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New chorological data for the flora of Sakar Mountain, South-eastern Bulgaria

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Abstract

The flora of Sakar Mt. is far from well-studied. The territory of the mountain is shared between two floristic regions in Bulgaria – Tundzha Hilly Country and Thracian Lowland. The aim of the study is to improve the knowledge of the floristic composition of these regions. We exploited standard methods widely used in floristic research. Resulting from the study we report eight vascular plant species from Sakar Mt. as new for the Tundzha Hilly Country floristic region incl. *Pulsatilla montana* (Hoppe) Rchb. and *Osyris alba* L., and three species as new for the Thracian Lowland floristic region incl. *Legousia pentagonia* (L.) Thell. assessed as Vulnerable in the Red List of Bulgarian vascular plants. The distribution of four species in the Tundzha Hilly Country floristic region is confirmed. The presence in Sakar Mt. of an interesting member of *Campanula rotundifolia* group is briefly discussed.

Key words: chorology, new floristic records, phytogeography, vascular plants.

Introduction

Sakar Mountain is a low mountain and hilly area located in Southeast Bulgaria and Northwest Turkey, with elevation between 50 and 856 m at the highest peak *Vishegrad (Kolev et al. 2002). It hosts very rich biodiversity in various biotope types* – grasslands, diverse types of natural forests and plantations (*Quercus cerris* L.*, Quercus frainetto* Ten.*, Pinus nigra* J.F.Arnold, etc.), rock formations (schists, limestone, etc.), freshwater ponds and arable land. The climate of the area is transitional continental with certain Mediterranean influence (Assenov 2021). The territory of the mountain is shared between two floristic regions in Bulgaria – Tundzha Hilly Country and Thracian Lowland.

The territory of Sakar Mountain is of significant interest from a botanical point of view, given its transitional biogeographical position and the increasing Mediterranean influence in the context of global climate change.

The existing information in scientific publications about the flora of the region is outdated or partial. First data on plant species distributed in the territory of Sakar can be found in the works of Velenovský (1891, 1898) and Podpéra (1902). The main publication on the subject is the study of Jordanov (1944) listing 420 species for Sakar Mountain distributed by vegetation types. Later, only individual floristic contributions were published (Stoyanov and Savchev 1965, Jordanov and Yanev 1968, Delipavlov and Cheshmedzhiev 1984, Assyov and Vassilev 2004, Vladimirov et al. 2012, Bancheva and Delcheva 2016, Petrova and Vassilev 2016, Stoyanov 2016, Stoyanov and Marinov 2016, Marinov and Stoyanov 2019, Stoyanov and Marinov 2021). Apart from the purely floristic studies the inventory of the Bulgarian flora produced some new for the science species which to date remain local endemic for Sakar Mt. (Bancheva and Raimondo 2013). Nevertheless, the region remains relatively rarely visited and poorly known. One possible explanation for this fact is the access restriction to Sakar which existed in the past as a border area.

Considering that the main publications on the flora of Sakar Mountain are relatively old, and that taxonomic concepts have changed rapidly in recent decades, a new comprehensive study of the area is necessary.

The flora of Sakar has piqued our interest in recent years, and we have conducted numerous field trips in the area, resulting in interesting findings. The purpose of this research is to contribute to the knowledge of the plant diversity of Sakar Mountain.

Materials and Methods

The transect method was used for the study. In the period 2016–2025 more than 20 field visits have been conducted, covering the mountain territory as evenly as possible and including a variety of habitats. Three Bulgarian herbaria (SO, SOM and BNHM) have been consulted and the reported here species have been checked for localities in the area. The identification was achieved with the use of Flora of Bulgaria (Vol. 1–11), Flora Europaea (Vol. 1–5) and determination keys (Andreev et al. 1992, Delipavlov et al. 2003, Stoyanov et al. 2022). The nomenclature follows the Euro+Med PlantBase. The names of taxa given in parentheses are according to the Conspectus of Bulgarian Vascular Flora (Assyov et al. 2012). The boundaries of the floristic regions are defined according to Jordanov (1966). The names and

conservation categories of the protected areas are according to the Register of protected areas in Bulgaria (2025). The localities of the reported taxa are shown in Figure 1.

Results and Discussion

Species new for the Tundzha Hilly Country floristic region

Aconogonon alpinum (All.) Schur (syn. *Pleuropteropyrum undulatum* A. Löve & D. Löve) (Polygonaceae)

Specimen examined: Sakar Mt., Dervishka Mogila peak, between rocks, 670 m a.s.l., 41°54′49.4″ N and 26°21′01.4″ E, 30.05.2020, with flowers and fruits, coll. A. Petrova and R. Vassilev (BG-NMNHS-BOT-5496).

So far, this species has been known only from mountain areas above 1500 m in the floristic regions of Stara planina (Western, Central), Vitosha, Rila, Pirin (Northern), West Frontier Mountains and Belasitsa (Asenov 1966, Assyov et al. 2012, Stoyanov et al. 2022). Its finding in Sakar Mountain at relatively low altitude significantly extends the distribution range of the species in Bulgaria. The locality is part of the protected area Skalnite Obrazuvania v Mestnost Dervishka Mogila nature monument (Register of protected areas in Bulgaria 2025).

Aethionema saxatile (L.) W. T. Aiton (Brassicaceae)

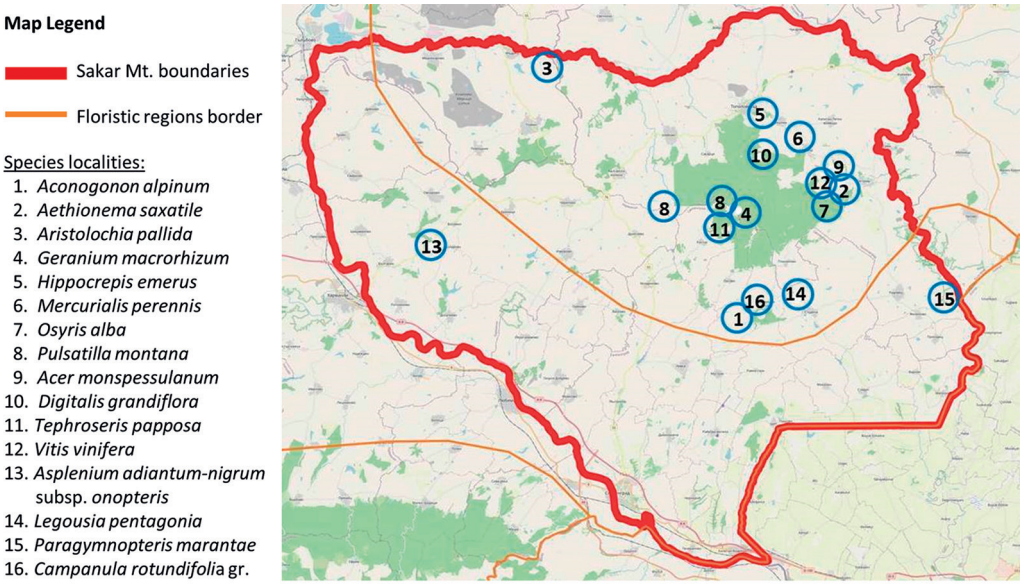


Fig. 1. Location of reported taxa.

Note: 1. *Aconogonon alpinum* (All.) Schur; 2. *Aethionema saxatile* (L.) W. T. Aiton; 3. *Aristolochia pallida* Willd.; 4. *Geranium macrorhizum* L.; 5. *Hippocrepis emerus* (L.) Lassen; 6. *Mercurialis perennis* L.; 7. *Osyris alba* L.; 8. *Pulsatilla montana* (Hoppe) Rchb.; 9. *Acer monspessulanum* L.; 10. *Digitalis grandiflora* Mill.; 11. *Tephroseris papposa* (Rchb.) Schur; 12. *Vitis vinifera* L.; 13. *Asplenium adiantum-nigrum* subsp. *onopteris* (L.) Heufl.; 14. *Legousia pentagonia* (L.) Thell.; 15. *Paragymnopteris marantae* (L.) K. H. Shing; 16. *Campanula rotundifolia* gr.

Specimen examined: Sakar Mt., along dry grassy areas between Bulgarska Polyana and Hlyabovo villages, 13.05.2002, coll. D. Stoyanov (SO 102256); Sakar Mt., State Forest of Sveta Troitsa Monastery nature monument, Topolovgrad Municipality, on calcareous rocky slope, 120 m a.s.l., 42°01'27.7" N and 26°26'11.1" E, 04.04.2024, with flowers, coll. R. Vassilev and K. Bakardzhiev (BG-NMNHS-BOT-5165).

This is a new species for the floristic region of Tundzha Hilly Country. According to Valev (1970) it occurs in numerous floristic regions in Central and Southern Bulgaria, mostly in mountainous areas.

Aristolochia pallida Willd. (Aristolochiaceae)
Specimen examined: Sakar Mt., in a mixed decidous forest near Vladimirovo village, Topolovgrad Municipality, 170 m a.s.l., 42°07'15.4" N and 26°07'46.6" E, 16.04.2025, with flowers, coll. R. Vassilev and K. Bakardzhiev (BG-NMNHS-BOT-5534).

New species for the Tundzha Hilly Country floristic region. It has been registered already in Forebalkan, Stara planina, Sofia region, Rila, Struma valley, Eastern Rhodopes (Asenov 1970), Southern Black Sea coast, Southern Pirin, Slavyanka, Mesta valley, Central Rhodopes, Thracian Lowland, Vitosha and West Frontier mountains (Assyov et al. 2012, Stoyanov et al. 2022).

Geranium macrorrhizum L. (Geraniaceae)

Specimen examined: Sakar Mt., Golemiya Zdravets locality, Topolovgrad Municipality, 700 m a.s.l., 41°59′59.6″ N and 26°19′33.9″ E, 22.04.2023, without generative organs, coll. A. Petrova and R. Vassilev (BG-NMNHS-BOT-5497); Sakar Mt., Golemiya Zdravets locality, Topolovgrad Municipality, 700 m a.s.l., 41°59′58.9″ and 26°19′33.2″, 07.05.2025, with flowers, obs. R. Vassilev (Pl@ntNet: https://identify.plantnet.org/k-southeastern-europe/observations/1026945383).

This species is quite common in the mountainous regions in Bulgaria but has not been reported until now from the floristic region of Tundzha Hilly Country, nor from the neighbouring floristic regions in South-eastern Bulgaria (Petrova and Kozhuharov 1979, Assyov et al. 2012, Stoyanov et al. 2022).

Hippocrepis emerus (L.) Lassen (syn. *Coronilla emerus* L.) (Fabaceae)
Specimen examined: Sakar Mt., on the outskirts of an artificial p ine forest SE from Topolovgrad town, 380 m a.s.l., 42°04′39.0″ N and 26°21′03.9″ E, 28.04.2025, with flowers, coll. R. Vassilev (BG-NMNHS-BOT-5906).

This thermophilic shrub is known from numerous floristic regions mainly in Southern Bulgaria (Kozhuharov 1976, Assyov et al. 2012) but Tundzha Hilly Country has been omitted from the distribution range of the species.

Mercurialis perennis L. (Euphorbiaceae)

Specimen examined: Sakar Mt., near Mramor village, Topolovgrad Municipality, in a deciduous forest, 230 m a.s.l., 42°03′23.6″ N and 26°23′27.6″ E, 11.04.2024, with fruits, obs. R. Vassilev (Pl@ntNet: https://identify.plantnet.org/k-southeastern-europe/observations/1025468804).

A widespread species in other floristic regions of Bulgaria but not recorded so far from Tundzha Hilly Country (Kuzmanov 1979, Assyov et al. 2012).

Osyris alba L. (Santalaceae)
Specimen examined: Sakar Mt., near Mramor village quarry, Topolovgrad Municipality, on steep calcareous rocky

slope, 25.05.2024, with flowers, obs. M. Nenchev; same location, 170 m a.s.l., 42°01′50.4″ N and 26°25′00.4″ E, 17.07.2024, without generative organs, coll. R. Vassilev (BG-NMNHS-BOT-5904); same location, 25.05.2025, with flowers, coll. R. Vassilev and B. Filipova (BG-NMNHS-BOT-6066).

So far, this Mediterranean floristic element has been known only from Black Sea coast (Southern), Struma valley (Southern), Rhodopes (Eastern) and Strandzha floristic regions (Kuzmanov and Kozhuharov 1966, Assyov et al. 2012). This is the first report of the taxon for Tundzha Hilly County. The plant was first found by M. Nenchev in May 2024. Later in the same year, more than 100 vegetative stems were counted by R. Vassilev in an area of 80 m^2. In the spring of 2025 the authors found out that all the stems of the population produce male flowers. It can be assumed that they all belong to one male individual.

Pulsatilla montana (Hoppe) Rchb. (Ranunculaceae)
Specimen examined: Sakar Mt., along the tarmac road from Topolovgrad to Vishegrad peak, Polyanata locality, Topolovgrad Municipality, 750 m a.s.l., 42°00′04.5″ N and 26°19′13.4″ E, 14.04.2018, with fruits, coll. R. Vassilev and K. Bakardzhiev (BG-NMNHS-BOT-5163); Sakar Mt., near Haydushkata Dupka natural monument, Harmanli Municipality, 700 m a.s.l., 41°59′53.5″ N and 26°14′52.1″ E, 20.03.2020, with flowers, obs. V. Trifonov (pers. comm.); Sakar Mt., Golemiya Zdravets locality, Topolovgrad Municipality, 750 m a.s.l., 41°59’56.9″ N and 26°19’30.0″ E, 22.04.2023, with fruits, coll. A. Petrova and R. Vassilev (BG-NMNHS-BOT-5498); Svetiiliyski Heights: in grassy places in young forests in their eastern half, Yambol region, 02.05.1943, with flowers, coll. D. Jordanov (SO 23350, sub *Anemone pulsatilla* L.).

The floristic region of Tundzha Hilly Country has not been included in the distribution range of *Pulsatilla montana* so far (Jordanov and Kozhuharov 1970, Assyov et al. 2012, Stoyanov et al. 2022). Our observations as well as an older specimen from the herbarium of Sofia University demonstrate that the species is distributed in that floristic region.

Species confirmed for the Tundzha Hilly Country floristic region

Acer monspessulanum L. (Sapindaceae)
Specimen examined: Sakar Mt., near Ustrem monastery, Topolovgrad Municipality, on calcareous slope, 150 m a.s.l., 42°02′00.3″ N and 26°25′37.1″ E, 15.04.2018, with fruits, coll. R. Vassilev (BG-NMNHS-BOT-5510).

Cheschmedjiev (1967) reported *Acer monspessulanum* var. *rumelicum* Grsb. as new record in Sakar Mt. Curiously, Palamarev (1979) mentioned the region of Topolovgrad in the distribution range of *Acer monspessulanum* var. *commutatum* (C. Presi) Palam., but erroneously placed this record in Thracian Lowland. The species distribution in Tundzha Hilly Country was further omitted in later sources (Delipavlov et al. 2003, Kozhuharov 1992, Stoyanov et al. 2022). Thus, we confirm that the species indeed occurs in this floristic region.

Digitalis grandiflora Mill. (Plantaginaceae)
Specimen examined: Sakar Mt., along the asphalt road to Vishegrad peak, in deciduous forest, with flowers, 05.07.2017, obs. K. Bakardzhiev (Pl@ntNet: https://identify.plantnet.org/k-southeastern-europe/observations/1029615440); Sa-

kar Mt., by a dirt road in deciduous forest, with flowers, 550 m a.s.l., 42°01′24.8″ N and 26°19′01.9″ E, 24.06.2025, obs. G. Gerdzhikov (pers. comm.).

This mostly mountainous species has been considered widespread in Bulgaria (Asenov 1995, Delipavlov et al. 2003) but in the Conspectus of Bulgarian vascular flora (Assyov et al. 2012) the region of Tundzha Hilly Country has been omitted from its distribution range.

Tephroseris papposa (Rchb.) Schur subsp. ***papposa*** var. ***papposa*** (syn. *Senecio procerus* var. *montanus* Stoj.) (Asteraceae)
Specimen examined: Sakar Mt., clearing and mixed forest edge on Golemiya Zdravets locality, Topolovgrad Municipality, 750 m a.s.l., 41°59′55.9″ N and 26°19′29.2″ E, 24.05.2025, with flowers, coll. R. Vassilev (BG-NMNHS-BOT-6236).

The species has been indicated for Sakar Mt. by Podpéra (1902), sub *Senecio procerus* Griseb. Jordanov (1944) is also listing it (sub *Senecio procerus* (Grsb.) Cuph. var. *montanus* Stoj.) among the herbaceous plant species forming the undergrowth on the high slopes of Sakar Mt. In more recent Bulgarian plant identification keys (Andreev et al. 1992, Delipavlov et al. 2003, Stoyanov et al. 2022) as well as in the Conspectus of Bulgarian vascular flora (Assyov et al. 2012) the Tundzha Hilly Country floristic region has been omitted from the distribution range of the species. Our material is identified following Vladimirov (2012).

Vitis vinifera L. (syn. *Vitis sylvestris* C.C.Gmel.) (Vitaceae)
Specimen examined: Sakar Mt., near Mramor village quarry, Topolovgrad Municipality, along the asphalt road, 140 m a.s.l., 42°01′59.8″ N and 26°25′32.7″ E, 22.04.2023, without generative organs, coll. R. Vassilev and K. Bakardzhiev (BG-NMNHS-BOT-5499).

This liana species is considered widespread throughout the country by Delipavlov et al. (2003), especially in floodplain (longoz-type) forests along swamps and rivers (Gramatikov 1992). However, Jordanov and Peev (1979) and Assyov et al. (2012) are limiting its distribution to the floristic regions of Black Sea coast, North-Eastern Bulgaria, Stara planina (Central, Eastern), Rhodopes (Western, Eastern), Struma valley (Southern), Mesta valley, Thracian Lowland and Strandzha. We confirm the distribution of the species in Tundzha Hilly Country floristic region.

Species new for the Thracian Lowland floristic region

Asplenium adiantum-nigrum subsp. ***onopteris*** (L.) Heufl. (syn. *Asplenium onopteris* L.) (Aspleniaceae)
Specimen examined: Sakar Mt., near Golyamata Zvezda road junction, Harmanli Municipality, in cedar plantation, 240 m a.s.l., 41°58′12.9″ N and 26°00′0.9″ E, 08.02.2024, without generative organs, coll. R. Vassilev and B. Assyov (BG-NMNHS-BOT-5162).

The taxon is new for the Thracian Lowland floristic region. According to Ahtarov and Jordanov (1963), it has been registered already in Stara planina (Central, Eastern), Sredna gora, Pirin (Northern), Rhodopes (Central, Eastern) and Strandzha.

Legousia pentagonia (L.) Druce (Campanulaceae)
Specimen examined: Sakar Mt., near Studena village, Svilengrad Municipality, in fields, 370 m a.s.l., 41°55′37.1″ N and 26°23′18.0″ E, 30.05.2020, with flowers, coll. A. Petrova and R. Vassilev (BG-

NMNHS-BOT-5501).

New floristic region for the distribution of this species, included in the Red List of Bulgarian vascular plants (Petrova and Vladimirov 2009) as Vulnerable. As East-Mediterranean element it is known so far only from the Eastern Rhodopes floristic sub-region (Assyov et al. 2012).

Paragymnopteris marantae (L.) K. H. Shing (syn. *Cheilanthes marantae* (L.) Domin.) (Pteridaceae)
Specimen examined: Sakar Mt., in rock crevices, on steep slope on the right bank of the Tundzha River, 120 m a.s.l., 41°56′08.4″ N and 26°33′18.8″ E, 04.05.2025, without generative organs, coll. R. Vassilev (BG-NMNHS-BOT-6047); Sakar Mt., in rock crevices, in the foothills of Mount Paleokastro, 270 m a.s.l., 42°04′22.7″ N and 26°17′47.7″ E, 03.06.2025, with sporangia, obs. G. Gerdzhikov and B. Assyov.

This is the first report of the species for the Thracian Lowland floristic region. The first locality is situated within the territory of Zhdreloto na Reka Tundzha protected site (Register of protected areas in Bulgaria 2025). So far the species has been registered in Central Stara planina, Rila, Pirin, Belasitsa, Eastern Rhodopes, Strandzha, Eastern Stara planina, West Frontier Mountains, Southern Struma valley, Western and Central Rhodopes (Ahtarov and Jordanov 1963, Assyov et al. 2012).

Further research needed

Campanula rotundifolia gr. (Campanulaceae)
Specimen examined: Mount Dervishka mogila, Svilengrad Municipality, on metamorphic rocks, 650 m a.s.l., 41°54′53.7″ N and 26°21′01.7″ E, 30.05.2020, with flowers, coll. R. Vassilev and A. Petrova (BG-NMNHS-BOT-5500); Sakar Mt. on the rocks of Dervishka mogila, silicate, 07.10.1962, with flowers and fruits, coll. N. Vyhodtsevsky (SOM 105859, sub *Campanula rotundifolia* L.); Sakar Mt. – along rock cracks in the upper parts of Dervishka Mogila, Svilengrad region, 26.05.1963, with flowers, coll. D. Jordanov (SO 91294, sub *Campanula rotundifolia* L.).

During a field visit to Mount Dervishka Mogila we observed an interesting plant belonging to the *Campanula rotundifolia* group. This is a taxonomically difficult group, with seven species in the Bulgarian flora (Anchev 2012). As this species complex is known to have a more or less mountain distribution in Bulgaria, it is our belief that its discovery at relatively low altitude prompts a dedicated study including genetic analysis of DNA sequences.

Conclusion

Floristic data are reported for 16 taxa, new or confirmed for the Tundzha Hilly Country and Thracian Lowland floristic regions. Among them are four species with mainly Mediterranean range: *Acer monspessulanum*, *Aristolochia pallida*, *Legousia pentagonia* and *Osyris alba*. The three mainly mountain species: *Aconogonon alpinum*, *Aethionema saxatile* and *Geranium macrorrhizum* have isolated locations in those low mountain areas.

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