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ИЗДАНИЕ НА ПРИРОДОНАУЧНИОТ МУЗЕЈ НА РЕПУБЛИКА СЕВЕРНА МАКЕДОНИЈА  
BOTIM I MUZEUT TË SHKENCAVE DE NATYRËS E REPUBLIKËS SE MAQEDONISE SË VERIUT

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## First record of the fly orchid, *Ophrys insectifera* L. (*Orchidaceae*) for the flora of the Republic of North Macedonia

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### Abstract

*Ophrys insectifera* L. (Fly Orchid) of the family Orchidaceae has European distribution although it is rarer towards south. The distribution and ecology in the central Balkans is little known. It was recorded in Jasen protected area at Kozjak locality (north-western parts of North Macedonia) in May 2021. This is the first record for the species in the flora of the Republic of North Macedonia. Data on the distribution, habitat preferences, and population size are presented in the article.

**Key words:** *Ophrys insectifera* L. (Fly Orchid), new record, North Macedonia, habitat, distribution

### Introduction

Genus *Ophrys* L. is distributed from Macaronesia, Europe to Caucasus, and Mediterranean to South Turkmenistan (POWO 2024). Depending on the species concept genus *Ophrys* may contain nine phylogenetic species with numerous subspecies, 28 distinct species with fewer subspecies, or at least 350 "ethological" species (Delforge 2016; Bateman 2018; POWO 2024). The center of diversity of this genus is in the Mediterranean region (Pedersen and Faurholdt 2007; Delforge 2016). Based on the structural differences of the lip, i.e., according to the pollinating insect position on the lip during pseudocopulation, the genus is divided into two sections – *Pseudophrys* Godfery, with 12 species groups and *Euophrys* Godfery (nom. nud.), with 20 groups (Antonopoulos and Tsiftsis 2017).

The genus *Ophrys* in the Republic of North Macedonia is represented by five confirmed taxa: *Ophrys apifera* Huds., *Ophrys scolopax* subsp. *cornuta* (Steven) E. G. Camus, *Ophrys sphegodes* subsp. *sphegodes* Mill., *Ophrys sphegodes* subsp. *mammosa* (Desf.) Soó ex E. Nelson and *Ophrys helenae* Renz (Hristovski and Bouchet 2024).

*Ophrys insectifera* L. (Fly Orchid) of the family Orchidaceae (section *Euophrys*, species group

'*insectifera*') is a widespread but rare European species with mostly central European distribution which reaches central Scandinavia; it is considered very rare in the Mediterranean zone (Delforge 2016). Modelling of the species distribution suggests that it will disappear from South Europe and the Balkans, but it will gain areas in North Europe (Charitonidou et al. 2022). In May of 2021 a small population was found in the Jasen protected area. Thus, the aim of this paper is to present the first records of *Ophrys insectifera* in North Macedonia with notes on its habitat and threat status.

### Materials and Methods

Fieldwork at Kozjak locality within Jasen protected area was part of the short botanical excursion of S. Hristovski (Skopje), G. Tomović (Belgrade) and M. Niketić (Belgrade) through different parts of North Macedonia conducted in May 2021. The species was identified already in the field according to the distinguishing features by Delforge (2016). No specimens were collected due to its small population size. The same population was observed by S. Nakev on 24.05.2021 and by S. Hristovski and S. Nakev on 19.05.2024. Photographs of the plants were taken by

digital camera.

The floristic composition of the habitat was analysed during the site visits. Nomenclature of the species follows Euro+Med PlantBase and Plants of the World Online database (Euro+Med 2006; POWO 2024). The floristic composition was used for identification of the plant community and habitat and based on published phytocenological data for the area.

### Results and Discussion

*Ophrys insectifera* is a genetically isolated *Ophrys* species that belongs to the “*insectifera*” group. The species is sometimes considered as one taxon (Euro+Med 2006), or sometimes three subspecies are recognized (POWO 2024): nominotypical, *O. insectifera* subsp. *aymoninii* Breistr. an endemic of France and *O. insectifera* subsp. *subinsectifera* (C.E.Hermos. & Sabando) O.Bolòs & Vigo – endemic to Spanish and French Pyrenees. The population from North Macedonia shares the characteristics of nominal subspecies: *Ophrys insectifera* subsp. *insectifera*. Other

authors treat these three taxa as distinct species: *O. insectifera* L., *O. aymoninii* (Breistr.) Buttler and *O. subinsectifera* C.E.Hermos. & Sabando (Delforge 2016). The results of molecular analysis indicated a recent diversification in the three extant Fly Orchid taxa with presence of isolated populations on the Balkans (Triponez et al. 2013).

*Ophrys insectifera* is an easily recognizable species (Fig. 1). The following description including the dimensions is only from literature (Fay et al. 2015; Delforge 2016). It is perennial plant, 15-60(–80) cm tall. Tubers globose. Stem with 2-5 basal leaves, glabrous, and 1–2 small, sheathing (stem) leaves. Inflorescence lax, with 2-15(–20) flowers. Sepals subequal, pointed, yellow-green, hooded at tips, 6-9mm long, 3-4mm wide. Petals linear-filiform, purple-brown, velvety, 4–7mm long. Labellum rich brown, velvety, three-lobed, longer than wide, (8-)9-12mm long, (5-)6–10mm wide; lateral lobes elongated, rounded at tip; median lobe divided apically in two triangular lobes. Speculum is iridescent blue. Chromosome number  $2n = 36$ . Flowers



Figure 1. Fly Orchid, *Ophrys insectifera* L., Kozjak, 22.05.2021 and 19.05.2024 (photo: S. Hristovski)



Figure 2. Distribution of *Ophrys insectifera* L. (Fly Orchid) in the Republic of North Macedonia.

from (April) May to July.

The pollination of flowers of *Ophrys insectifera* is achieved by sexual deception i.e. pseudocopulation like most of the species in genus *Ophrys*. However, *Ophrys insectifera* is one of the few *Ophrys* species which is pollinated by male wasps while others species are pollinated by solitary bees (Pridgeon et al. 2001). Primary pollinators are male digger wasps *Argogorytes* (Hymenoptera: Sphecidae): *A. mystaceus* (L.) and *A. fargei* (Schuckard) (Fay et al. 2015; Delforge 2016). The scent that is produced to attract pollinators differs among different populatios in the amounts of aliphatic hydrocarbons, methyl esters, short chain aliphatic 1-alcohols and monoterpene alcohols (Borg-Karlson et al. 1993).

#### *Distribution in North Macedonia*

*Ophrys insectifera* was observed at the following locality (Fig. 2):

Karadzica, Rudine, Kozjak, N41.889568°, E21.226139° (UTM EM13), 1060 m a.s.l., 22.05.2021, leg. S. Hristovski, G. Tomović, M. Niketić, (photographed, not collected)

The same population was observed by S. Nakev on 24.05.2021 and by S. Hristovski and S. Nakev on 19.05.2024 when 7 and 12 specimens were counted, respectively.

#### *Habitat and ecology*

The habitats of the species in its areal of distribution are usually grasslands, roadside verges, forest edges open forests but also wetlands, and dark forests

on calcareous to neutral substrates, sometimes acidic, up to 1600 m a.s.l. (Fay et al. 2015; Delforge 2016). In the Balkan countries (Serbia and Bulgaria) it was mostly found on limestone substrates in communities of *Ostrya carpinifolia* and other low-growing deciduous woods and rarely in grasslands, forest clearings, etc. (Peev et al. 2015; Djordjević et al. 2017).

The specimens on Kozjak develop in the community *Globulario-Centaureetum grbavacensis* Matevski, Čarni, Čušterevska, Kostadinovski et Mucina, 2015 (Matevski et al. 2015). Dominant plant species were *Anthyllis aurea*, *Centaurea grbavacensis*, *Fumana procumbens*, *Juniperus oxycedrus*, accompanied by: *Globularia cordifolia*, *Ephedra major*, *Paronychia chionaea*, *Poa bulbosa*, *Matthiola fruticulosa* subsp. *vallesiaca*, *Helianthemum canum*, *Iris pumila*, *Thymus skopjensis.*, *Muscari racemosum*, *Thalictrum minus*, *Carex liparocarpos*, *Genista januensis*, *Achillea ageratifolia* subsp. *serbica*, *Saxifraga federici-augusti* subsp. *grisebachii*, *Scorzonera austriaca*, *Viola herzogii*, *Haplophyllum albanicum*, *Achillea fraasii*, *Thesium linophyllum*, *Hypericum rumeliacum*, *Dactylis glomerata*, *Onosma heterophylla*, *Sesleria* cf. *commosa*, *Salvia ringens*, *Silene conica*, *Saponaria bellidifolia*, *Linum austriacum*, *Vincetoxicum hirundinaria*, *Globularia bisnagarica*, *Asphodeline lutea*, *A. taurica*, *Asphodelus albus*, *Papaver dubium*, *Ajuga laxmannii*, *Melampyrum arvense*, etc. Scattered patches with trees are also present (*Ostrya carpinifolia*, *Fraxinus ornus*, *Syringa vulgaris*, *Buxus sempervirens*, *Sorbus aria*, *Populus tremula*, *Quercus petraea*, *Cotoneaster nebrodensis*, *Pinus nigra*, *Pyrus communis* subsp. *pyraster*, *Cornus mas*, *Crataegus monogyna*).

The following Orchid taxa were also present at the same locality: *Neotinea ustulata* var. *ustulata* (L.) R.M.Bateman, Pridgeon & M.W.Chase, *Neotinea tridentata* (Scop.) R.M.Bateman, Pridgeon & M.W.Chase, *Anacamptis coriophora* (L.) R.M.Bateman, Pridgeon & M.W.Chase, *Anacamptis pyramidalis* (L.) Rich., *Ophrys sphegodes* subsp. *mammosa* (Desf.) Soó ex E. Nelson, *Ophrys scolopax* subsp. *cornuta* (Steven) E. G. Camus, *Orchis purpurea* Huds. and *Orchis mascula*





Figure 3. Habitat of *Ophrys insectifera* L., Kozjak, 19.05.2024 (photo: S. Hristovski)

subsp. *mascula* (L.) L. *Platanthera chlorantha* (Custer) Rchb. and *Cephalanthera damasonium* (Mill.) Druce. were recorded in some of the small groups of trees. In total, 11 orchid species were recorded.

The habitat of *Ophrys insectifera* on Kozjak is actually calcareous grassland of Helleno-Balkan *Satureja montana* steppes (code E1.21 according to the EUNIS classification, <https://eunis.eea.europa.eu/habitats/1845>) that develops on dolomite bedrock (Fig. 3). According to the EU Habitats Directive this habitat is Semi-natural dry grasslands and scrubland facies on calcareous substrates (*Festuco-Brometalia*). This habitat can be considered as priority (\* important orchid sites) due to the presence of several Orchid species, including the single known locality of *Ophrys insectifera* in North Macedonia.

#### Distribution and threat status

*Ophrys insectifera* is rare species throughout its range in Europe with isolated populations on the Balkans. It is known from most of the Balkan countries: Bulgaria (Tsvetanov et al. 2005), Albania (Barina et al. 2018), Greece (Strid 2024), Serbia (Djordjević et al. 2021), Bosnia and Herzegovina (Šabanović et al. 2021), Croatia (Nikolić 2020) and Slovenia (Pezzetta 2018). So far, we are not aware of records from Kosovo and Montenegro.

It is included in the Appendix II of the CITES convention which covers species not necessarily threatened with extinction, but in which trade must be controlled in order to avoid utilization incompatible

with their survival (CITES 2023).

The species is assessed as Least Concern according to the global assessment in the IUCN red list of Threatened species (Rankou 2011). However, it is declining in many countries. For example, the status of Least Concern was attributed to the species in the United Kingdom in 1999 but later on, due its population decline it received a status of a Vulnerable species (Fay et al. 2015).

In Bulgaria it is known from four locations, each of them with less than 25 individuals, hence assessing the species as Critically Endangered: CR [C2a(i); D] (Peev et al. 2015). *Ophrys insectifera* was not evaluated separately in the red list assessment of Albania but all of the *Ophrys* species were considered as Vulnerable – VU [A1b]. In Croatia it was also assessed as Vulnerable: VU (NT) [A4c] (Nikolić and Topić 2005). The status in Serbia was not presented in the Red Data Book of the Flora of Serbia (Stevanović 1999); but later on its status was assessed by Djordjević et al. (2017) as Endangered – EN B2ab(iii); D.

*Ophrys insectifera* in North Macedonia is confined to only one locality with less than 50 individuals. Consequently its status can be assessed as **Critically Endangered - B1a+2a; C2a(i,ii); D**.

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## New distribution data of twenty rare or insufficiently recorded species in the flora of North Macedonia

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### Abstract

New distribution data are presented for twenty species in the vascular flora of North Macedonia: *Ambrosia artemisiifolia*, *Artemisia annua*, *Crepis paludosa*, *Jacobaea erucifolia*, *Lactuca quercina*, *Petasites albus*, *Pilosella onegensis*, *P. rothiana*, *Senecio sylvaticus*, *Tephrosia wagneri*, *Urospermum picroides* (Asteraceae); *Carex paniculata* (Cyperaceae); *Danthonia alpina* (Poaceae); *Epilobium alpestre* (Onagraceae); *Euphorbia oblongata* (Euphorbiaceae); *Linum elegans* (Linaceae); *Melampyrum cristatum* (Scrophulariaceae); *Myosotis nemorosa* (Boraginaceae); *Rubus wahlbergii* (Rosaceae); *Succisa pratensis* (Dipsacaceae). Most of the listed plants are rare in the country, while others, although having a wider distribution in certain regions, were poorly known due to being largely overlooked in floristic studies. A distribution map for each treated taxon and photographs of live or herbarium specimens for most of them are provided.

**Keywords:** distribution data, localities, North Macedonia, species, vascular flora.

### INTRODUCTION

Macedonian flora has been continuously studied for nearly two centuries, beginning with the pioneering work of A. Griesbach, published in 1844. To date, the estimated number of recorded species exceeds 3,200, making the flora of this small country among the richest in Europe. In addition to taxa with a well-known broad distribution, numerous others are known only from one or a few localities mentioned in the literature. These include various categories, ranging from rare plants to those with broader distributions, which have been overlooked in floristic studies. Such oversights have occurred for various reasons, including the limited focus of botanists on certain regions or taxonomic groups and difficulties in detecting and identifying specific taxa. Based on the author's fieldwork and laboratory studies, this article aims to enhance the understanding of the distribution of some of these plants in the country. Eleven of the discussed species belong to the family Asteraceae, while the families Boraginaceae, Cyperaceae, Dipsacaceae, Euphorbiaceae, Linaceae, Onagraceae, Poaceae, Rosaceae, and Scrophulariaceae are each represented by one species. All but one species are native to North Macedonia.

### MATERIALS AND METHODS

Fieldwork was conducted from 2012 to 2024 across various regions of North Macedonia. Plant material was collected from each reported locality and herbarized using standard procedures, often accompanied by photographs of live specimens. Herbarium specimens are labeled with data on location (usually including GPS coordinates), habitat types, and population characteristics and are stored in the author's private herbarium collection. Species identification was performed according to Matevski & Melovski (2010), Micevski (2001, 2005), Tutin et al. (1964–1980), Weber (1995), and Zahn (1921–1923, 1932–1930). Relevant floristic literature on North Macedonia was reviewed to compile published distribution data on the studied species.

### RESULTS AND DISCUSSION

***Ambrosia artemisiifolia* L. (Asteraceae) (Figs. 1, 2)**  
Bitola, railway station, 16.8.2019, 41.020096°N, 21.342547°E, leg. & det. A. Teofilovski.

Native to North America, this species is globally recognized as highly invasive, but fortunately, it has only limited occurrences in North Macedonia so far.

Two previous records include Skopje (Ilinden) (Milkovska et al. 2013) and Tetovo (railway station) (Teofilovski 2017, leg. A. Teofilovski, 30.8.2009). The status of the small population recorded in Bitola has not been recently reassessed, while the Tetovo population has declined.



Fig. 1. *Ambrosia artemisiifolia*, habitus, Bitola, photo. A. Teofilovski.



Fig. 2. Distribution of *Ambrosia artemisiifolia* in North Macedonia, ● - new data, ● - author's published data, ○ - other literature data.

***Artemisia annua* L. (Asteraceae) (Figs. 3, 4)**

Gostivar, Stenče village, near house wall, 560 m, 41.876102°N, 21.001336°E, 3.11.2016 leg. & det. A.

Teofilovski; Tetovo, waste place in the urban area, 42.003280°N, 20.973920°E, 24.10.2016, leg. & det. A. Teofilovski.

In the flora of North Macedonia, this annual species is quite rare. After the first reports of Urumov (1923) for Kriva Palanka and Kratovo, the only subsequent report was from a waste place in the vicinity of Tetovo (Kljukovo) (Matevski & Teofilovski 2004).



Fig. 3. *Artemisia annua*, habitus, Stenče village, Gostivar, photo A. Teofilovski.

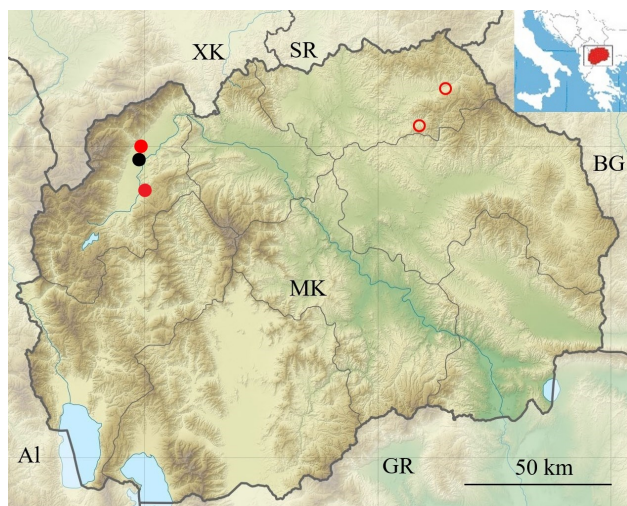


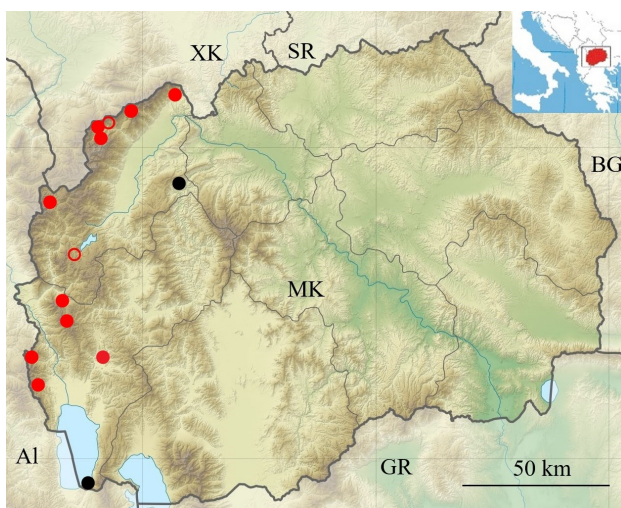
Fig. 4. Distribution of *Artemisia annua* in North Macedonia, ● - new data, ● - author's published data, ○ - other literature data.



***Carex paniculata* L. (Cyperaceae) (Fig. 5)**

Ohrid, Belčiško Blato, 773 m, 41.317992°N, 20.820892°E, 9.6.2019, leg. & det. A. Teofilovski; Jablanica Mt., Lakavica village, 1380 m, 41.324661°N, 20.519831°E, 13.7.2016, leg. & det. A. Teofilovski; Jablanica Mt., Gorna Belica village, 1630 m, 41.225853°N, 20.538272°E, 12.7.2017, leg. & det. A. Teofilovski; Stogovo Mt., Gari village, 1710 m, 41.453487°N, 20.674837°E, 30.8.2014, leg. A. Teofilovski & Z. Nikolov, det. A. Teofilovski; Stogovo Mt., Ehloec village, 1670 m, 41.435150°N, 20.732419°E, 30.7.2020, leg. & det. A. Teofilovski; Šar Mts., Ljuboten, 1640 m, 42.185556°N, 21.127486°E, 24.7.2013, leg. A. Teofilovski & Z. Nikolov, det. A. Teofilovski; Šar Mts., Bistrica River gorge, 1650 m, 42.122322°N, 20.977392°E, 18.6.2018, leg. & det. A. Teofilovski; Šar Mts., Ceripašina, 1960 m, 42.021541°N, 20.836024°E, 16.8.2012, leg. & det. A. Teofilovski; Šar Mts., Bozovce village, 1625 m, 42.037656°N, 20.788461°E, 20.9.2012, leg. & det. A. Teofilovski; Korab Mt., Štirovica, 41.809386°N, 20.615508°E, 1489 m, 23.7.2023, leg. A. Teofilovski & D. Mandzukovski, det. A. Teofilovski.

This *Carex* species is sporadically distributed in the western parts of North Macedonia, occurring in wetlands from the lowlands to the subalpine belt. In the floristic literature, it has been largely overlooked, with only the following few localities mentioned: Šar Mountains (Kobilica) (Bornmüller, 1928), Bistra Mt. (Toni Voda) (Micevski, 1994), Suva Gora Mt. (Lukovica), and Ohrid (Sveti Naum) (Teofilovski, 2011).

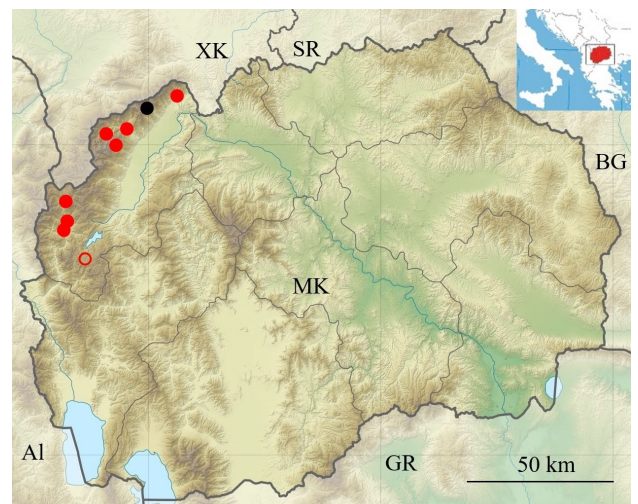


**Fig. 5.** Distribution of *Carex paniculata* in North Macedonia, ● - new data, ● - author's published data, ○ - other literature data.

***Crepis paludosa* (L.) Moench (Asteraceae) (Fig. 6)**

Korab Mt., Ribnička River gorge, wet place, 904 m, 41.712485°N, 20.645964°E, 1.7.2023, leg. A. Teofilovski & D. Mandzukovski, det. A. Teofilovski; Radika River gorge, wet place, 970 m, 41.735404°N, 20.671964°E, 12.7.2023, leg. & det. A. Teofilovski; Šar Mts., Adžina Reka, forest margin, 1477 m, 41.819863°N, 20.654204°E, 12.7.2023, leg. & det. A. Teofilovski; Šar Mts., Kaptaza Jelovjane, wet place, 1385 m, 12.6.2015, observ. A. Teofilovski; Šar Mts., near Pena River, wet rocky place, 855 m, 42.055300°N, 20.908098°E, 17.7.2018, leg. & det. A. Teofilovski; Šar Mts., south of Bozovce village, near stream, 1408 m, 42.042576°N, 20.819180°E, 6.7.2024, leg. A. Teofilovski, V. Matevski & Z. Nikolov, det. A. Teofilovski; Šar Mts., Vratnička River, moist place, 800 m, 42.155237°N, 21.119454°E, 4.6.2015, leg. & det. A. Teofilovski.

In the literature, this species was reported only from Bistra Mt. (Moliter) (Micevski 1994), and Šar Mts. (Čaušica) (Teofilovski 2011, as *C. paludosa* var. *glabra* Diklić & Nikolić). All examined plants from the Macedonian populations deviate from typical *C. paludosa* by consistently having glabrous involucre, a characteristic also observed in Albanian and Serbian populations (Diklić & Nikolić 1986, Meyer 2011).



**Fig. 6.** Distribution of *Crepis paludosa* in North Macedonia, ● - new data, ● - author's published data, ○ - other literature data.

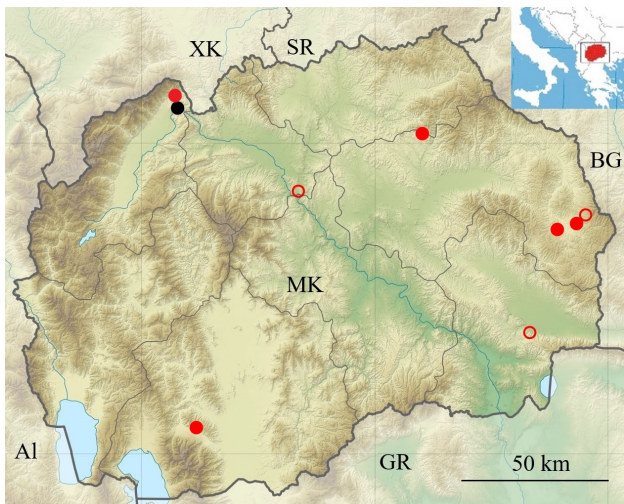
***Danthonia alpina* Vest (Poaceae) (Fig. 7)**

= *D. calycina* (Vill.) Reichenb. = *D. provincialis* DC.

Bitola, Gorno Srpce village, 1060 m, 41.090419°N, 21.223383°E, 20.6.2019, leg. & det. A. Teofilovski;

Maleševo Mts., Vladimirovo village, 971 m, 41.695475° N, 22.779917°E, 25.5.2017, leg. & det. A. Teofilovski; Maleševo Mts., Smojmirovo village, 920 m, 41.735431° N, 22.856428°E, 22.5.2017, leg. & det. A. Teofilovski; Osogovo Mt., Dobrevo village, 771 m, silicate, 42.036322°N, 22.201253°E, 26.6.2017, leg. & det. A. Teofilovski; Tetovo, Rogačevo village, serpentine, 751 m, 42.144181°N, 21.156039°E, 22.5.2015, leg. & det. A. Teofilovski.

This South European and Southwest Asian species has a sporadic distribution in the country and is mentioned in the literature from the following localities: Katlanovo (Šmarda 1968, as *D. provincialis*), Strumica (Soška 1953, as *D. calycina*), Pehčevo (Micevski 1978, as *D. calycina*), and Tetovo (Orašje) (Teofilovski 2011). In the recorded localities, it inhabits dry, grassy areas, exclusively on non-calcareous geological substrates.



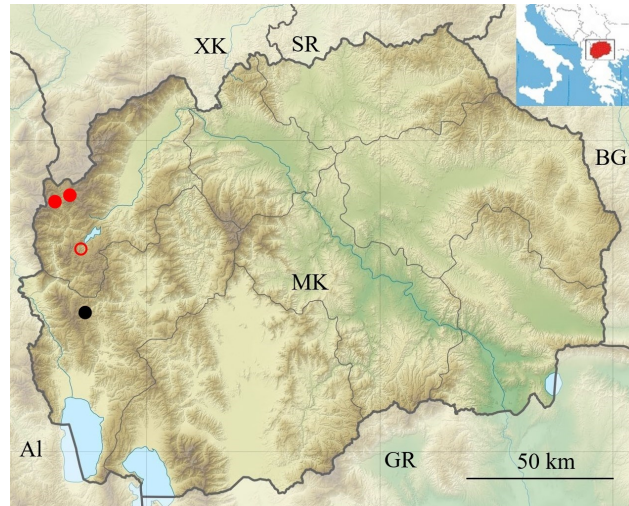
**Fig. 7.** Distribution of *Danthonia alpina* in North Macedonia, ● - new data, ● - author's published data, ○ - other literature data.

***Epilobium alpestre* (Jacq.) Krock. (Onagraceae) (Fig. 8)**

Šar Mountains, Adžina Reka, moist place, 1477 m, 41.821380°N, 20.664053°E, 12.7.2023, leg. & det. A. Teofilovski; Korab Mt., Štirovica, wet place, 1485 m, 41.809801°N, 20.615502°E, 23.7.2023, leg. & det. A. Teofilovski.

A rare *Epilobium* species in the Macedonian flora, previously reported only from Bistra Mt. (Careva Češma) (Micevski 2001) and Stogovo Mt. (Ehloec) (Teofilovski 2021).

***Euphorbia oblongata* Griseb. (Euphorbiaceae) (Figs. 9, 10)**



**Fig. 8.** Distribution of *Epilobium alpestre* in North Macedonia, ● - new data, ● - author's published data, ○ - other literature data.

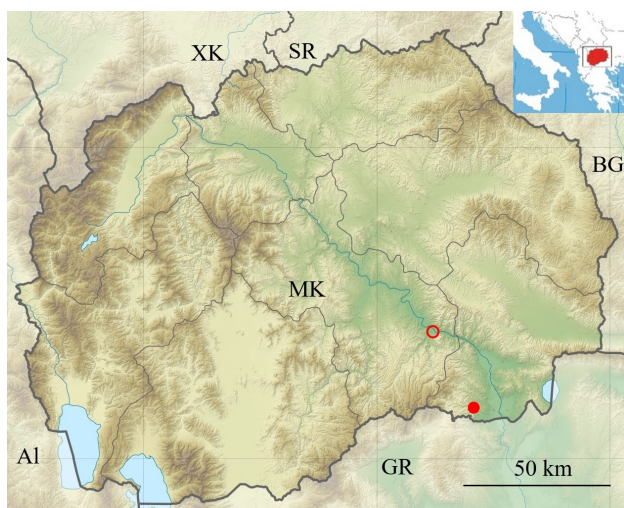
Gevgelija, Novo Konsko, near road to Konsko village, 187 m, 41.156161°N, 22.431531°E, 2.6.2023 leg. & det. A. Teofilovski.

This Balkan-Suothwest Asian perennial *Euphorbia* is a rare species in the flora of North Macedonia. The only previously reliable report of its presence in the country comes from Micevski (1998), who cited it from the vicinity of Demir Kapija. This author deemed the report from Skopska Crna Gora Mt. (Pržalj) (Grupče, 1958) doubtful due to the absence of supporting



**Fig. 9.** *Euphorbia oblongata*, habitus with details of fruits and indumentum of the stem, Novo Konsko vilage, Gevgelija, photo A. Teofilovski.





**Fig. 10.** Distribution of *Euphorbia oblongata* in North Macedonia, ● - new data, ○ - literature data.

specimens in Grupče's herbarium. The recorded population grows in a shrubby area dominated by *Carpinus orientalis*.

***Jacobaea erucifolia* (L.) G. Gaertn. & al. (Asteraceae) (Figs. 11, 12)**

Osoj Mt., southeast of Merovo village, forest clearing, limestone, 1190 m, 41.916737°N, 21.173282°E, 13.9.2022, leg. & det. A. Teofilovski.

This Euro-Siberian species is rare in the flora of North Macedonia and has not been recently confirmed. The literature references include Bitola (Grecescu, 1897), Kavadarci (Resava) (Jurišić, 1923), and Skopska Crna Gora Mt. (Pešter, Ramno) (Grupče, 1958).

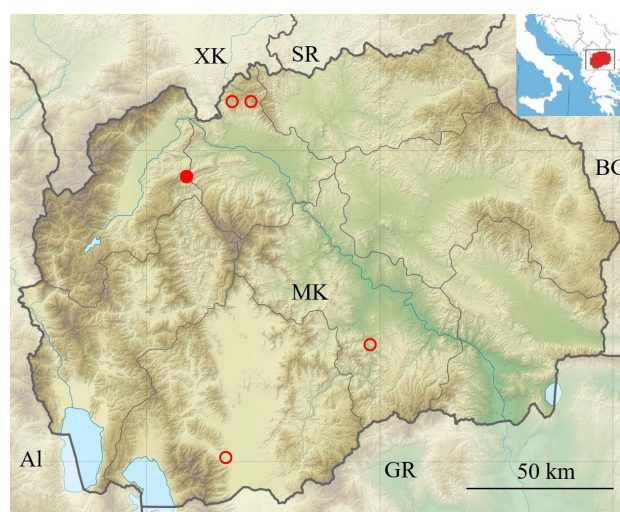
***Lactuca quercina* L. (Asteraceae) (Figs. 13, 14)**

Berovo, south of Avramski Kolibi, roadside, 1150 m, 41.608668°N, 22.845612°E, 23.7.2016, leg. & det. A. Teofilovski; Belasica Mt., Bansko village, 1367 m, 41.330537°N, 22.782694°E, 22.09.2018, leg. & det. A. Teofilovski; Suva Gora Mt., Lukovica village, meadow margins, 1030 m, 15.7.2020, 41.889769°N, 21.153719°E, leg. & det. A. Teofilovski; Makedonski Brod, Zvečan village, shrubby place, silicate, 1070 m, 41.701753°N, 21.122553°E, 16.8.2020, leg. & det. A. Teofilovski; Bistra Mt., northwest of Ivančišta village, roadside, 1310 m, 41.482066°N, 20.776505°E, 11.8.2020, leg. & det. A. Teofilovski; Karaorman Mt., 41.356817°N, 20.799017°E, 17.8.2021, photo. A. Teofilovski; Baba Mt., Palisnopje, roadside, 41.036358°N, 21.190774°E, 10.7.2024, leg. & det. A. Teofilovski.

This species likely has a sporadic distribution across



**Fig. 11.** *Jacobaea erucifolia*, habitus, Merovo village, Osoj Mt., photo. A. Teofilovski.



**Fig. 12.** Distribution of *Jacobaea erucifolia* in North Macedonia, ● - new data, ○ - literature data.

much of the country but seems to have been overlooked in recent floristic studies. In the literature, it is reported from Golešnica Mt. (Crvena Voda) (Bornmüller 1926, sub. *L. sagittata* Waldst. & Kit.), Žeden Gorge (Orašje) (Soška 1938), Skopska Crna Gora Mt. (Sastance) (Grupče 1958), between Veles and Demir Kapija (Nikolovski & Cirimotić 1958), and Bitola (Brusnik) (Todorovski 1969). The new records near Berovo and in Belasica Mt. are the first from the eastern part of the country.



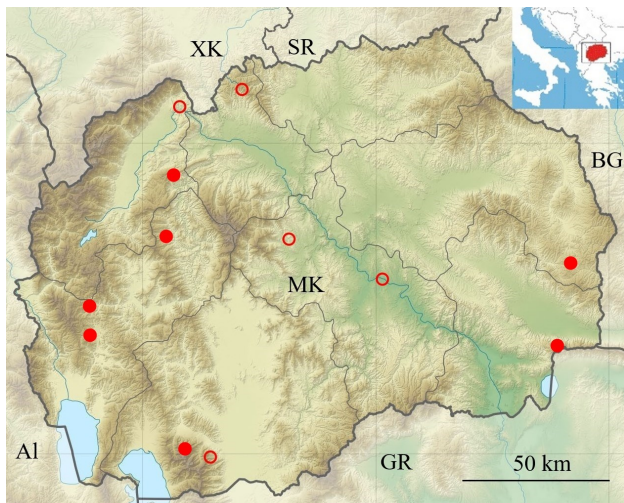


**Fig. 13.** *Lactuca quercina*, part of synflorescence, Lukovica village, Suva Gora Mt., photo. A. Teofilovski.

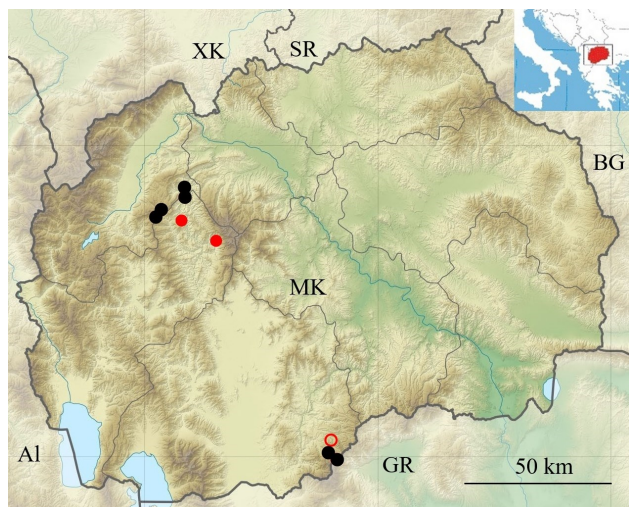
from Nidže Mt. (Zmejca, Suvi Dol, Belo Grotlo) (Micevski 2005, as *L. elegans* var. *iberidifolium*; Teofilovski 2011) and Suva Gora Mt. (Dupen Kamen, Taul, Lukovica, Gurgurnica) (Teofilovski 2011).



**Fig. 15.** *Linum elegans*, habitus, Trebovle village, Makedonski Brod, photo. A. Teofilovski.



**Fig. 14.** Distribution of *Lactuca quercina* in North Macedonia, ● - new data, ○ - literature data.



**Fig. 16.** Distribution of *Linum elegans* in North Macedonia, ● - new data, ● - author's published data, ○ - other literature data.

***Linum elegans* Spruner ex Boiss. (Linaceae) (Figs. 15, 16)**

= *L. elegans* var. *iberidifolium* (Aucher) Hayek

Makedonski Brod, Trebovle village, *Pinus nigra* forest, limestone, 1000-1100 m, 41.773167°N, 21.126578°E, 25.5.2016, leg. A. Teofilovski; Dautica Mt., sources of Belička River, *Pinus nigra* forest, limestone, 650 m, 41.677753°N, 21.312714°E, 15.6.2016, leg. & det. A. Teofilovski.

This Balkan endemic has a narrow distribution in North Macedonia and was previously reported only

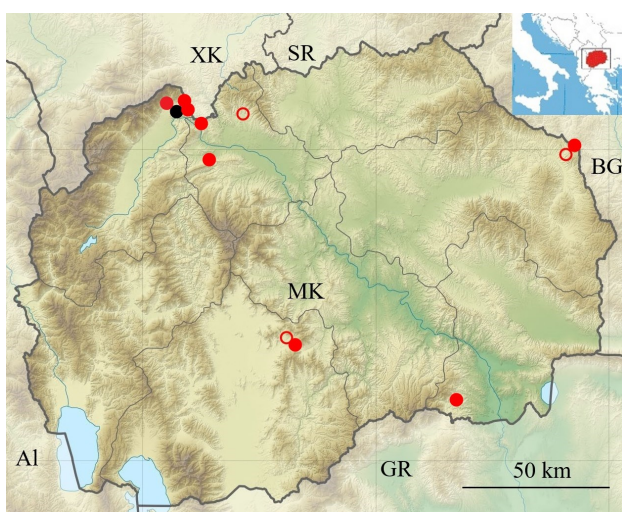
***Melampyrum cristatum* L. (Scrophulariaceae) (Fig. 17)**

Šar Mts., Belovište village, grassy place, silicate, 820 m, 42.140953°N, 21.099353°E, 26.6.2013, leg. & det. A. Teofilovski; Tetovo, Jažince village, shrubby place, serpentine, 748 m, 42.152818°N, 21.180707°E,



1.7.2013, leg. & det. A. Teofilovski; Skopje, Raduša village, grassy place, serpentine, 510 m, 16.6.2013, leg. & det. A. Teofilovski; Skopje, Karaula Čaška, 524 m, 42.076719°N, 21.276572°E, 13.6.2013, leg. & det. A. Teofilovski; Osoj Mt., between Matka and Arnakija villages, shrubby place, 540 m, 41.975237°N, 21.286319°, 6.7.2013, leg. & det. A. Teofilovski; Berovo, Smilanci village, forest clearing, silicate, 940 m, 41.664816°N, 22.666401°E, 16.5.2017, leg. A. Teofilovski; Delčevo, Zvegor village, black pine forest, limestone, 870 m, 41.964089°N, 22.818461°E, 24.6.2020, observ. & photo. A. Teofilovski; Prilep, Pletvar, grassy place, 17.6.2019, leg. & det. A. Teofilovski; Gevgelija, Konsko village, oak forest, 41.183809°N, 22.341042°E, 586 m, 2.6.2023, leg. & det. A. Teofilovski.

A Eurasian species with a limited distribution in North Macedonia, absent from much of its territory. In the literature it is cited from Skopska Crna Gora Mt. (between Radišani and Pobužje) (Grupče, 1958), Prilep (Sivec) (Todorovski, 1969), Delčevo (Arnautski Grob) (Džekov & Rizovski, 1978), and Tetovo (Gorno Orašje) (Teofilovski, 2011).



**Fig. 17.** Distribution of *Melampyrum cristatum* in North Macedonia, ● - new data, ● - author's published data, ○ - other literature data.

***Myosotis nemorosa* Besser (Boraginaceae) (Figs. 18, 19)**

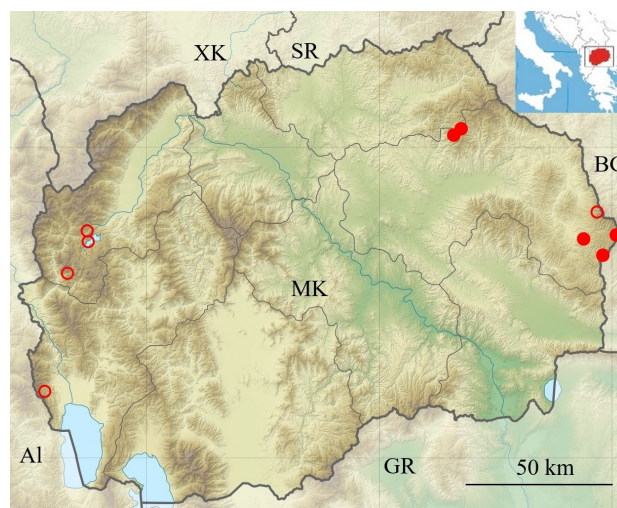
Berovo, northwest of Berovo Lake dam, 980 m, 41.683209° N, 22.890492°E, 30.5.2017, leg. & det. A. Teofilovski; Berovo, Čengino Kale, 41.720864°N, 23.028832°E, 1690 m, leg. A. Teofilovski & D. Mandzu-

kovski, det. A. Teofilovski; Berovo, Klepalo, 1340 m, 41.650762°N, 22.981502°E, 13.6.2019, leg. A. Teofilovski & D. Mandzukovski, det. A. Teofilovski; Osoгово Mt., northeast of Ponikva, wet place, 1452 m, 42.043966°N, 22.359048°E, 15.6.2021, leg. & det. A. Teofilovski; Osoгово Mt., west of Ponikva, 1421 m, 42.040125°N, 22.338401°E, 16.6.2021, leg. & det. A. Teofilovski.

A rare wetland *Myosotis*, previously reported from Kavadarci (Alšar) (Degen & Döerfler, 1897), Mavrovo (Mavrovi Anovi, Vrben, Mavrovsko Pole), Bistra Mt. (Galičnik), Jablanica Mt. (Gorna Belica), and Pehčevo (Buković) (Matevski & Melovski 2010).



**Fig. 18.** *Myosotis nemorosa*, habitus, Ponikva, Osogovo Mt., photo. A. Teofilovski.



**Fig. 19.** Distribution of *Myosotis nemorosa* in North Macedonia, ● - new data, ○ - literature data.

***Petasites albus* (L.) Gaertn. (Asteraceae) (Figs. 20, 21)**

Berovo, near Bezgaštevka River, 765 m, 41.608411°N, 22.760717°E, 15.10.2016, leg. & det. A. Teofilovski; Berovo, near Zamanička River, 1085 m, 41.646479°N, 22.914991°E, photo. A. Teofilovski;

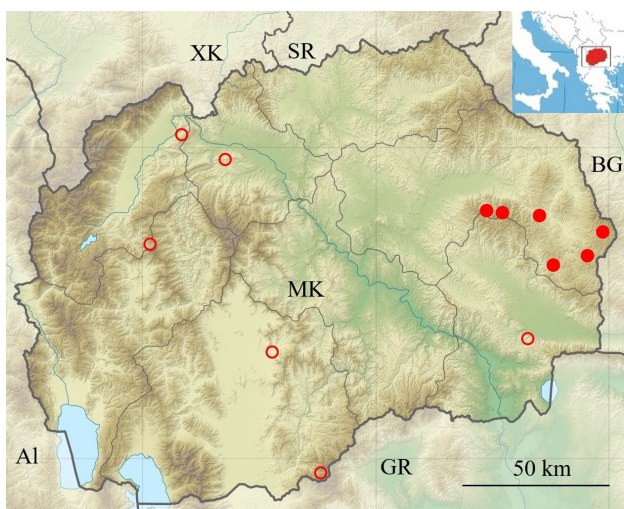


Pehčevo, Ramna Reka, 1150 m, 12.6.2019, leg. & det. A. Teofilovski; Vinica, near Osojnica river, alder forest, 785 m, 41°47'49.09"N, 22°40'33.59"E, 18.6.2018, photo. A. Teofilovski; Plačkovica Mt., near road to Lisec, 1200 m, 16.6.2018, leg. & det. A. Teofilovski; Plačkovica Mt., near road to Momin Preslap, 1200 m, 17.6.2018, photo. A. Teofilovski.

This species has a sporadic distribution in some parts of North Macedonia, with several localities mentioned, mostly in older literature: Vodno (Vandas 1909), Nidže Mt., Prilep (Velenovski 1922), Strumica (Sv. Ilija) (Rudski 1943), Žeden Mt. (Matvejeva 1965), and Dobra Voda Mt. (Matevski 1995).



**Fig. 20.** *Petasites albus*, habitus, Ramna Reka, Pehčevo, photo. A. Teofilovski.



**Fig. 21.** Distribution of *Petasites albus* in North Macedonia, ● - new data, ○ - literature data.

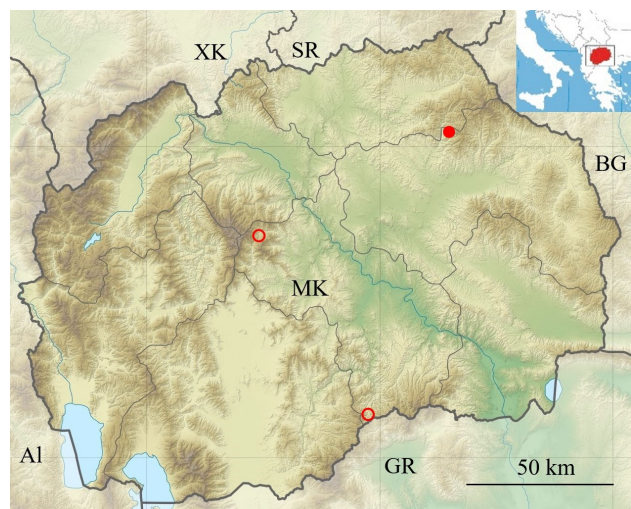
***Pilosella onegensis* Norrl. (Asteraceae) (Figs. 22, 23)**  
 ≡ *Hieracium pratense* subsp. *silvicola* (Fr.) Zahn

Osogovo Mt., east of Jamište village, grassy place, silicate, 42.052970°N, 22.318338°E, 1465 m, 10.6.2021, leg. & det. A. Teofilovski; Osogovo Mt., northeast of Jamište village, grassy place, silicate, 1272 m, 42.063327°N, 22.314169°E, 10.6.2021, 1.7.2021, leg. & det. A. Teofilovski.

This species has a wide Eurasian distribution but is rare and recently not confirmed in North Macedonia. The only, literature data refer to the localities of Alšar (Zahn 1921–1923, as *Hieracium pratense* subsp. *eu-silvicolum* f. *alcharicum* Zahn), and Golešnica Mt. (Pepelak) (Behr et al., 1937, as *H. pratense* subsp. *eu-silvicolum* Zahn).



**Fig. 22.** *Pilosella onegensis*, plants collected near Jamište village, Osogovo Mt., photo. A. Teofilovski.



**Fig. 23.** Distribution of *Pilosella onegensis* in North Macedonia, ● - new data, ○ - literature data.



***Pilosella rothiana* (Wallr.) F. W. Schultz & Sch. Bip.** (Asteraceae) (Figs. 24, 25)

≡ *Hieracium rothianum* Wallr. ≡ *H. setigerum* subsp. *rothianum* (Wallr.) Nyman

Dautica Mt., Belica village, 630 m, limestone, 41.677588°N, 21.312392°E, 15.6.2016, leg. & det. A. Teofilovski; Makedonski Brod, Kalugjerec village, dry abandoned meadow, 470 m, 41.668191°N, 21.251543°E, 7.6.2016, leg. A. Teofilovski; Ogražden Mt., Drvoš village, 770 m, 41.524067°N, 22.766237°E, 29.5.2020, leg. & det. A. Teofilovski.

Broadly distributed across much of Europe and Asia Minor, this species is rare in the Balkan Peninsula, where it has been reported from only a few localities in North Macedonia, Serbia, and Bulgaria (Zahn 1922–1930, Stojanov et al. 1966, Gajić 1975, as *Hieracium rothianum*). In North Macedonia, it has not been recently reported, although in the older literature is mentioned from several locations: Skopje (Treska River gorge), Skopska Crna Gora Mt., Bitola (Crničani), Mariovo (Labinica), and Demir Kapija (Kalugjer, Bel



Fig. 24. *Pilosella rothiana*, herbarium specimen from Kalugjerec village, Makedonski Brod.

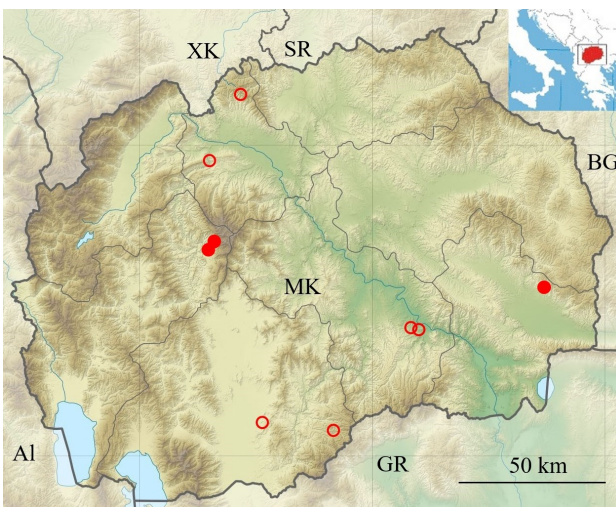


Fig. 25. Distribution of *Pilosella rothiana* in North Macedonia, ● - new data, ○ - literature data.

Kamen) (Vandas 1909, as *Hieracium setigerum* subsp. *pseudechioides* Nägeli & Peter, Behr & al. 1937, Zahn 1922–1930, as *H. rothianum* subsp. *rothianum*, Soška 1939, as *H. setigerum*).

***Rubus wahlbergii* Arrh.** (Rosaceae) (Figs. 26, 27)

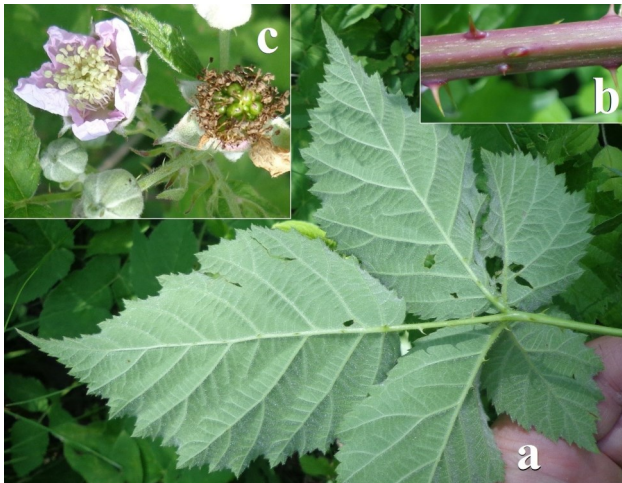
Šar Mts., Setole village, beech forest clearings, 1050 m, 42°3'18.65"N, 20°59'27.71"E, 11.7.2013 leg. & det. A. Teofilovski; Makedonski Brod, Kovče village, walnut plantation, 555 m, 41°39'45.13"N, 21°10'6.87"E, 8.6.2016, leg. & det. A. Teofilovski; Makedonski Brod, near road to Trebovle village, 790 m, 41°44'48.05"N, 21°6'39.15"E, 9.6.2016, leg. & det. A. Teofilovski; Makedonski Brod, Dolna Belica village, meadow margin, 480 m, 41°40'23.70"N, 21°6'39.15"E, 31.6.2016, leg. & det. A. Teofilovski; Kruševo, between Pusta Reka and Dolno Divjaci villages, roadsides, sparse forests and shrubby places, 940 m, 41°23'51.93"N, 21°10'6.46"E, 5.9.2018, leg. & det. A. Teofilovski; Kruševo, between Dolno Divjaci and Kočište villages, roadside, 790 m, 41°22'15.17"N, 21°10'45.90"E, 5.9.2018, photog. A. Teofilovski; Baba Mt., Resen, southeast of Kozjak village, oak forest, 1170 m, 41°2'49.29"N, 21°4'55.82"E, 22.10.2014, leg. & det. A. Teofilovski.

The main geographical range of this species (or possibly an aggregate of microspecies) includes northern and central Europe, from southern Sweden and Norway to northern Bavaria and Moravian Silesia (Weber 1995, 2000). Its presence in North Macedonia was only recently discovered (Teofilovski 2011), but it has not yet been reported from other parts of southeastern Europe, likely due to a lack of studies. It is the only representative of *Rubus* sect. *Corylifolii* that occurs in the Balkan Peninsula.

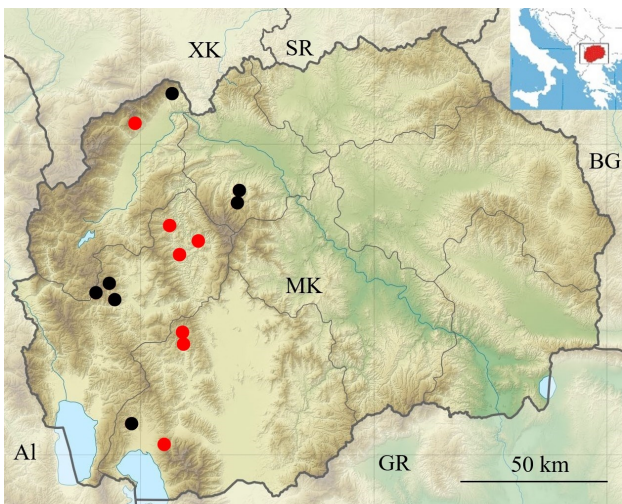
The previously reported localities of *R. wahlbergii* in North Macedonia include the Šar Mts. (Staro Selo), Jakupica Mt. (Mala Reka, Kitka, Crvena Voda), Kičevo (Javorec, Knežino, Dolno Dobrenoec), and Galičica Mt. (Istočka Reka) (Teofilovski 2011). Although seven new localities have been added, *R. wahlbergii* is still considered a rare species in the country.

***Senecio sylvaticus* L.** (Asteraceae) (Fig. 28)

Osogovo Mt., Jamište village, 1428 m, 42.049841°N, 22.319651°E, 1.7.2021, leg. & det. A. Teofilovski; Pehčevo, Ramna Reka, 41.744903°N, 22.976366°E, 1300 m, leg. A. Teofilovski & D. Mandzukovski, det. A. Teofilovski; Berovo, Vladimirovo village, 970 m, 41.691713°N, 22.699306°E, 24.7.2020, leg. A. Teofilov-



**Fig. 26.** *Rubus whalbergii*, Makedonski Brod, Kovče vilage, **a.** leaf of sterile offshoot (dorsal surface), **b.** detail of sterile offshoot, **c.** part of inflorescence, photo. A. Teofilovski.

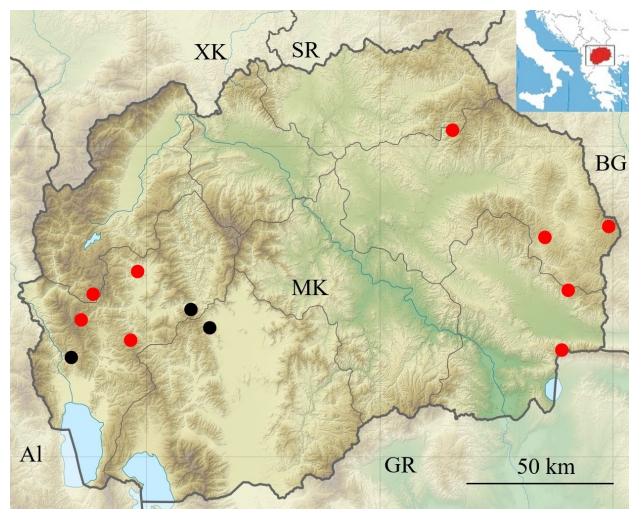


**Fig. 27.** Distribution of *Rubus whalbergii* in North Macedonia, ● - new data, ● - author's published data.

ski & D. Mandzukovski, det. A. Teofilovski; Ogražden Mt., Barbarevo village, 1500 m, 41.523870°N, 22.811730°E, 1.8.2020, leg. A. Teofilovski & D. Mandzukovski, det. A. Teofilovski; Belasica Mt., Bansko village, 1360 m, 41.331124°N, 22.782406°E, 22.09.2018, leg. & det. A. Teofilovski; Ilinska Mt., Belica village, 1010-1050 m, 41.378504°N, 20.930322°E, 8.7.2020, leg. & det. A. Teofilovski; Stogovo Mt., Ehloec village, 41°26'7.61"N, 20°44'29.00"E, 1610 m, 30.7.2020, leg. & det. A. Teofilovski; Bistra Mt., Gorna Dušegubica village, 1200 m, 41.500693°N, 20.776750°E, 23.8.2020, leg. & det. A. Teofilovski; Kičevo, above Oslomej village, 910 m, 41.583840°, 20.980270°,

6.6.2024, leg. & det. A. Teofilovski.

This species, native to much of Europe, was only recently reported in the flora of North Macedonia, from the vicinity of Kruševo (Pusta Reka, Vrboec) and Struga (Brčevo) (Teofilovski, 2018). New data indicate a wider, though not common, distribution in some parts of the country. The records from Osogovo Mt., Berovo, and Belasica Mt. are the first from the eastern part of the country. In North Macedonia, the habitats of *Senecio sylvaticus* are confined to beech and sessile oak forest zones, where it typically grows as a pioneer plant along newly constructed forest roads and in recently logged areas.



**Fig. 28.** Distribution of *Senecio sylvaticus* in North Macedonia, ● - new data, ● - author's published data.

***Succisa pratensis* Moench (*Dipsacaceae*) (Figs. 29, 30)**

Jablanica Mt., west of Lakavica village, dump places, 1430 m, 41.332535°N, 20.503183°E, 31.8.2016, leg. & det. A. Teofilovski; Berovo, south of Avramski Kolibi, wet place, 1200 m, 41.608186°N, 22.841613°E, 28.8.2016, leg. & det. A. Teofilovski; Berovo, southwest of Avramski Kolibi, wet place, 1210 m, 41.616826°N, 22.819412°E, 23.7.2016, leg. & det. A. Teofilovski.

*Succisa pratensis* is a rare wetland plant in Macedonian flora, with the following three localities previously mentioned in the literature: Osogovo Mt. (Sultan Tepe) (Urumov 1923), Ogražden Mt. (Suvi Laki) (Micevski 1978), and Ilinska Mt. (Janjić 1990).





Fig. 29. *Succisa pratensis*, habitus, Lakavica village, Jablanica Mt., photo A. Teofilovski.

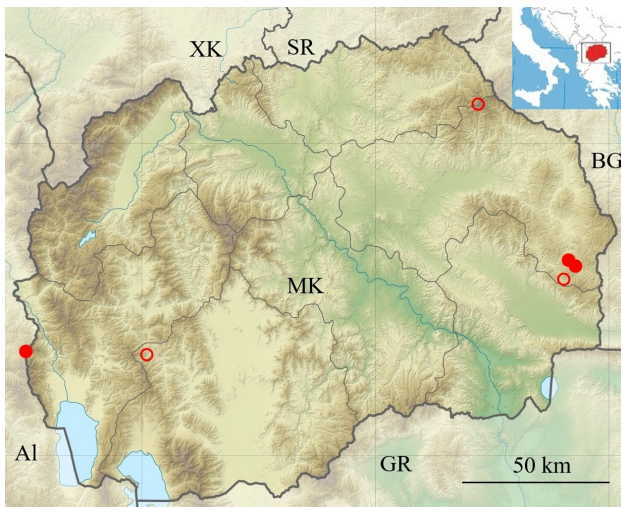


Fig. 30. Distribution of *Succisa pratensis* in North Macedonia, ● - new data, ○ - literature data.

***Tephrosieris wagneri* (Degen) Holub (Asteraceae) (Figs. 31, 32)**

≡ *Senecio wagneri* Degen ≡ *Tephrosieris papposa* subsp. *wagneri* (Degen) B. Nord.

Šar Mts., Ljuboten, alpine meadow, limestone, 2400 m, 42.206554°N, 21.116997°E, 27.7.2014, leg. A. Teofilovski, Z. Nikolov, D. Mandzukovski, det. A. Teofilovski.



Fig. 31. *Tephrosieris wagneri*, synflorescence, Ljuboten, Šar Mts., photo A. Teofilovski.



Fig. 32. Distribution of *Tephrosieris wagneri* in North Macedonia, ● - new data, ○ - literature data.

***Urospermum picroides* (L.) F. W. Schmidt (Asteraceae) (Figs. 33, 34)**

Kavadarci, Tikveš lake dam, shrubby place, 267 m,

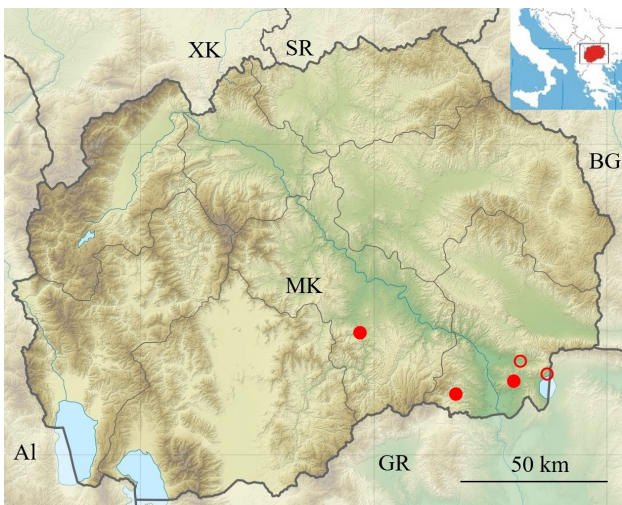


41.403804°N, 21.939453°E, 2.6.2019, leg. A. Teofilovski & D. Mandzukovski, det. A. Teofilovski; Bogdanci, 2.7 km northeast, shrubby place, 290 m, 7.5.2020. leg. A. Teofilovski & Z. Nikolov, det. A. Teofilovski; Gevgelija, Novo Konsko village, near road to Konsko village, 221 m, 41.161863°N, 22.420180°E, 2.6.2023, leg. & det. A. Teofilovski.

The presence of this rare Mediterranean annual species in the Macedonian flora has not been confirmed for nearly a century. In the literature, it is reported only from Dojran (Nikolić) (Bornmüller, 1927) and Valandovo (Tatarli) (Stojanoff, 1928).



**Fig. 33.** *Urospermum picroides*, habitus, Novo Konsko village, Gevgelija, photo. A. Teofilovski.



**Fig. 34.** Distribution of *Urospermum picroides* in North Macedonia, ● - new data, ○ - literature data.

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## ***Phelipanche nowackiana* (Markgr.) Soják and *Orobanche esulae* Pančić (*Orobanchaceae*) in the flora of the Republic of North Macedonia**

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### **Abstract**

*Phelipanche nowackiana*, a new species in the Macedonian flora and *Orobanche esulae*, with one, very old data, are presented in this work. *P. nowackiana* is a serpentine-soil species, parasitic on species of the *Brassicaceae* family, primarily the genera *Alyssum* s.l. (incl. *Aurinia* and *Odontarrhena*) and *Bornmuellera*. The range is Balkan countries (Albania, Greece, Serbia) and Turkey (Asiatic part), possibly further into western Asia. A population of this species grows on the host plant *Aurinia saxatilis* (L.) Desv. (≡ *Alyssum saxatile* L.), in the gorge Matka (Skopje), alongside the bank of the river Treska. *O. esulae* is a Balkan endemic species confined to Serbia and Bulgaria. It parasitizes only species of the genus *Euphorbia*. So far, there was one, very old data, for its presence in our flora. The filed-researches, over a decade, revealed populations on several localities: Katlanovo, Veles (gorge of the river Babuna), Strumica (foothill of the Mt. Belasica), Kavadarci (village Drenovo), Debar (valley of the river Crn Drim), Mariovo (village Melnica), Gevgelija (village Moin). The host plants are *Euphorbia*-species: *E. myrsinites*, *E. sequieriana* subsp. *niciana*, *E. barrelieri* and *E. amygdaloides*.

**Key words:** *Phelipanche nowackiana*, *Orobanche esulae*, serpentine-soil species, host plants, Balkan endemic species.

***Phelipanche nowackiana*** (Markgr.) Soják in Čas. Nár. Mus., Odd. Přír. 140: 130. 1972.

(Basionim: *Orobanche nowackiana* Markgr. in Ber. Deutsch. Bot. Ges., 44: 429. 1926).

### Introduction

*Phelipanche nowackiana* (Markgr.) Soják (Fig. 1, 6) is a species of serpentine-soils described by Markgraf (1926), from the mountain serpentine localities from Albania (as *Orobanche nowackiana*). Latter, Gilli (1966), from the serpentine soils from Greece, described another, similar species – *Orobanche rechingeri*. However, Foley (2000), on the base of comparative study, concluded that the latter is conspecific with *O. nowackiana* and, on the base of priority, kept the name *O. nowackiana* whilst the name *O. rechingeri*, put in its synonymy. Soják (1972) combined the name as *Phelipanche nowackiana*, following latter in Euro+Med (Domina & Raab-Straube (2010+) and by Dimopolus et al. (2013).

*P. nowackiana* belongs to Sect. *Arenariae* Teryokhin (in Opred. Zarazikhovykh Fl. SSSR (ed. L.Yu. Budantsev):

43 (1993). According to the literature data, two more species of our flora belong to this Section: *Phelipanche arenaria* (Borkh.) Pomel (Grupče, 1958; Matvejeva, 1968; Teofilovski & Mandzukovski, 2023) and *Phelipanche purpurea* (Jacq.) Soják (Ade, 1954; Grupče, 1958).

### Host plant

*P. nowackiana* parasitizes serpentine species of the *Brassicaceae* family, especially the genera *Alyssum* and *Bornmuellera*, possibly on other taxa also (Foley, 2000).

### General distribution

The distribution area of *P. nowackiana* (Markgr.) Soják includes Albania, Greece, the eastern Aegean, Turkey, and possibly further into western Asia (Foley, 2000; Euro+Med. 2010+). There is also a data of Papović, Miljković, Ranđelović & Ranđelović (2014) for the presence of *P. nowackiana* on Rogozna Mountain, in Southwestern Serbia (sub *O. nowackiana*).

### Material and methods

Material of *P. nowackiana* was collected during the fieldwork in the gorge Matka (Skopje), along the trail to the caves (alongside the bank of the river Treska) on 12





Fig. 1. *Phelipanche nowackiana* (Markgr.) Soják  
(Photo; Z. Nikolov)

- and 18.05.2023. Nine voucher specimens (No.: 15169-15177) are deposited in the herbarium collection of the Natural History Museum. The following sources have been used, for the identification of the material: Chater & Webb (1972); Hartvig (1991); Uhlich, Pusch & Barthel (1995), Foley (2000). Photos of live plants, in their habitat, different parts of the plants as well as the holoparasite, with its host plant, have been also taken.

Distribution map, with the first data for the presence of *P. nowackiana*, on the territory of North Macedonia, is also given.

#### Results and discussion

*Phelipanche nowackiana* (Markgr.) Soják in Čas. Nár. Mus., Odd. Přír. 140: 130. 1972.





Fig. 2. *Phelipanche nowackiana* ( Markgr.) Soják  
 a) Habitat (alongside the bank of the river Treska)  
 b) Plant with a cluster of flowers (at the lower part of the stem)  
 (Photo: Z. Nikolov)

*Description (based on the collected material)*

Stem (with the subterranean part) (7)10-15(18) cm, yellowish, with white arachnoid-villous indumentum, simple, exceptionally with a clustered stem in the lower part of the plant; scales 7-8 mm long, 3-4 mm wide; inflorescence (1.5)3.5-7.5(9) cm, dense (with few) to  $\pm$  elongate (with several flowers); bract 7-10 mm long; bracteoles linear-lanceolate, up to 8.5 mm long; calyx c. 11 mm long, with 4 tapering teeth, covered with dense, glandular hairs; corolla 18-20(23) mm long, pale-yellow; the lower-lip lobes rounded; filaments ciliate at the broaden base, glabrous above, inserted (4)7 mm from the base of the corolla; anthers pale-yellow, glabrous; ovarium glabrous, style with rare, short glandular hairs; stigma lobes pale-yellow.

*Discussion on the species characteristics*

In compare to the description of Foley (2000), for *P. nowackiana*, the plants from the gorge Matka match the most of the main morphological characteristics. The stem is dominantly simple (Fig. 1, 6) except one

plant with a clustered stem, nearby the base (Fig. 2, b). The length of the calyx is c. 11 mm, with 4 long, tapering teeth. The corolla (Fig. 3, a) is pale-yellow, 18-20 mm long, very rare some flowers reach 23 mm. The lobes of the lower lip of the corolla are rounded (Fig. 3, b). The filaments are mostly inserted at c. 7 mm from the corolla base, except by one plant where the insertion was at 4 mm. The filaments are ciliate at the base, in the upper part, they are glabrous. The anthers and the stigma lobes are pale-yellow (Fig. 3, a). The only remarkable deviation, comparing to the Foley's description (2000), is the pilosity of the anthers – by our plants, the anthers are glabrous, by Foley's, pilose. But, this characteristic, often found inconstant, has, in this case, insignificant taxonomic value.

*Distribution in North Macedonia*

During the field-researches in the gorge Matka, near the capitol Skopje, a population of *P. nowackiana* was encountered (Fig. 5). The locality is alongside the bank of the river Treska, on the trail to the caves, on a





Fig. 3. *Phelipanche nowackiana* ( Markgr.) Soják  
 a) Flower – pale-yellow anthers and stigma b) rounded lobes of the lower lip  
 (Photo: Z. Nikolov)

level of 327 and 345 m. The list of the collected material (numbered voucher specimens) is as following:

Matka (Skopje); along the trail to the caves (alongside the bank of the river Treska), 327 m a.s.l., 12.05.2023; No.: 15169, 15170, 15171, 15172, 15173, 15174, 15175; N 41°56.227', E 021°18.198' Leg./Det.: Z. Nikolov,

Matka (Skopje); along the trail to the caves (alongside the bank of the river Treska), 345 m a.s.l., 18.05.2023; No.: 15176; N 41°56.217', E 021°18.184' Leg./Det.: Z. Nikolov,

Matka (Skopje); along the trail to the caves (alongside the bank of the river Treska), 345 m a.s.l., 18.05.2023; No.: 15177; N 41°56.217', E 021°18.184' Leg./Det.: Z. Nikolov.

*Habitat*

Rocky places and grassy slopes alongside the bank of the river Treska (Fig. 2, a).

*Host plant*

The plants parasitize on *Aurinia saxatilis* (L.) Desv. (≡ *Alyssum saxatile* L.) Fig. 4).



Fig. 4. *Phelipanche nowackiana* ( Markgr.) Soják, with the host plant *Aurinia saxatilis* (L.) Desv.  
 (Photo: Z. Nikolov)



Fig. 5. Distribution of *Phelipanche nowackiana* (Markgr.) Soják  
 ● first data





Fig. 6. *Phelipanche nowackiana* (Markgr.) Soják  
- Voucher specimen

*Remark*

The following *Orobanche*-species were recorded, at the same time with *P. nowackiana*, on this, very short trail to the caves (c. 2 km), alongside the river Treska (Gorge Matka): *O. elatior* Sutton [parasitic on *Centaurea triniifolia* subsp. *campylacme* (Bornm.) Wagenitz], *O. alba* Stephan ex Willd. (parasitic on *Thymus* sp.), *P. purpurea* (Jacq.) Soják [parasitic on *Achillea ageratifolia*

(Sm.) Benth. & Hook], *O. pubescens* d'Urv. [parasitic on *Lamium maculatum* (L.) L.], *O. gracilis* Sm. (parasitic on *Coronilla* sp.) and *O. hederæ* Duby (parasitic on *Hedera helix* L.). Two other *Phelipanche*-species (one parasitic on *Cerintho minor* L., the other on undetermined host) as well as two representatives of *Orobanche* sect. *Orobanche*, subsect. *Minores* (Beck) Teryokhin [one parasitic on *Haplophyllum albanicum* (Bald.) Bornm.,



the other on *Lactuca* sp.], found on the same trail (01.06.2023), remain for further determination work.

***Orobanche esulae*** Pančić, Fl. Serbiae Add.: 194. 1884

Introduction

*Orobanche esulae* Pančić (Fig. 1) is a Balkan

endemic species so far known from Serbia and Bulgaria (Beck, 1890, 1930; Hayek & Markgr. (1929); Parabućski, 1974; Uhlich, Pusch & Barthel, 1995; Stoyanov, 2020). It was described by Pančić (1884), from eastern part of Serbia as a parasitic on *Euphorbia esula* L. *O. esulae* belongs to the *O.* subsect. *Minores* (Beck) Teryokhin.

According to Uhlich, Pusch & Barthel (1995), ca. 16



Fig. 1. *Orobanche esulae* Pančić

- Habitus

(Photo: Z. Nikolov)





Fig. 2. *Orobanche esulae* Pančić  
- Inflorescence  
(Photo: Z. Nikolov)

species belong to the subsection *Minores* (sub trib./ *Grex Minores*, sensu Beck), 7 of which are recorded (on the base of literature and own data) for the flora of North Macedonia: *O. hederæ* (Bornmüller, 1928; Rudski, 1943; Nikolov, 2020), *O. amethystea* Thuill. (Stojanov, 1921; Bornmüller, 1928; Soška, 1938-1939a, 1941), *O. artemisiae-campestris* Gaudin (Syn. *O.*

*loricata* Rchb.) (Uhlich, Pusch & Barthel, 1995), *Orobanche picridis-hieracioides* Vaucher ex Holandre (Syn. *O. picridis* F.W. Schultz) (Bornmüller, 1928; Soška, 1938-1939a; Drenkovski, 1969), *O. pubescens* d'Urv. (Syn. *O. versicolor* F.W. Schultz) (Beck, 1930; Nikolov, 2020), *O. serbica* Beck & Petrović (Syn. *O. ozanonis* F.W. Schultz) (Stojanov, 1921; Nikolov, 2020) and *O.*





Fig. 3. *Orobanche esulae* Pančić- Inflorescences

a) Strumica (Belasica): along the road to the village Gabrovo, 209 m a.s.l., 01.06.2012; host – *E. seguieriana* subsp. *niciciana*.

b) Veles: Gorge of the river “Babuna”, locality “Pešti”, hill pasture, 258 m a.s.l., 27.05.2012; host – *E. myrsinites*  
(Photo: Z. Nikolov)

*minor* Sm. (Grisebach, 1844; Grecescu, 1899; Jovanović, 1904; Dimitrov, 1908; Soška, 1938-1939a; Teofilovski, 2011).

*O. esulae* is a parasitic on species of the genus *Euphorbia*: *E. esula* L. (Pančić, 1884; Beck, 1890, 1930; Hayek & Markgr. (1929); Parabučki, 1974; Delipavlov, 1995; Uhlich, Pusch & Barthel, 1995), *E. seguieriana* Neck., *E. myrsinites* L., *E. niciciana* Borbas and *E. cyparissias* L. (Stoyanov, 2009).

#### Materials and methods

Most of the material was collected during the fieldwork on the project “Taxonomy and chorology of the genus *Orobanche* in the Republic of Macedonia” (2011-2013). The herbarium vouchers, dried and labelled, in accordance with the common accepted botanical practices, are stored at the Herbarium of the Natural History Museum. For the determination, the following literature sources were consulted: Pančić (1884), Beck (1890, 1930), Hayek & Markgr. (1929), Chater & Webb (1972), Parabučki (1974), Delipavlov

(1995), Uhlich, Pusch & Barthel, (1995), Stoyanov (2009, 2020). Photos of the plants in their habitats, different parts of the plants as well as plants with the hosts are also given. Distribution map of *O. esulae* is presented, as well.

#### Results and discussion

*Orobanche esulae* Pančić, Fl. Serbiae Add.: 194. 1884

#### Description (based on the collected material)

Stem (13)16-44(47) cm, slight thicker at the base, simple, yellowish, with ± brown to purple-pink nuance, covered with dense, pale-yellow glandular hairs, at the base - with many, up - rare scales; scales 12-15(20) mm long, up to 5 mm broad; inflorescence (3)4-25(28) cm, many-flowered, dense in the upper part, lax at the base; bracts (13)15-20(21) mm, usually deflexed; calyx (12)14-16(18) mm, segments unequal bifid, extremely rare entire; corolla (15)18-20(23) mm, at the base erect (almost parallel with the stem), then almost horizontal, pale-yellow, tinged with brown, pale-purple to pink

Fig. 4. *Orobanche esulae* Pančić

a) flower b) upper part of the inflorescence - flowers with white stigma  
(Photo: Z. Nikolov)

nuance to the lips, covered with colorless glandular hairs, upper lip relatively shallow 2-lobed, lower lip 3-lobed, the middle largest; filaments inserted (3)4-5 mm above corolla base, hairy in the lower (broaden) part, above with very rare, short glandular hairs; anthers pointed, glabrous,  $\pm$  black; ovarium pale-yellow, glabrous, style with rare, glandular hairs; stigma lobes purple to almost pink, exceptionally white.

#### Discussion on the species characteristics

The description of the collected plants from North Macedonia mainly corresponds to those, from the most reliable sources: Beck (1890, 1930), Hayek & Markgr. (1929), Chater & Webb (1972), Parabućski (1974), Delipavlov (1995), Uhlich, Pusch & Barthel (1995), Stoyanov (2009, 2020). The stem is simple, with differences in color – from yellowish to  $\pm$  brown (Fig. 1, 2, 3, a, b). In addition, on the locality Mariovo, a yellow form of *O. esulae*, parasitizing on *E. mysinites*, was encountered (Fig. 5). The bracts and the calyx are shorter than the corolla, exceptionally, the bracts reach the length of the corolla. The calyx segments are unequal bifid, except in one case where the calyx

segments were entire (Fig. 3, b). The corolla is at first almost erect, going shortly parallel with the stem, then spreads almost horizontal (Fig. 4, a), pale-yellow (evidently at the base), then tinged pink (Fig. 3, a), pale-brown (Fig. 3, b) to dark-brown (Fig. 2) to the lips. The filaments are inserted mostly at 4-5 mm above the corolla base, very rare at 3 mm. The anthers are glabrous, more or less, black. The color of stigma lobes varies from pale to dark purple (Fig. 1, 2, 3, b), almost pink (Fig. 3, a) or, extremely rare, white (Fig. 4, b).

The differences, in the descriptions, concern the length of the bracts and calyx segments, insertion of the filaments and the stigma-lobes color. In the original diagnosis of Pančić (1884), repeated latter by the above-mentioned authors, the stigma lobes are entirely yellow (when mature – brownish), the calyx segments reach the half of the corolla tube, and the filaments are inserted 5-6 mm, from the corolla base. In our plants, the color of the stigma lobes is pale to dark purple, pink or, extremely rare (only one plant), white, the bracts are usually shorter of the corolla, the calyx segments are longer of the half of the corolla and the filaments





Fig 5. *Orobanche esulae* Pančić  
- yellow form  
(Photo: Z. Nikolov)

are inserted at (3)4-5 mm above the corolla base. This partially matches the var. *bulgarica*, separated by Georgiev (1937), from the typical form, on the base of

the differences between the plants from Bulgaria and the Pančić's original diagnosis. According the Georgiev's description (var. *bulgarica*), the bracts are longer of the flowers, calyx segments are equal with the corolla tube and the filaments are inserted at 3 mm from the corolla base. In the determination key, Georgiev (1937) put *O. esulae* in the group of species with yellow stigma. This obvious differences (bracts, calyx segments and color of stigma lobes), except the partially match of filament's insertion, cause us serious difficulties in closing our plants to the var. *bulgarica* Georg. That's why, we take the species as *Orobanche esulae* Pančić, the same as in Euro+Med 2010+.

*Remark*

Since the finding of Pančić (1884) - *O. esulae* (parasitic on *Euphorbia*-species), with yellow stigma lobes, no new available data, with this characteristic, is reported. Stoyanov (2009, 2020), for the plants in Bulgaria, recorded pink color of the stigma lobes and

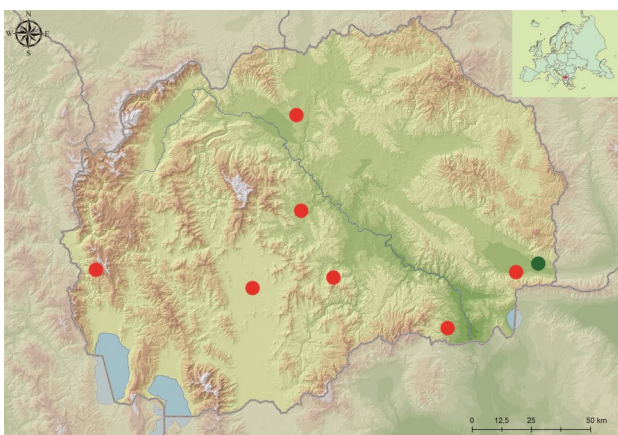


Fig. 6. Distribution of *Orobanche esulae* Pančić  
● literature data ● new data





Fig. 7. *Orobanche esulae* Pančić

- host plants: a) *E. myrsinites* b) *E. barrelieri* c) *E. amygdaloides* d) *E. seguieriana* subsp. *niciana*  
(Photo: Z. Nikolov)

gathered them in the var. *bulgarica* Georg.

#### *Distribution in North Macedonia*

The data of Rudski (1943), for the village Bansko [Belasica mountain (city Strumica), eastern part of the country], was the only so far known, for *O. esulae*, in North Macedonia. The work on this genus, for more than a decade, revealed populations on several locations (Fig. 6). Here is the detailed list of the new findings of *O. esulae*, in our country:

Katlanovo: along the road from Katlanovo-spa to the village Gradmanci, 286 m a.s.l.; 06.06.2011; No. 8350; Leg./Det. Z. Nikolov,

Katlanovo: along the road from Katlanovo-spa to the village Gradmanci, 269 m a.s.l., 22.05.2012; No.: 8910; N: 41° 54' 01.9"/E: 021° 43' 02.8"/ Leg./Det.: Z. Nikolov,

Veles: Gorge of the river "Babuna", locality "Pešti", along the river Babuna, 250 m a.s.l.; 23.05.2010; No.



8717; Leg./Det.: Z. Nikolov ,

Veles: Gorge of the river "Babuna", locality "Pešti", 242 m a.s.l.; 16.05.2011; No. 8533-8536; Leg./Det.: Z. Nikolov,

Veles: Gorge of the river "Babuna", locality "Pešti", 230-360 m a.s.l.; 23.05.2011; No. 8340; Leg./Det.: Z. Nikolov,

Veles: Gorge of the river "Babuna", locality "Pešti", hill pasture, 258 m a.s.l., 27.05.2012; No.: 8832; N: 41° 40' 19.0"; E: 021° 47' 32.1"; Leg./Det.: Z. Nikolov,

Veles: Gorge of the river "Babuna", locality "Pešti", 298 m a.s.l., 21.05.2013; No. 15057; Leg./Det.: Z. Nikolov,

Veles: Gorge of the river Babuna, locality "Pešti", 254 m a.s.l., 13.05.2016; No.: 13255; Leg./Det.: Z. Nikolov,

Strumica: along the road to the village Gabrovo, 209 m a.s.l., 01.06.2012; No. 8929; 8932; Leg./Det.: Z. Nikolov,

Strumica: along the road between the villages Gabrovo and Kolešino, 268 m a.s.l., 02.06.2012; No. 8940-8941; Leg./Det.: Z. Nikolov,

Debar: (village Modrič): valley of the r. Crn Drim, 624 m a.s.l., 22.06.2012; No. 8925; Leg./Det.: Z. Nikolov,

Gevgelija: village Moin, 400 m a.s.l., 08.06.2012; No. 8552-8554; Leg./Det.: Z. Nikolov,

Kavadarci: village Drenovo, gorge of the river Raec, 228 m a.s.l., 08.06.2014; No. 11160-11170; Leg./Det.: Z. Nikolov,

Mariovo (village Melnica): Gola Skrka, above the quarry, 1062 m a.s.l.; 10.06.2023; N: 41° 11.077'/E: 021° 47.557'; Leg./Det.: Z. Nikolov,

Mariovo (village Melnica): Gola Skrka, above the quarry, 10.06.2023; 1148 m a.s.l.; N: 41° 11.021'/E: 021° 47.735'; Leg./Det.: Z. Nikolov.

#### Habitat

*O. esulae* populates dry, rocky places, hill-pastures, open forest-meadows, disturbed places alongside roads, at level 228 to 1148 m a.s.l.

#### Host plant

The following species of the genus *Euphorbia* have been registered, as host plants of *O. esulae*, in North Macedonia: *E. amygdaloides*, *E. seguieriana* subsp. *niciciana*, *E. barrelieri*, *E. myrsinites* (Fig. 7).

#### Conclusion

The continuous work on the genera *Phelipanche* and *Orobanche* (*Orobanchaceae*), in North Macedonia, resulted with one new species – *Phelipanche nowack-*

*iana* (Markgr.) Soják, for our flora and several new findings of *Orobanche esulae* Pančić, so far known only from one locality.

#### Acknowledgement

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## Mycodiversity in the southwestern part of Jablanica mountain

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### Abstract

Fungi are vital components of ecosystems, serving as crucial decomposers and playing an important role in nutrient cycling. This study explored fungal diversity in southern part of Jablanica Mountain, a potential future protected area. Field and lab work identified plenty of species not yet found in the area, as well as new data for Macedonian mycobiota, and some species listed in the national red list of fungi.

These findings significantly enhance knowledge of Jablanica's mycodiversity and underscore the area's ecological importance. The results can support conservation efforts and the mountain's designation as a protected national park, showcasing its incredible fungal diversity within a small area. The research contributes to understanding fungi's role in ecosystems and their value to local communities and biodiversity preservation.

**Key words:** fungal diversity, ecology, Jablanica Mountain, N. Macedonia

### Introduction

Jablanica Mountain is found on the border between Macedonia and Albania, the eastern slope of the mountain is located in the southwestern part of Macedonia, between the valleys of Debar and Ohrid-Struga, west of the river Black Drim and the shore of the Ohrid Lake. The lake has influence on the local climate of the mountain with its moderating effects, it creates a unique microclimate characterized by high humidity and mild temperatures, conditions that are particularly favorable for fungal growth. The area of research was the southern part of Jablanica Mountain (Fig. 1), with main focus on the habitats: planted *Pinus nigra* at the locality Kjafasan, mixed forest of *Quercus* sp. and *Castanea sativa* at locality Kalishta and above the Radozhda village, mixed forest of *Quercus pubescens* and *Carpinus orientalis* located along the border patrol path, pure forest of *Quercus* sp. found above Radozhda village. Also, fungal material was collected from park area planted with *Abies*, *Cupressus*, *Acer* and *Populus* trees located at Camp Treska, as well as from meadows found along all the previously

mentioned habitats. However, the mycodiversity of Jablanica Mt. remains relatively understudied. The first published data on diversity of fungi on this mountain were provided by Karadelev et al. (2007) in a preliminary study. Despite this initial effort, comprehensive studies of the fungal diversity in this area are still lacking. Given the ecological importance of the fungi and the mountain's potential designation as a

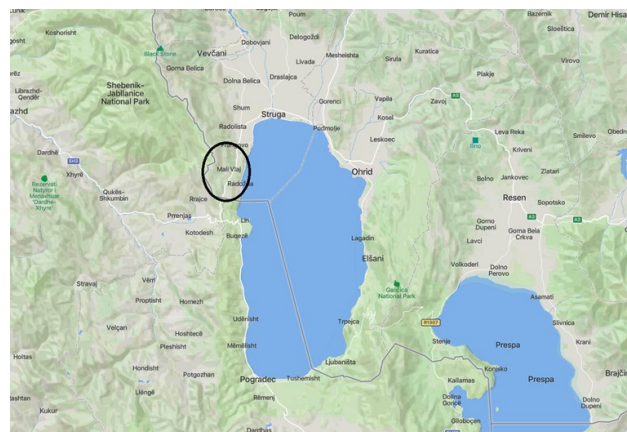


Figure 1 The study area in the most southwestern part of North Macedonia

protected area, understanding its fungal composition is crucial. This study aims to expand the existing knowledge by exploring the fungal diversity of the southern Jablanica region and provide data for future selection of important fungal areas on this mountain.

#### Methodology

The field work was realized in spring and autumn season in 2023, where a total of 12 visits were done. Most of the mycological material was photographed on the field and the specimens were collected in aluminum foil and refrigerated until determination and analysis in the Mycological laboratory (Institute of

Biology, Faculty of Natural Science and Mathematics in Skopje). Notes on the location, coordinates, altitude, habitat, substrate type and date were taken for each collection. The lab work included using various literature for determination of the specimen based on their macro- and microscopic features, such as: Breitenbach & Kränzlin (1981, 1986, 1991, 1995, 2000), Calogne (1998), Galli (2001), Galli (2003), Kränzlin (2005), Knudsen & Vesterholt (2012). Microscopical analyses were conducted using reagents, such as KOH, Melzer, Lactophenol cotton blue and Congo Red. Index Fungorum 2023 was used to provide the current name



Figure 2 New data for Macedonian mycobiota: a. *Schizopora flavipora*, b. *Inocybe muricellata*, c1.-c2. *Marasmiellus vaillantii* (hymenium and basidiocarps, respectively).



of the species. After analysis the specimens were dried in a dehydrator and stored in the Macedonian Collection of Fungi (MCF) in the Mycological.

### Results and discussion

From a total of 238 specimens collected, 181 species were determined at species level (Tab. 1.) out of which 126 represent new data for the mycobiota of Jablanica Mt., and 55 species are confirmed findings (Karadelev et al., 2007).

Highest number of taxa are identified in Basidiomycota phylum with 167 species while in Ascomycota phylum only 9 species and Myxomycota has 5 identified species. The species discovered belong to 65 families, of which the most numerous are Russulaceae with 18, Boletaceae with 15, Tricholomataceae with 14 and Mycenaceae with 10 species present. According to the type of substrate, 128 species are terricolous, 47 lignicolous, 4 foliicolous, 1 on chestnut husk, and 1 coprophilous. Considering the ecology of the species saprotrophic fungi dominate with 100 species, 72 are mycorrhizal and 9 are parasitic.

Three species are registered for the first time for the country: *Shizopora flavipora* (Berk. & M.A. Curtis ex Cooke) Ryvarden, *Marasmiellus vaillantii* (Pers.) Singer and *Inocybe muricellata* Bres.

*Shizopora flavipora* is a widely distributed polypore in Central and Southern Europe and concerning its ecology it is a saprotroph on deadwood of various deciduous trees (rarely on conifers) (Ryvarden and Gilbertson, 1993-1994). The collected specimen was found on fallen branch of *Quercus* sp.

*Marasmiellus vaillantii* is a widespread saprotroph that grows on various remnants of different grasses (*Carex*, *Juncus*), but also on wood remains (Breitenbach & Kränzlin., 1991). The collection in this study was found on stump of *Quercus* sp.

*Inocybe muricellata* is a mycorrhizal fungus found in various deciduous forests (rarely in coniferous) from summer to autumn (Vesterholt, 2012). The specimen identified in this study was collected near planted *Abies* sp. in late autumn.

Five identified species are assessed in the National Red List of Fungi (Karadelev et al, 2021): *Hericium erinaceus* (Bull.) Pers. as endangered (EN), *Sarcosphaera coronaria* (Jacq.) J. Schröt., *Butyriboletus regius* (Krombh.) D. Arora & J.L. Frank and *Tricholoma acerbum* (Bull. ex Pers.) Quél. as vulnerable (VU) and *Amanita caesarea* (Scop.) Pers. categorized as least concern (LC).

Tab. 1. List of registered species on Mt. Jablanica

Num.	Species	Date 2023	Forest type/host	Substrate	Coordinates
1	<i>Agaricus campestris</i> L.	5 Nov.	meadow	soil	41.093411, 20.633588 41.136098, 20.634478
2	<i>Agaricus macrosporus</i> Mont.	2 Nov.	meadow	soil	41.093411, 20.633588
3	<i>Agaricus xanthodermus</i> Genev.	2 Nov.	meadow	soil	41.093411, 20.633588
4	<i>Agrocybe praecox</i> (Pers.) Fayod	21 May	oak forest	soil	41.060482, 20.374495
5	<i>Aleuria aurantia</i> (Pers.) Fuckel	3 Nov.	planted black pine forest	soil	41.102961, 20.619442
6	<i>Amanita caesarea</i> (Scop.) Pers.	2 Nov., 5 Nov.	oak forest	soil	41.091308, 20.630482, 41.136098, 20.634478
7	<i>Amanita citrina</i> Pers.	2 Nov.	oak forest	soil	41.091308, 20.630482
8	<i>Amanita pantherina</i> (DC.) Krombh.	20 May	oak forest	soil	41.085128, 20.382094
9	<i>Amanita phalloides</i> Fr.: Fr. Link	5 Nov.	oak forest	soil	41.136098, 20.634478
10	<i>Amanita rubescens</i> Pers.	20 May	oak forest	soil	41.085128, 20.382094

Num.	Species	Date 2023	Forest type/host	Substrate	Coordinates
11	<i>Amanita simulans</i> Contu	2 Nov.	under planted Abies	soil	41.093411, 20.633588
12	<i>Amanita vaginata</i> (Bull.) Lam.	20 May	planted black pine forest	soil	41.060604, 20.371194
13	<i>Arcyria incarnata</i> Pers. ex J.F. Gmel.	20 May	Quercus sp.	branch	41.085128, 20.382094
14	<i>Armillaria mellea</i> (Vahl) P. Kumm.	2 Nov., 5 Nov.	Quercus sp.	stump	41.091308, 20.630482, 41.136098, 20.634478
15	<i>Aspropaxillus candidus</i> (Bres.) M.M. Moser	5 Nov.	meadow	soil	41.136098, 20.634478
16	<i>Astraeus hygrometricus</i> (Pers.) Morgan	20 May, 21 May, 2 Nov., 5 Nov.	meadow	soil	41.085128, 20.382094, 41.060482, 20.374495, 41.093411, 20.633588, 41.136098, 20.634478
17	<i>Aureoboletus gentilis</i> (Quél.) Pouzar	5 Nov.	chestnut forest	soil	41.136098, 20.634478
18	<i>Auricularia auricula-judae</i> (Bull.) Quél.	20 May, 17 June	<i>Pinus nigra</i> , Quercus sp.	branch	41.060604, 20.371194, 41.060482, 20.374495
19	<i>Auricularia mesenterica</i> (Dicks.) Pers.	2 Nov.	<i>Populus tremula</i>	stump	41.093411, 20.633588
20	<i>Bjerkandera adusta</i> (Willd.) P. Karst.	2 Nov.	<i>Populus tremula</i>	stump	41.093411, 20.633588
21	<i>Bolbitius titubans</i> (Bull.) Fr.	17 June	oak forest	soil	41.060482, 20.374495
22	<i>Boletus edulis</i> Bull.	5 Nov.	oak forest	soil	41.136098, 20.634478
23	<i>Bovista plumbea</i> Pers.	22 Apr., 20 May, 21 May, 2 Nov.	meadow	soil	41.093005, 20.633481, 41.060604, 20.371194, 41.060482, 20.374495, 41.093411, 20.633588
24	<i>Bovista dermoxantha</i> (Vittad.) De Toni	8 Oct.	meadow	soil	41.060482, 20.374495
25	<i>Butyriboletus regius</i> (Krombh.) D. Arora & J.L. Frank	17 June	oak forest	soil	41.060482, 20.374495
26	<i>Caloboletus calopus</i> (Pers.) Vizzini	20 May, 5 Nov.	oak forest	soil	41.085128, 20.382094, 41.136098, 20.634478
27	<i>Caloboletus polygonius</i> (A.E. Hills & Vassiliades) Vizzini	5 Nov.	oak forest	soil	41.136098, 20.634478
28	<i>Caloboletus radicans</i> (Pers.) Vizzini	5 Nov.	oak forest	soil	41.136098, 20.634478



Num.	Species	Date 2023	Forest type/host	Substrate	Coordinates
29	<i>Calocera cornea</i> (Batsch) Fr.	20 May, 5 Nov., 3 Nov.	<i>Pinus nigra</i> , Quercus sp.	dry branch	41.060604, 20.371194, 41.136098, 20.634478, 41.102881, 20.625116
30	<i>Calonarius elegantissimus</i> (Rob. Henry) Niskanen & Liimat.	5 Nov.	oak forest	soil	41.136098, 20.634478
31	<i>Calvatia cyathiformis</i> (Bosc) Morgan	5 Nov.	meadow	soil	41.136098, 20.634478
32	<i>Cantharellus cibarius</i> Fr.	20 May	planted black pine forest	soil	41.060604, 20.371194
33	<i>Ceratiomyxa fruticulosa</i> T. Macbr.	20 May	<i>Pinus nigra</i>	branch	41.060604, 20.371194
34	<i>Cerrena unicolor</i> (Bull.) Murrill	23 Apr.	Quercus sp.	stump	41.083000, 20.384552
35	<i>Clitocybe nebularis</i> (Batsch) P. Kumm.	5 Nov.	oak forest	soil	41.136098, 20.634478
36	<i>Clitocybe odora</i> (Bull.) P. Kumm.	3 Nov.	planted black pine forest	soil	41.102961, 20.619442
37	<i>Clitocybe dealbata</i> (Sowerby) P. Kumm.	3 Nov.	Planted black pine forest	soil	41.102961, 20.619442
38	<i>Clitocybe metachroa</i> (Fr.) P. Kumm.	3 Nov.	planted black pine forest	soil	41.102961, 20.619442
39	<i>Clitopilus prunulus</i> (Scop.) P. Kumm.	2 Nov.	Oriental hornbeam forest	soil	41.091308, 20.630482
40	<i>Collybia fusipes</i> (Bull.) Quél.	18 June	Quercus sp.	stump	41.060482, 20.374495
41	<i>Coprinopsis picacea</i> (Bull.) Redhead, Vilgalys & Moncalvo	2 Nov.	Oriental hornbeam forest	soil	41.091308, 20.630482
42	<i>Cortinarius anomalus</i> var. <i>anomalus</i> (Fr.) Fr.	3 Nov.	oak forest	soil	41.102881, 20.625116
43	<i>Cortinarius cotoneus</i> Fr.	3 Nov.	oak forest	soil	41.102881, 20.625116
44	<i>Cortinarius duracinus</i> Fr.	2 Nov., 3 Nov.	oak forest	soil	41.091308, 20.630482, 41.102881, 20.625116
45	<i>Cortinarius trivialis</i> J.E. Lange	5 Nov.	chestnut forest	soil	41.136098, 20.634478
46	<i>Craterellus cornucopioides</i> (L.) Pers.	5 Nov.	chestnut forest	soil	41.136098, 20.634478
47	<i>Crepidotus luteolus</i> Sacc.	2 Nov.	<i>Carpinus orientalis</i>	branch	41.091308, 20.630482
48	<i>Crucibulum laeve</i> (Huds.) Kambly	20 May, 3 Nov.	<i>Pinus nigra</i>	branch	41.060604, 20.371194, 41.102881, 20.625116
49	<i>Dacrymyces stillatus</i> Nees	23 Apr.	<i>Pinus nigra</i>	branch	41.083000, 20.384552

Num.	Species	Date 2023	Forest type/host	Substrate	Coordinates
50	<i>Daedalea quercina</i> (L.) Pers.	17 June	oak forest	soil	41.060482, 20.374495
51	<i>Delicatula integrella</i> (Pers.) Fayod	20 May	<i>Pinus nigra</i>	pine needles	41.060604, 20.371194
52	<i>Dichomitus squalens</i> (P. Karst.) D.A. Reid	20 May	<i>Pinus nigra</i>	trunk	41.060604, 20.371194
53	<i>Entoloma rhodopholium</i> (Fr.) P. Kumm.	5 Nov.	oak forest	soil	41.136098, 20.634478
54	<i>Exidia glandulosa</i> Fr.	20 May, 17 June	<i>Pinus nigra</i> , <i>Quercus</i> sp.	branch	41.060604, 20.371194, 41.060482, 20.374495
55	<i>Exidia saccharina</i> Fr.	20 May	<i>Pinus nigra</i>	trunk	41.060604, 20.371194
56	<i>Fistulina hepatica</i> (Schaeff.) With.	8 Oct.	<i>Castanea sativa</i>	bark	41.060482, 20.374495
57	<i>Flammulina velutipes</i> (Curtis) Singer	2 Nov.	<i>Populus tremula</i>	stump	41.093411, 20.633588
58	<i>Fuligo septica</i> (L.) F.H. Wigg.	3 Nov.	planted black pine forest	soil	41.102961, 20.619442
59	<i>Galerina marginata</i> (Batsch) Kühner	23 Apr.	<i>Pinus nigra</i>	branch	41.083000, 20.384552
60	<i>Ganoderma lucidum</i> (Curtis) P. Karst.	2 Nov.	<i>Populus tremula</i>	stump	41.093411, 20.633588
61	<i>Gymnopilus penetrans</i> (Fr.) Murrill	3 Nov.	planted black pine forest	soil	41.102961, 20.619442
62	<i>Gymnopus erythropus</i> (Pers.) Antonín, Halling & Noordel.	2 Nov.	oak forest	soil	41.091308, 20.630482
63	<i>Gymnopus dryophilus</i> (Bull.) Murrill	2 Nov., 20 May, 17 June	meadow, planted black pine forest, oak forest	soil	41.093411, 20.633588, 41.060604, 20.371194, 41.085128, 20.382094, 41.060482, 20.374495
64	<i>Gymnopus foetidus</i> (Sowerby) P.M. Kirk	5 Nov.	<i>Quercus</i> sp.	branch	41.136098, 20.634478
65	<i>Gymnopus hariolorum</i> (Bull.) Antonín, Halling & Noordel.	5 Nov.	oak forest	soil	41.136098, 20.634478
66	<i>Gyroporus castaneus</i> (Bull.) Quéf.	5 Nov.	chestnut forest	soil	41.136098, 20.634478
67	<i>Hebeloma sinapizans</i> (Paulet) Gillet	5 Nov.	chestnut forest	soil	41.136098, 20.634478
68	<i>Helvella lacunosa</i> Afzel.	20 May, 21 May	oak forest, plant- ed black pine forest	soil	41.060604, 20.371194, 41.060482, 20.374495

Num.	Species	Date 2023	Forest type/host	Substrate	Coordinates
69	<i>Helvella queletti</i> Bres.	22 Apr.	Park, under <i>Populus tremula</i>	soil	41.093005, 20.633481
70	<i>Hericium erinaceus</i> (Bull.) Pers.	3 Nov.	Quercus sp.	living tree	41.102881, 20.625116
71	<i>Heterobasidion annosum</i> (Fr.) Bref.	18 June	oak forest	soil	41.060482, 20.374495
72	<i>Hydnellum scabrosum</i> (Fr.) E. Larss., K.H. Larss. & Kõljalg	5 Nov.	chestnut forest	soil	41.136098, 20.634478
73	<i>Hydropus scabribes</i> (Murrill) Singer	20 May	Quercus sp.	stump	41.060604, 20.371194
74	<i>Hygrocybe conica</i> var. <i>conicopalustris</i> R. Haller Aar. ex Heinem.	5 Nov.	meadow	soil	41.136098, 20.634478
75	<i>Hygrophorus eburneus</i> (Bull.) Fr.	5 Nov., 3 Nov.	oak forest	soil	41.136098, 20.634478, 41.102881, 20.625116
76	<i>Hyphodontia quercina</i> Pers. J. Erikss.	20 May	Quercus sp.	branch	41.085128, 20.382094
77	<i>Hypholoma erycaceoides</i> P.D. Orton	21 May	oak forest	soil	41.060482, 20.374495
78	<i>Hypholoma fasciculare</i> (Huds.) P. Kumm.	22 Apr., 23 Apr., 20 May, 3 Nov.	<i>Pinus nigra</i>	stump	41.093005, 20.633481, 41.083000, 20.384552, 41.060604, 20.371194, 41.102961, 20.619442
79	<i>Hymenochaete rubiginosa</i> (Dicks.) Lév.	23 Apr.	<i>Castanea sativa</i>	trunk	41.083129, 20.383060
80	<i>Infundibulicybe gibba</i> (Pers.) Harmaja	2 Nov.	meadow	soil	41.093411, 20.633588
81	<i>Inocybe adequata</i> (Britzelm.) Sacc.	20 May	oak forest	soil	41.060604, 20.371194
82	<i>Inocybe curvipes</i> P. Karst.	20 May	planted black pine forest	soil	41.060604, 20.371194
83	<i>Inocybe geophylla</i> P. Kumm.	2 Nov.	park, under plant- ed Abies	soil	41.093411, 20.633588
84	<i>Inocybe lilacina</i> (Peck) Kauffman	2 Nov.	park, under plant- ed Abies	soil	41.093411, 20.633588
85	<i>Inocybe muricellata</i> Bres.	2 Nov.	park, under plant- ed Abies	soil	41.093411, 20.633588
86	<i>Inocybe phaeoleuca</i> Kühner	21 May	oak forest	soil	41.060482, 20.374495
87	<i>Irpex lacteus</i> (Fr.) Fr.	23 Apr.	Quercus sp.	branch	41.083129, 20.383060
88	<i>Laccaria laccata</i> (Scop.) Cooke	5 Nov.	chestnut forest	soil	41.136098, 20.634478

Num.	Species	Date 2023	Forest type/host	Substrate	Coordinates
89	<i>Laccaria amethystina</i> Cooke	2 Nov., 3 Nov., 5 Nov., 22 Apr.	oak forest, park	soil	41.093411, 20.633588, 41.102881, 20.625116, 41.136098, 20.634478, 41.093005, 20.633481
90	<i>Lactarius chrysorrheus</i> Fr.	18 June, 5 Nov.	oak forest	soil	41.060482, 20.374495, 41.136098, 20.634478
91	<i>Lactarius piperatus</i> (L.) Pers.	17 June	oak forest	soil	41.060482, 20.374495
92	<i>Lactarius queitus</i> (Fr.) Fr.	17 June	oak forest	soil	41.060482, 20.374495
93	<i>Lactarius subumbonatus</i> Lindgr.	21 May	oak forest	soil	41.060482, 20.374495
94	<i>Lactarius volemus</i> (Fr.) Fr.	17 June	oak forest	soil	41.060482, 20.374495
95	<i>Lanzia echinophila</i> (Bull.) Korf	5 Nov.	<i>Castanea sativa</i>	chestnut husk	41.136098, 20.634478
96	<i>Lentinus strigosus</i> Fr.	21 May	<i>Castanea sativa</i>	stump	41.060482, 20.374495
97	<i>Lentinus arcularius</i> (Batsch) Zmitr.	22 Apr., 3 Nov.	Quercus sp.	branch	41.102881, 20.625116, 41.090195, 20.631455
98	<i>Lepiota cristata</i> (Bolton) P. Kumm.	2 Nov.	meadow	soil	41.093411, 20.633588
99	<i>Lepista inversa</i> (Scop.) Pat.	21 May	chestnut forest	soil	41.060482, 20.374495
100	<i>Leucoagaricus leucothides</i> (Vittad.) Wasser	2 Nov.	meadow	soil	41.093411, 20.633588
101	<i>Leucopaxillus tricolor</i> (Peck) Kühner	5 Nov.	chestnut forest	soil	41.136098, 20.634478
102	<i>Lycogala epidendrum</i> (J.C. Buxb. ex L.) Fr.	23 Apr.	Quercus sp.	rotten wood	41.083129, 20.383060
103	<i>Lycoperdon atropurpureum</i> Vittad.	23 Apr.	chestnut forest	soil	41.083129, 20.383060
104	<i>Lycoperdon molle</i> Pers.	8 Oct.	meadow	soil	41.060482, 20.374495
105	<i>Macrolepiota mastoidea</i> (Fr.) Singer	3 Nov.	oak forest	soil	41.102881, 20.625116
106	<i>Macrolepiota procera</i> (Scop.) Singer	2 Nov., 3 Nov., 5 Nov.	Oriental hornbeam and oak forest	soil	41.091308, 20.630482, 41.102881, 20.625116, 41.136098, 20.634478
107	<i>Marasmiellus vaillantii</i> (Pers.) Singer	18 June	Quercus sp.	stump	41.060482, 20.374495
108	<i>Marasmius oreades</i> (Bolton) Fr.	17 June	oak forest	soil	41.060482, 20.374495
109	<i>Marasmius rotula</i> (Scop.) Fr.	2 Nov., 3 Nov.	Quercus sp., <i>Carpinus orientalis</i>	trunk	41.091308, 20.630482, 41.102881, 20.625116
110	<i>Marasmius wynneae</i> Berk. & Broome	17 June	oak forest	leaves	41.060482, 20.374495



Num.	Species	Date 2023	Forest type/host	Substrate	Coordinates
111	<i>Marasmius epiphyllus</i> (Pers.) Fr.	22 Apr., 23 Apr., 2 Nov.	oak forest	fallen leaves	41.093005, 20.633481, 41.083129, 20.383060, 41.093411, 20.633588
112	<i>Melanoleuca excissa</i> (Fr.) Singer	20 May	meadow	soil	41.060604, 20.371194
113	<i>Melanoleuca meloleuca</i> (Pers.) Murrill	22 Apr.	meadow	soil	41.093005, 20.633481, 41.090195, 20.631455
114	<i>Melanoleuca polioleuca</i> (Fr.) Kühner & Maire	22 Apr.	park	soil	41.093005, 20.633481
115	<i>Melanoleuca substrictipes</i> Kühner	3 Nov.	planted black pine forest	soil	41.102961, 20.619442
116	<i>Mycena cyanorhiza</i> Quél	20 May	<i>Pinus nigra</i>	branch	41.060604, 20.371194
117	<i>Mycena olida</i> Bres.	20 May	oak forest	soil	41.060604, 20.371194
118	<i>Mycena pelianthina</i> (Fr.) Quél.	20 May, 3 Nov.	oak forest, planted black pine forest	soil	41.060604, 20.371194, 41.102881, 20.625116
119	<i>Mycena polygramma</i> (Bull.) Gray	5 Nov.	Quercus sp.	living tree	41.136098, 20.634478
120	<i>Mycena pura</i> (Pers.) P. Kumm.	3 Nov.	oak forest	soil	41.102881, 20.625116
121	<i>Mycena renatii</i> Quél.	5 Nov., 3 Nov.	Quercus sp.	branch	41.136098, 20.634478, 41.102881, 20.625116
122	<i>Mycena rosea</i> Gramberg	3 Nov., 5 Nov.	planted black pine forest, oak forest	soil	41.102961, 20.619442, 41.136098, 20.634478
123	<i>Neoboletus erythropus</i> Pers.	17 June	oak forest	soil	41.060482, 20.374495
124	<i>Omphalotus olearius</i> (DC.) Singer	17 June	oak forest	soil	41.060482, 20.374495
125	<i>Panaeolus accuminatus</i> (P. Kumm.) Quél.	20 May	meadow	soil	41.060604, 20.371194
126	<i>Panaeolus reticulatus</i> Overh.	21 May	oak forest	soil	41.060482, 20.374495
127	<i>Panellus stipticus</i> (Bull.) P. Karst.	21 May, 17 June	Quercus sp.	stump	41.060482, 20.374495, 41.060482, 20.374495
128	<i>Paxillus involutus</i> (Batsch) Fr.	2 Nov.	park	soil	41.093411, 20.633588
129	<i>Paxina acetabulum</i> (L.) Kuntze	20 May	oak forest	soil	41.060604, 20.371194
130	<i>Peniophora lycii</i> (Pers.) Höhn. & Litsch.	22 Apr.	Quercus sp.	branch	41.090195, 20.631455
131	<i>Peziza badia</i> Pers.	20 May	planted black pine forest	soil	41.060604, 20.371194

Num.	Species	Date 2023	Forest type/host	Substrate	Coordinates
132	<i>Phellinus torulosus</i> (Pers.) Bourdot & Galzin	21 May	chestnut forest	soil	41.060482, 20.374495
133	<i>Phellodon confluens</i> (Pers.) Pouzar	5 Nov.	oak forest	soil	41.136098, 20.634478
134	<i>Phlegmacium glaucopus</i> (Schaeff.) Wünsche	2 Nov.	park, under planted Abies	soil	41.093411, 20.633588
135	<i>Pluteus cervinus</i> (Schaeff.) P. Kumm.	20 May	<i>Pinus nigra</i>	stump	41.060604, 20.371194
136	<i>Pluteus exsiguus</i> (Pat.) Sacc.	18 June	oak forest	soil	41.060482, 20.374495
137	<i>Polyporus umbellatus</i> (Pers.) Fr.	17 June	oak forest	soil	41.060482, 20.374495
138	<i>Protostropharia semiglobata</i> (Batsch) Redhead, Moncalvo & Vilgalys	18 June	meadow	dung	41.060482, 20.374495
139	<i>Psathyrella candolleana</i> (Fr.) Maire	22 Apr., 21 May	oak forest	soil	41.093005, 20.633481, 41.060482, 20.374495
140	<i>Psilocybe coronilla</i> (Bull.) Noordel.	20 May, 2 Nov.	meadow	soil	41.091308, 20.630482, 41.060604, 20.371194
141	<i>Ramaria aurea</i> (Schaeff.) Quél.	5 Nov.	oak forest	soil	41.136098, 20.634478
142	<i>Ramaria botrytis</i> (Pers.) Bourdot	20 May	oak forest	soil	41.085128, 20.382094
143	<i>Resupinatus trichotis</i> (Pers.) Singer	3 Nov.	Quercus sp.	branch	41.102881, 20.625116
144	<i>Rhytisma acerinum</i> (Pers.) Fr.	2 Nov.	<i>Acer campestre</i>	leaf	41.093411, 20.633588
145	<i>Rickenella fibula</i> (Bull.) Raithehl.	21 May	Quercus sp.	branch	41.060482, 20.374495
146	<i>Russula adusta</i> (Pers.) Fr.	20 May	planted black pine forest	soil	41.060604, 20.371194
147	<i>Russula cyanoxantha</i> (Schaeff.) Fr.	20 May, 21 May, 17 June	planted black pine forest, oak forest, chestnut forest	soil	41.060604, 20.371194, 41.085128, 20.382094, 41.060482, 20.374495, 41.060482, 20.374495
148	<i>Russula heterophylla</i> (Fr.) Fr.	17 June	oak forest	soil	41.060482, 20.374495
149	<i>Russula luteotacta</i> Rea	18 June	oak forest	soil	41.060482, 20.374495
150	<i>Russula virescens</i> (Schaeff.) Fr.	17 June	oak forest	soil	41.060482, 20.374495
151	<i>Russula emetica</i> (Schaeff.) Pers.	2 Nov.	Oriental hornbeam forest	soil	41.091308, 20.630482

Num.	Species	Date 2023	Forest type/host	Substrate	Coordinates
152	<i>Russula sanguinea</i> Fr.	5 Nov.	oak forest	soil	41.136098, 20.634478
153	<i>Russula torulosa</i> Bres.	3 Nov.	planted black pine forest	soil	41.102961, 20.619442
154	<i>Russula vesca</i> Fr.	3 Nov.	planted black pine forest	soil	41.102961, 20.619442
155	<i>Sarcosphaera coronaria</i> (Jacq.) J. Schröt.	22 Apr., 23 Apr.	park	soil	41.093005, 20.633481, 41.083000, 20.384552
156	<i>Schizopora flavipora</i> (Berk. & M.A. Curtis ex Cooke) Ryvarden	20 May	Quercus sp.	branch	41.060604, 20.371194
157	<i>Schizopora paradoxa</i> (Schröd.) Donk	22 Apr., 5 Nov.	Quercus sp. , <i>Carpinus orientalis</i>	branch	41.090195, 20.631455, 41.136098, 20.634478
158	<i>Steccherinum fimbriatum</i> (Pers.) J. Erikss.	22 Apr.	Quercus sp.	branch	41.090195, 20.631455
159	<i>Stemonitis fusca</i> Roth	20 May	<i>Pinus nigra</i>	branch	41.060604, 20.371194
160	<i>Stereum hirsutum</i> (Willd.) Pers.	17 June, 22 Apr.	Quercus sp.	branch	41.060482, 20.374495, 41.090195, 20.631455
161	<i>Strobilurus tenacellus</i> (Pers.) Singer	23 Apr., 20 May	<i>Pinus nigra</i>	pine cone	41.083000, 20.384552, 41.060604, 20.371194
162	<i>Stropharia caerulea</i> Kreisel	5 Nov.	chestnut forest	soil	41.136098, 20.634478
163	<i>Suillellus luridus</i> Schaeff.	18 June	oak forest	soil	41.060482, 20.374495
164	<i>Suillellus queletii</i> (Schulzer) Vizzini, Simonini & Gelardi	5 Nov., 17 June	oak forest	soil	41.136098, 20.634478, 41.060482, 20.374495
165	<i>Suillus granulatus</i> (L.) Roussel	20 May, 3 Nov.	planted black pine forest	soil	41.060604, 20.371194, 41.102961, 20.619442
166	<i>Suillus collinitus</i> (Fr.) Kuntze	3 Nov.	oak forest	soil	41.102881, 20.625116
167	<i>Suillus luteus</i> (L.) Roussel	3 Nov., 5 Nov.	oak forest, planted black pine forest	soil	41.102961, 20.619442, 41.136098, 20.634478
168	<i>Tapinella atrotomentosa</i> (Batsch) Šutara	3 Nov.	planted black pine forest	soil	41.102961, 20.619442
169	<i>Tarzetta cupularis</i> (L.) Lambotte	20 May	planted black pine forest	among moss	41.060604, 20.371194
170	<i>Trametes versicolor</i> (L.) Lloyd	2 Nov.	Quercus sp.	trunk	41.091308, 20.630482
171	<i>Tricholoma acerbum</i> (Bull. ex Pers.) Quéf.	2 Nov.	oak forest	soil	41.091308, 20.630482
172	<i>Tricholoma colossus</i> (Fr.) Quéf.	5 Nov.	oak forest	soil	41.136098, 20.634478
173	<i>Tricholoma focale</i> (Fr.) Ricken	5 Nov.	oak forest	soil	41.136098, 20.634478



Num.	Species	Date 2023	Forest type/host	Substrate	Coordinates
174	<i>Tricholoma sejunctum</i> (Sowerby) Quél.	3 Nov.	oak forest	soil	41.102881, 20.625116
175	<i>Tricholoma ustale</i> (Fr.) P. Kumm.	5 Nov.	oak forest	soil	41.136098, 20.634478
176	<i>Verpa conica</i> (O.F. Müll.) Sw.	22 Apr.	meadow	soil	41.090195, 20.631455
177	<i>Viteoporus dichrous</i> (Fr.) Zmitr.	5 Nov.	Quercus sp.	branch	41.136098, 20.634478
178	<i>Vuilleminia comedens</i> (Nees) Maire	23 Apr.	Quercus sp.	branch	41.083129, 20.383060
179	<i>Xerocomus ferrogineus</i> (Schaeff.) Alessio	17 June	oak forest	soil	41.060482, 20.374495
180	<i>Xerocomus subtomentosus</i> (L.) Quél.	20 May, 17 June	oak forest	soil	41.085128, 20.382094, 41.060482, 20.374495
181	<i>Xerula pudens</i> (Pers.) Singer	2 Nov.	Oriental hornbeam and oak forest	soil	41.091308, 20.630482

### Conclusion

This study provided further understanding of the fungal biodiversity on Jablanica mountain, confirming some of the species found in the first study, as well as discovering three new data records for the country. Combining the findings of both studies the current number of fungal species in the area is 314, a number which does not represent the true diversity in the area, but provide additional significant mycological data. Further research is needed to expand the knowledge and provide arguments for future conservation of this significant habitats for the fungal biodiversity.

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