environment and Waters National Geofund and Geology.

The voucher specimens were deposited in the herbarium of the Agricultural University in Plovdiv (SOA).

RESULTS AND DISCUSSION

Moehringia jankae

In the present study there were no discovered populations of the species in North-Eastern Bulgaria (Shumen region).

On the territory of Eastern Balkan Range - Sinite Kamani Natural Park were registered a total of 12 populations of *Moehringia jankae* – 4 in Kamilata area, 3 along Haiduschka pateka area, 2 in Karandila area, and 1 population each in Karandilska polyana, Micro dam area, Kaloyanovi kuli (**Figure 1**). Data for the established populations are shown in **Table 1**.

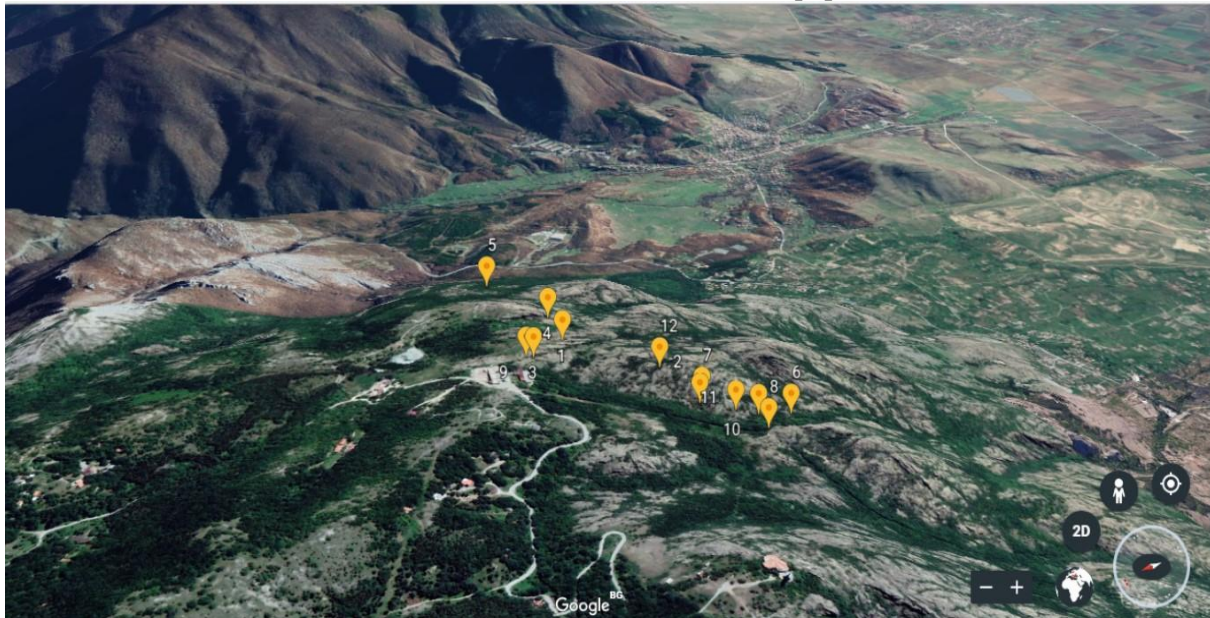


Figure 1. Distribution of *Moehringia jankae* in Bulgaria
*populations are labeled with the numbers indicated in **Table 1**

The populations of *M. jankae* located 350 m. south of hotel complex Karandila, 450 m. south-west of hotel complex Karandila, rock

formations near Karandilska polyana, Micro dam area, area Kaloyanovi kuli, rock formation in Kamilata area, along Haiduschka pateka

area east of hotel complex Karandila, along Haiduschka pateka area going south from hotel complex Karandila, on rock formations near Haiduschka pateka area, east of Kamilata area, north of Kamilata area, rocks between hotel complex Karandila and Kamilata area were described by Grozeva & al. (8) after field studies during the vegetation periods 2013 – 2015. For the six-year period (2013-2018) they have increased in number while only the population from Kaloyanovi kuli area has experienced slight decrease in 2018 compared with 2015. A great increase in the numbers was registered for the population along Haiduschka pateka area east of hotel complex Karandila, from 4 specimens in 2013 to 24

specimen in 2017 respectively. Regarding the area they cover there has been no discovered decrease during the six-year period. Two of the populations – from Karandilska polyana and Kaloyanovi kuli area have retained their area, while for the other seven populations is recorded an increase in the area. This, according to Grozeva et al. (8), is most probably due to the wetter spring and summer and the more abundant moisture allowed for the majority of mature seeds that had fallen in rock crevices to develop successfully. For the newly established three populations of the species from Kamilata area, indicated under numbers 10 to 12 in **Table 1**, there were no recorded changes in the area and numbers during the two-year period of study.

Table 1. Data for the registered populations of *Moehringia jankae* on the territory of "Sinite Kamani Natural Park", Eastern Balkan Range during the vegetation periods 2017-2018

Number of herbarium specimens	Location	Geographic coordinates in the central part of the population, elevation	Rock, facing	Area and number of specimens	Dominant and accompanying species
SOA 062311	1. 350 m. south of hotel complex Karandila	N 42° 42.709', E 26° 22.355', 933 m	Vertical quartz-porphry rocks facing north	Area of 2.5 m ² and 14 specimens	lichens and mosses
SOA 062311	2. 450 m. south-west of hotel complex Karandila	N 42° 42.712', E 26° 22.252', 908 m	Vertical conglomerates facing south	Area of 55,5 m ² and 55 specimens in 2017 and 61 specimens in 2018	lichens and mosses
SOA 062309	3. rock formations near Karandilska polyana	N 42° 42.873', E 26° 22.452', 955 m	Vertical quartz-porphry rocks facing south	Area of 796 m ² and 63 specimens	<i>Moehringia grisebachii</i> , lichens and mosses
SOA 062313	4. Micro dam area	N 42° 42.790', E 26° 22.612', 972 m	Vertical quartz-porphry rocks facing east	Area of 26 m ² and 22 specimens	<i>Moehringia grisebachii</i> lichens and mosses
SOA 062312	5. Kaloyanovi kuli area	N 42° 42.755', E 26° 23.015', 756 m	Vertical quartz-porphry rocks facing west	Area of 19 m ² and 45 specimens	lichens and mosses
SOA 062314	6. rock formation in Kamilata area	N 42° 42.603', E 26° 22.180', 857 m	Vertical quartz-porphry rocks facing south	Area of 4.8 m ² and 35 specimens in 2017 and 33 specimens in 2018	<i>Moehringia grisebachii</i> , lichens and mosses
SOA 062311	7. along Haiduschka pateka area east of hotel complex Karandila	N 42° 42.704', E 26° 22.261', 889 m	Vertical quartz-porphry rocks facing north-west	Area of 82 m ² and 22 specimens in 2017 and 33 specimens in 2018	lichens and mosses
SOA 062315	8. along Haiduschka pateka area going south from hotel complex Karandila	N 42° 42.654', E 26° 22.160', 879 m	Vertical quartz-porphry rocks facing west	Area of 1.2 m ² and 19 specimens	lichens and mosses

SOA 062310	9. on rock formations near Haiduschka pateka area	N 42° 42.881', E 26° 22.458', 551-620 m	Vertical quartz-porphry rocks facing west, east and south	Area of 22 m ² and 73 specimens	lichens and mosses
SOA 062385	10. East of Kamilata area	N 42° 42.647', E 26° 22.198', 863-869 m	Vertical quartz-porphry rocks facing west	Area of 38 m ² and 15 specimens	lichens and mosses
SOA 062386	11. north of Kamilata area	N 42° 42.673', E 26° 22.217', 866 m	Vertical quartz-porphry rocks facing north	Area of 70 m ² and 13 specimens	lichens and mosses
SOA 062387	12. rocks between hotel complex Karandila and Kamilata area	N 42° 42.726', E 26° 22.349', 913-952 m	Vertical quartz-porphry rocks facing west	Area of 1,5 m ² and 8 specimens	lichens and mosses

The data from the field studies show that all populations of *Moehringia jankae* are in good general condition. Anthropogenic influence was not observed but the potential threat exists.

Moehringia grisebachii

In the present study there were no discovered populations of the species in Thracian Plane (the surroundings of Simeonovgrad) and Tundja Hilly region (Sakar Mountains, north of the village of Matochina, Svilengrad).

A total of 32 populations of *Moehringia grisebachii* were registered, respectively 3 in North-Eastern Bulgaria, 19 in the Eastern Balkan Range on the territory of Sinite Kamani Natural Park and 10 in Sredna Gora Mts above the villages Rozovets and Pesnopoy (Table 2, Figure 2-4).

The smallest area occupies the three populations from North-Eastern Bulgaria – along the trail above the Madara Rider in The Madara national historical-archeological reserve, near the stone steps north-west of the Madara Rider, the fortress above village Madara (Figure 2). The conducted field research and analysis allow us to believe that the small area of this population was affected by the registered anthropogenic pressures, due to its immediate proximity with sites with national and worldwide historical significance. Despite the increased tourist flow, there were no registered changes in the numbers of the three populations during the two-year period of study. Their limited area is a cause for concern and requires further observation, so that if necessary, the appropriate measures could be taken to preserve the populations.



Figure 2. Distribution of *Moehringia grisebachii* in Northeastern Bulgaria
*populations are labeled with the numbers indicated in Table 2

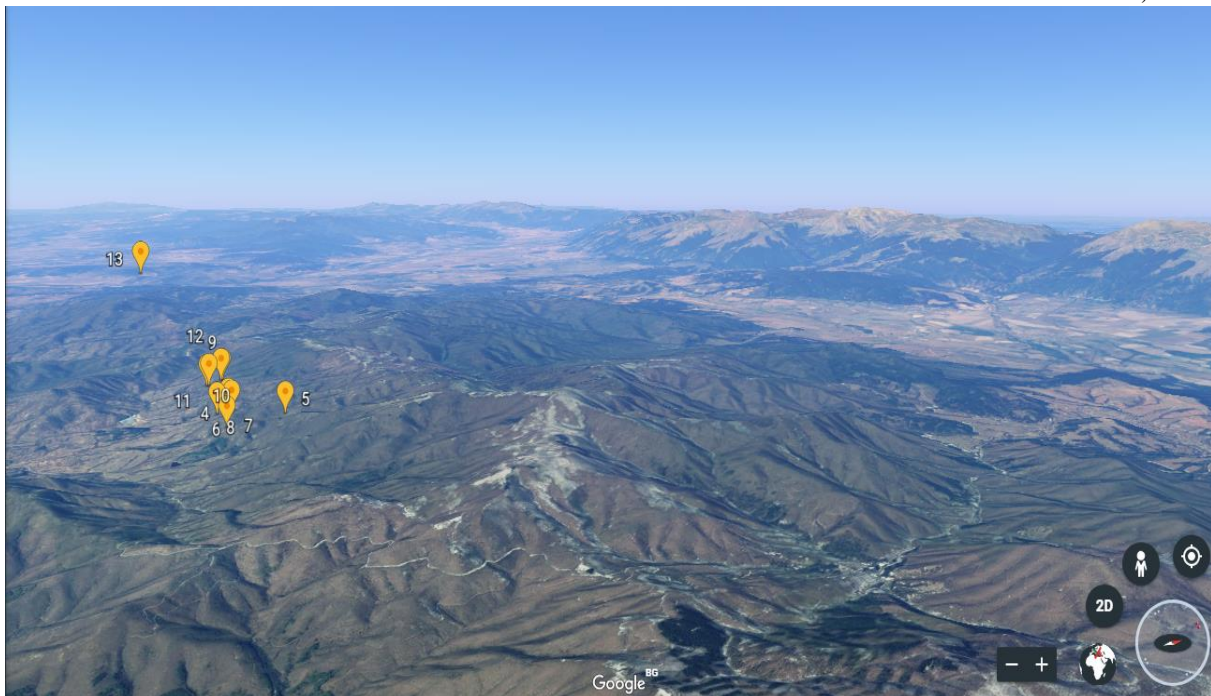


Figure 3. Distribution of *Moehringia grisebachii* Janka in Sredna Gora Mts.
*populations are labeled with the numbers indicated in **Table 2**

During a two-year period of study there was no registered change in the numbers and area for the ten populations of *M. grisebachii* established in Sredna Gora Mts. – above village Rozovets at the first corner after the path towards Bratan peak; rock formation along the old Roman road north of Chepilskata Cheshma; rock formation at the first peak on the way to the megalith Popova Turla, Orlite Peak; rock formation in the west part of Orlite Peak; rock formation between Orlite Peak and the megalith Popova Turla; rock formation on the way from village Rozovets to the rock formation Pravite Kamani; rock formation Pravite Kamani; rock formation northwest of rock formation Pravite Kamani; rock massifs west of rock formation Pravite Kamani; above village Pesnopoy, area Usoykata (**Figure 3**). During the field studies anthropogenic and negatively impacting factors were not observed.

In this study are described five of the nineteen in total populations of *M. grisebachii* from Eastern Balkan Range, Sinite kamani Natural Park shown in **Table 2** and **Figure 4** – from Eastern Balkan Range, Sinite kamani Natural park – rock formation between Kamilata area and hotel complex Karandila, rock formations bellow hotel

complex Karandila, south of Karandilska polyana, south-east of hotel complex of Karandila, and north of Micro dam area. During the two-year period of study there was no discovered decrease in their numbers or area. Despite being located in one of the areas most visited by tourists in the park, there was no observed anthropogenic impact; however the potential threat still exists. Data for the other 14 populations was published by Grozeva & al. (8) for the vegetation periods 2013-2015. During the six-year period from 2013 to 2018 for these populations was registered a gradual increase in numbers and area, which for eight of the populations – rock formations before the crossroad for Kafedzhiiskiyya kaynak, south-east of Haydushka pateka, Haydushka polyana, rock formation near Karandilska polyana, west of the marked trail for Mollova kuria area, rocks in Gornaka area, rock massifs in Karakyutyuk area and Golyama Chatalka Peak – in the past two years remains. For the other six populations – from Kaloyanovi kuli area, east of Haydushka pateka, south-east of hotel complex Karandila, east of Micro dam area, rocks at the corner of the trail from Gornaka to Mollova kuria, and rock formations in Kamilata area – in the last.



Figure 4. Distribution of *Moehringia grisebachii* Janka in Eastern Balkan Range
* populations are labeled with the numbers indicated in **Table 2**

Table 2. Data for the registered during the vegetation periods 2017-2018 populations of *Moehringia grisebachii* in North-Eastern Bulgaria, Sredna Gora Mts. and Eastern Balkan Range.

Number of herbarium specimens	Location	Geographic coordinates in the central part of the population, elevation	Rock, facing	Area and number	Dominant and accompanying species
SOA 062316	1. North-Eastern Bulgaria, along the trail above the Madara rider in The Madara national historical-archeological reserve	N 42° 25.631', E 25° 37.181', 293 m	Vertical carbonate sandy limestones facing south	Area of 1 m ² and 11 specimens	lichens and mosses
SOA 062317	2. North-Eastern Bulgaria, near the stone steps north-west of the Madara Rider	N 43° 16.742', E 27° 07.108', 285 m	Vertical conglomerates facing south	Area of 1,2 m ² and 5 specimens	-none
SOA 062318	3. North-Eastern Bulgaria, the fortress above village Madara	N 43° 16.599', E 27° 07.214', 392 m	Vertical carbonate limestones facing south	Area of 20 m ² and 24 specimens	lichens and mosses
SOA 062323	4. Sredna Gora Mts., above village Rozovets at the first corner after the path towards Bratan peak	N 42° 28.708', E 25° 07.427', 741 m	Vertical granite acid rocks facing south	Area of 45 m ² and 16 specimens	lichens and mosses
SOA 062322	5. Sredna Gora Mts., rock formation along the old Roman road north of Chepilskata Cheshma	N 42° 29.067', E 25° 07.421', 845 m	Vertical granite acid rocks facing south-east	Area of 48 m ² and 17 specimens	lichens and mosses
SOA 062320	6. Sredna Gora Mts., rock formation at the first peak on the way to the megalith Popova Turla, Orlite Peak.	N42° 28.714', E 25° 06.885', 741 m	Vertical granite acid rocks facing south and south-east	Area of 80,4 m ² and 42 specimens	lichens and mosses
SOA 062321	7. Sredna Gora Mts., rock massifs in the west part of Orlite Peak	N42° 28.783', E 25° 06.896', 773 m	Vertical granite acid rocks facing north-west	Area of 60,2 m ² and 31 specimens	lichens and mosses
SOA 062324	8. Sredna Gora Mts., rock formations between Orlite Peak and the megalith Popova Turla	N42° 28.794', E 25° 06.975', 786 m	Vertical granite acid rocks facing south	Area of 61 m ² and 32 specimens	lichens and mosses

SOA 062388	9. Sredna Gora Mts., rock formations on the way from village Rozovets to the rock formation Pravite Kamani	N42° 28.831', E 25° 05.204', 638 m	Vertical granite acid rocks facing west and east	Area of 100 m ² and 56 specimens	lichens and mosses
SOA 062389	10. Sredna Gora Mts., rock formation Pravite Kamani	N42° 28.935', E 25° 05.290', 731-738 m	Vertical granite acid rocks facing west and east, north and south	Area of 128 m ² and 54 specimens	lichens and mosses
SOA 062390	11. Sredna Gora Mts., rock formations north-west of rock formation Pravite Kamani	N42° 28.845', E 25° 05.206', 602 m	Vertical granite acid rocks facing north	Area of 1200 m ² and 25 specimens	lichens and mosses
SOA 062391	12. Sredna Gora Mts., rock formations west of rock formation Pravite Kamani	N42° 28.929', E 25° 05.271', 725 m	Vertical granite acid rocks facing south	Area of 40 m ² and 14 specimens	lichens and mosses
SOA 062319	13. Sredna Gora Mts., above village Pesnopoy, area Usoykata	N42° 29.489', E 24° 48.011', 378 m	Vertical granite acid rocks facing north-east	Area of 10,5 m ² and 17 specimens	lichens and mosses
SOA 062304	14. Eastern Balkan Range, Sinite Kamani Natural Park Kaloyanovi kuli area	N 42° 42.833', E 26° 23.169', 685 m	Vertical quartz-porphry rocks facing south	Area of 2,5 m ² and 21 specimens	lichens and mosses
SOA 062310	15. Eastern Balkan Range, Sinite Kamani Natural Park, rock formations before the crossroad for Kafedzhiiskiia kaynak	N 42° 42.720', E 26° 22.968', 770 m	Vertical quartz-porphry rocks facing south-east	Area of 12 m ² and 28 specimens	lichens and mosses
SOA 062303	16. Eastern Balkan Range, Sinite Kamani Natural Park, south-east of Haydushka pateka	N42° 42.828', E 26° 22.432', 951 m	Vertical conglomerates facing south	Area of 12 m ² and 22 specimens	lichens and mosses
SOA 062308	17. Eastern Balkan Range, Sinite Kamani Natural Park, Haydushka polyana	N42° 42.290', E 26° 21.655', 641 m	Vertical quartz-porphry rocks facing east	Area of 14 m ² and 26 specimens	lichens and mosses
SOA 062301	18. Eastern Balkan Range, Sinite Kamani Natural Park, east of Haydushka pateka	N42° 42.785', E 26° 21.349', 921 m	Vertical quartz-porphry rocks facing south-east	Area of 25 m ² and 28 specimens	lichens and mosses
SOA 062396	19. Eastern Balkan Range, Sinite Kamani Natural Park, west of Karandilska polyana	N42° 42.818', E 26° 22.482', 965 m	Vertical quartz-porphry rocks facing north-west	Area of 1720 m ² and 256 specimens	<i>M. jankae</i> , lichens and mosses
SOA 062305	20. Eastern Balkan Range, Sinite Kamani Natural Park, South of Karandilska polyana	N42° 42.828', E 26° 22.530', 956 m	Vertical quartz-porphry rocks facing south	Area of 200 m ² and 39 specimens	<i>M. jankae</i> , lichens and mosses
SOA 062394	21. Eastern Balkan Range, Sinite Kamani Natural Park, rock formation near Karandilska polyana	N42° 42.848', E 26° 22.546', 919 m	Vertical quartz-porphry rocks facing south and south-east	Area of 800 m ² and 65 specimens	lichens and mosses
SOA 062395	22. Eastern Balkan Range, Sinite Kamani Natural Park, south-east of hotel complex of Karandila	N42° 42.851', E 26° 22.447', 971 m	Vertical quartz-porphry rocks facing south	Area of 55 m ² and 18 specimens	lichens and mosses
SOA 062396	23. Eastern Balkan Range, Sinite Kamani Natural Park, rock formations east of Micro dam area	N42° 42.818', E 26° 22.482', 922 - 975 m	Vertical quartz-porphry rocks facing west and north-west	Area of 615 m ² and 97 specimens	<i>M. jankae</i> , lichens and mosses

SOA 062397	24. Eastern Balkan Range, Sinite Kamani Natural Park, rock formations north of Micro dam area	N42° 42.815', E 26° 22.647', 951 m	Vertical quartz- porphyry rocks facing north-east	Area of 2660 m ² and 63 specimens	lichens and mosses
SOA 062398	25. Eastern Balkan Range, Sinite Kamani Natural Park, west of the marked trail for Mollova kuria area	N42° 42.727', E 26° 22.800', 830 m	Vertical limestone facing west	Area of 16 m ² and 22 specimens	lichens and mosses
SOA 062307	26. Eastern Balkan Range, Sinite Kamani Natural Park, rocks at the corner of the trail from Gornaka to Mollova kuria	N42° 42.664', E 26° 22.869', 831 m	Vertical quartz- porphyry rocks facing east	Area of 15,5 m ² and 25 specimens	lichens and mosses
SOA 062299	27. Eastern Balkan Range, Sinite Kamani Natural Park, rocks in Gornaka area	N42° 42.828', E 26° 23.735', 920 m	Vertical quartz- porphyry rocks facing west	Area of 60 m ² and 17 specimens	lichens and mosses
SOA 062298	28. Eastern Balkan Range, Sinite Kamani Natural Park, rocks in Kamilata area	N42° 42.595', E 26° 22.181', 838 m	Vertical conglomerates facing west	Area of 19,5 m ² and 31 specimens	lichens and mosses
SOA 062302	29. Eastern Balkan Range, Sinite Kamani Natural Park, rocks in Karakyutyuk area	N42° 42.861', E 26° 18.662', 854 m	Vertical limestone facing west	Area of 4,7 m ² and 22 specimens	lichens and mosses
SOA 062306	30. Eastern Balkan Range, Sinite Kamani Natural Park, rocks in Golyama Chatalka area	N42° 43.362', E 26° 21.093', 1049 m	Vertical quartz- porphyry rocks facing west	Area of 29,5 m ² and 25 specimens	lichens and mosses
SOA 062399	31. Eastern Balkan Range, Sinite Kamani Natural Park, rock formations between Kamilata area and hotel complex Karandila	N42° 43.082', E 26° 22.157', 909 m	Vertical quartz- porphyry rocks facing south	Area of 2 m ² and 7 specimens	lichens and mosses
SOA 062400	32. Eastern Balkan Range, Sinite Kamani Natural Park, rock formations bellow hotel complex Karandila	N42° 42.786', E 26° 22.360', 919 m	Vertical quartz- porphyry rocks facing east	Area of 215 m ² and 11 specimens	lichens and mosses

For two years was registered a slight increase in numbers and area. The observed stabilization and light increase in area and number of these populations is most probably due to both the actions taken by the directorate of Sinite Kamani Natural Park to restrict the access of tourists to the populations, as well as the favorable climate conditions which helped for the regular passing of vegetation.

CONCLUSION

The data from the present study gave us reason to believe that in Bulgaria the Balkan endemic *M. jankae* forms populations only on the territory of Sinite Kamani Natural Park, Eastern Balkan Range on quartz porphyry rock formations and conglomerates in Karandila,

Karandilska polyana, Haydushka—pateka, Kaloyanovi kuli, Kamilata area at an altitude of 551 to 972 m. Populations number from 8 to 73 specimens at an area of 1.2 to 796 m². Dominant in the *M. jankae* populations are lichens and mosses. An accompanying conservation significant species in a three of the registered populations – south-east of Karandilska polyana, rocks to the east in Kamilata area and Micro dam area is *M. grisebachii*.

Balkan endemic *M. grisebachii* forms populations in North-Eastern Bulgaria (above the village of Madara, Shumensko), Eastern Balkan Range (Sinite Kamani Natural Park), Sredna Gora Mts (between the village of

Rozovets and Bratan peak and above the village Pesnopoy), on carbonate sandy limestones, carbonate limestones, granite acid rocks, quartz-porphry rock formations, conglomerates, sandstones and limestones at an elevation from 285 to 1049 m. Populations number from 5 to about 256 specimens on an area of 1 to 1720 m². Dominant in the *M. grisebachii* populations are lichens and mosses. An accompanying conservation significant species in three of the registered populations in Eastern Balkan Range is *M. jankae*.

Despite the lack of registered increased anthropogenic impact during the field studies, the potential threats for each of the established populations of the two Balkan endemics still exist, because of their attachment to specific locations – crevices of rocks and their strong dependence on the humidity during the vegetation period. Taking into account that *M. jankae* and *M. grisebachii* have limited distribution in the country and that the seed reproduction of all studied populations is far from theoretically possible, it is necessary to continue observing the already established populations, to make an effort to find new populations and to study in detail the mechanisms of their reproduction.

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