ПРИЛОЗИ, Одделение за природно-математички и биотехнички науки, МАНУ, том **44**, бр. 1–2, стр. 271–278 (2023)
CONTRIBUTIONS, Section of Natural, Mathematical and Biotechnical Sciences, MASA, Vol. **44,** No. 1–2, pp. 271–278 (2023)

Received: December 17, 2024
Accepted: February 2, 2025

ISSN 1857–9027
e-ISSN 1857–9949
UDC:
DOI: 10.20903/masa/nmbsci.2023.44.53

Original scientific paper

FIRST NATIONAL IUCN ASSESSMENT OF SOME RARE AND ENDEMIC SPECIES FROM GALIČICA NP IN THE REPUBLIC OF NORTH MACEDONIA

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This paper presents the initial results of assessing the threatened status at the national level for several rare and endemic plants from Galichica National Park in North Macedonia: *Dianthus galicicae* Micevski, *Centaurea galicicae* Micevski, *Centaurea soskae* Košanin, *Rindera graeca* (DC.) Boiss. & Heldr. and *Helichrysum zivojinii* Černjavski & Soška. The threatened status and criteria were proposed according to the latest IUCN methodology guidelines. By applying the parameters set by this methodology, it was determined that *Dianthus galicicae* is Critically Endangered (CR), while *Centaurea galicicae*, *Centaurea soskae*, *Rindera graeca*, and *Helichrysum zivojinii* are Endangered (EN), according to various criteria that will be detailed in this paper.

Key words: endemics; flora; Critically Endangered; Endangered; IUCN; Galichica National Park

INTRODUCTION

The IUCN Red List of Threatened Species highlights species that are at the highest risk of extinction and promotes their conservation [1]. It is a key tool that helps conserve biodiversity, with applications ranging from local to global scales [2].

The National Red Lists are crucial for the protection and recovery of threatened species because the institutions that most directly influence in conservation actions and legislation are the national governments. They also play role in supporting global conservation efforts, especially that the information can be incorporated into the Regional and Global IUCN Red Lists [3].

The National Red Lists help the responsible institutions to recognize the priority species and areas where conservation actions are needed. Assessing the conservation status of the species at the national level simultaneously facilitates the development of National Conservation Policy, improves compliance with International Agreements, and provides a basis for accelerating the EU accession process.

Until now, an official National Red List of plants has not been prepared in North Macedonia. However, at the end of 2019, a Preliminary Red List of the Macedonian flora was promoted. The Preliminary Red List listed 480 plant taxa (445 species and 35 subspecies) that should be evaluated for the National Red List. The majority of the listed taxa are found in the western part of North Macedonia, particularly in the mountain pastures, the gorges of the Radika, Crn Drim, and Treska rivers, and along the shorelines of Ohrid and Prespa Lakes. Shar Mountains is represented by at least 70, Galichica by 55, Jakupica by almost 50, and Korab by 40 plant taxa. This distribution is expected due to the geographical and climatic characteristics of the western part of North Macedonia [4, 5].

Additionally, 14 plant species listed in Annex II of the Habitat Directive and the Bern Convention, were officially assessed according to the IUCN methodology (https://redlist.moepp.gov.mk/). Meanwhile, through various conservation projects, 17 plant species, 12 of which are endemic to Galichica National Park, were assessed. The assessments

of the endangered status of these plants have not been yet published as final at the national level.

This paper is focused on five endemic plants from Galichica National Park, which have been determined to be Critically Endangered (CR) and Endangered (EN) by recent research using the IUCN methodology. Galichica is very interesting from a floristic point of view. The endemic and sub-endemic species existing on the territory of Galichica Mountain, whose range also extends to its Albanian part, are of particular importance. Namely, Galichica Mountain represents the locus classicus of over 30 plant taxa, some of which are exclusively limited to this territory and represent local endemics (steno-endemics) [5]. The assessment of these local (sub) endemic plants significantly contributes to the process of creating the National Red List of the Macedonian Flora.

MATERIALS AND METHODS

The assessment data of the threatened status were collected during field research from 2020 to 2021 on Galichica Mountain. During the field research, several parameters necessary for the assessments were noted: the coordinates, distribution area, habitats quality, the number of mature individuals, total number of individuals in the populations, potential threats, population stability etc. Geographic information was determined using OruxMaps (www.oruxmaps.com), and the data were entered into pre-prepared forms in both printed format and the Memento database (https://mementodatabase.com/). Distribution maps were created in QGis3.22 using GPS information from fieldwork. *Note: Precise coordinates for the species' distribution are not provided in this paper due to the sensitivity of the data and the risk of further endangering the species.*

The assessment was carried out using the IUCN methodology [6, 7]. Online tools developed by IUCN for species assessment were employed: GEOCAT (https://geocat.iucnredlist.org/) to calculate the Extent of Occurrence (EOO) and Area of Occupancy (AOO), and the Species Information Service (https://www.iucnredlist.org/assessment/sis) to organize information and determine the threatened status. Due to the lack of sufficient data for Criteria A and C, Criteria B and D were used for the assessments. (see Table 1). Criterion B includes geographic parameters – B1 uses EOO and B2 uses AOO. In addition to the small distribution area, at least two conditions should be met to be evaluated according to these Criteria. Criterion D applies to species with a small and restricted population size.

During the evaluation process, herbarium data from the Macedonian National Herbarium (MKNH), as well as literature data on the species that were the subject of interest [5, 8–15], were taken into account.

Table 1. Criteria from the IUCN Methodology used for the assessment of the species [6]

B. Geographic range in the form of either B1 (extent of occurrence) AND/OR B2 (area of occupancy)			
	Critically Endangered	**Endangered**	**Vulnerable**
B1. Extent of occurrence (EOO)	< 100 km²	< 5,000 km²	< 20,000 km²
B2. Area of occupancy (AOO)	< 10 km²	< 500 km²	< 2,000 km²
AND at least 2 of the following 3 conditions:			
(a) Severely fragmented OR Number of locations	= 1	≤ 5	≤ 10
(b) Continuing decline observed, estimated, inferred or projected in any of: (i) extent of occurrence; (ii) area of occupancy; (iii) area, extent and/or quality of habitat; (iv) number of locations or subpopulations; (v) number of mature individuals			
(c) Extreme fluctuations in any of: (i) extent of occurrence; (ii) area of occupancy; (iii) number of locations or subpopulations; (iv) number of mature individuals			
D. Very small or restricted population			
	Critically Endangered	**Endangered**	**Vulnerable**
D. Number of mature individuals	< 50	< 250	D1. < 1,000
D2. Only applies to the VU category Restricted area of occupancy or number of locations with a plausible future threat that could drive the taxon to CR or EX in a very short time.	-	-	D2. typically: AOO < 20 km² or number of locations ≤ 5

RESULT AND DISCUSSION

***Dianthus galicicae* Micevski (Caryophyllaceae)** (Fig. 1 a)

Distribution. North Macedonia [12] and Albania.

This species was first discovered on Mount Galicica, with the type locality located on the southern slopes of Vojtina, above the village of Ljubanishta [12]. According to current knowledge, it has also been recorded on the Albanian side of Mount Galicica, in the border region with North Macedonia (personal communication with Prof. L. Shuka).

North Macedonia: Galichica National Park - Vojtina (above Ljubanishta village), on dry grasslands, 1200–1300 m (Fig. 1b) [12].

a) b)

Figure 1. *Dianthus galicicae*: a) Inflorescence (photo Vlado Matevski); b) Distribution map

Habitat and ecology. The species grows on dry grasslands, in the belt of *Quercus cerris*, between 1200-1300 m.

This species develops in forest clearings that are secondary habitats resulting from deforestation or abandoned agricultural lands in an advanced stage of succession.

Threats. The main threat is the overgrowth of shrubs in the habitats of this species. Snow avalanches occasionally occur in Vojtina, but there is insufficient data to determine their impact on this species. Assessing the potential effects of climate change also presents significant challenges due to the lack of specific information. In general, the species is not exposed to anthropogenic threats that considerably impact its population.

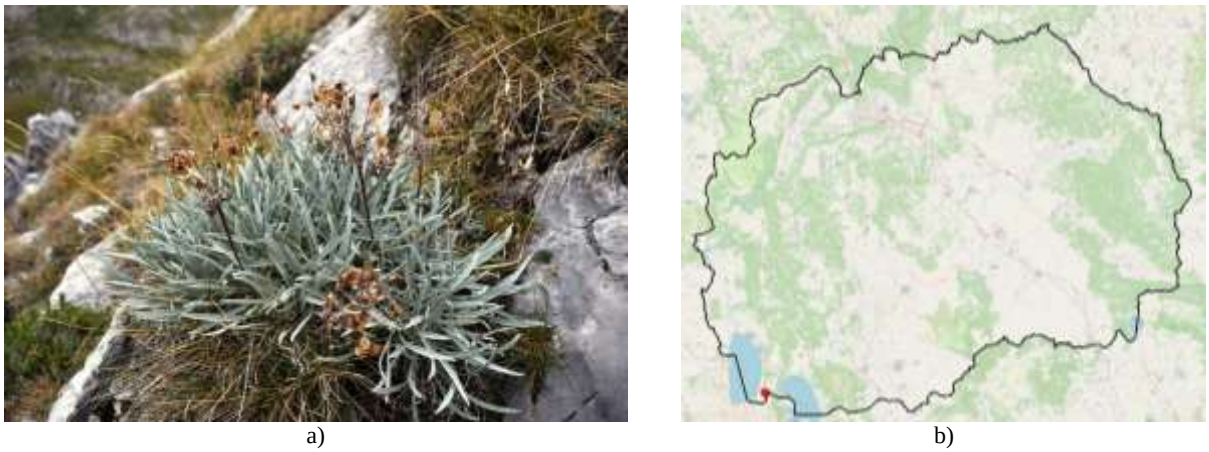
A significant problem is the lack of knowledge about the distribution and ecology of the species. Increasing the knowledge would likely lead to a more accurate identification of potential threats. As part of the species' population extends into the Albanian side of Galichica, it is essential to adopt an integrated management approach involving the relevant authorities from both countries. Such collaboration is necessary for defining threats and developing appropriate mitigation measures (grazing, moving, control shrub succession etc.).

***Rindera graeca* (A. DC.) Boiss. & Heldr. (Boraginaceae)** (Fig. 2a)

Distribution. North Macedonia [14, 16] and Greece [15].

Rindera graeca is a rare species in North Macedonia. It is currently known only from a single locality on Mount Galicica [14, 16].

North Macedonia: Stara Galichica – Golem Kazan (Fig. 2b) [14, 16].



a) b)

Figure 2. *Rindera graeca*: a) Habitus (photo Cvetanka Stojchevska); b) Distribution map

Habitat and ecology. The habitat of the species is limestone rock crevices, 1850-1900 m, with dominant vegetation that belongs to class *Elyno-Seslerietea*, order *Onobrychido-Seslerietalia* and alliance *Seslerion nitidae*. According to the Habitats Directive (HD), these environments corre-

spond to habitat type 6170 – Alpine and subalpine calcareous grasslands.

Threats. Currently, there are no significant threats to the species because its area of distribution is in the strictly protected zone of Galichica NP. Due to recent phytochemical data on its potential widespread use [17], a risk of attracting heightened interest from both scientists and the public is posed, which could lead to increased pressure on its natural populations.

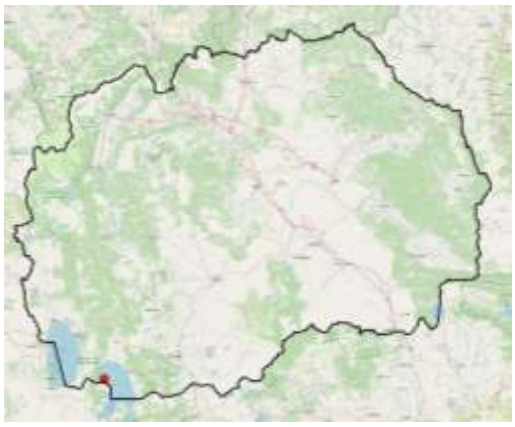
***Centaurea galicicae* Micevski (Asteraceae)** (Fig. 3a)

Distribution. North Macedonia [18], Albania [19] and Greece [20].

Centaurea galicicae is a chasmophyte species that has been described from the limestone rocks of the coastal areas of Lake Prespa, between the villages of Stenje and Konjsko [18].

North Macedonia: Galichica NP - between the villages Stenje and Konjsko (Fig. 3b) [18].

a)



b)

Figure 3. *Centaurea galicicae*: a) Inflorescence (photo Vlado Matevski); b) Distribution map

Habitat and ecology. A narrow endemic species restricted to Prespa Lake, found on limestone cliffs. This corresponds to habitat type 8210 under the Habitats Directive (HD) – Calcareous rocky slopes with chasmophytic vegetation.

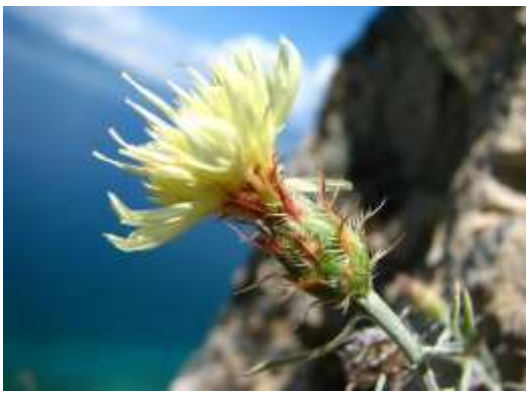
Threats. So far, there are no significant anthropogenic threats. However, there is a certain danger of being over-collected by collectors of endemic and rare plants. Additionally, the construction of tourist or any other facilities could cause certain population disorders.

***Centaurea soskae* Hayek ex Košanin (Asteraceae)** (Fig. 4a)

Distribution. North Macedonia [8], Greece [21] and Albania [19].

Centaurea soskae was first described from Lake Ohrid by Hayek in a floristic paper by Košanin [8, 21].

North Macedonia: Galichica NP - Golem Osoj, between St. Naum and the village Trpejca [8] (Fig. 4b).



a)

b)

Figure 4. *Centaruea soskae*: a) Inflorescence (photo Vlado Matevski); b) Distribution map

Habitat and ecology. An endemic limited to the narrow coastal part of Ohrid Lake, on limestone cliffs at 700-850 m.a.s.l., with dominant vegetation that belongs to class *Asplenietea trichomanes*, order *Potentilletalia speciosae* and alliance *Ramondion nataliae*. The species is registered in shrub association *Phyllireo-Carpinetum orientalis* near the village Trpejca [22]. The species habitat is located in the zone of submediterranean thermophilus vegetation – HD: 8210 – Calcareous rocky slopes with chasmophytic vegetation.

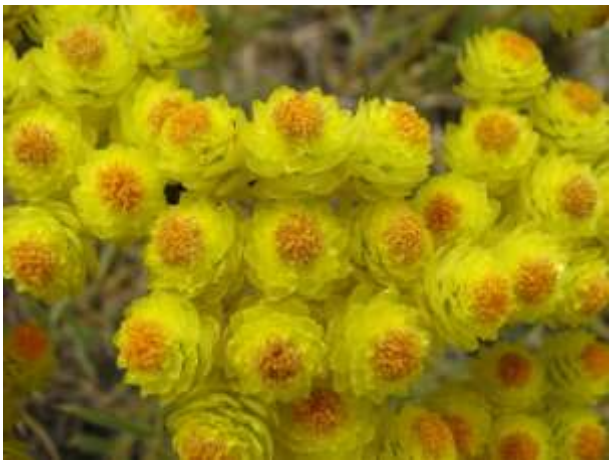
Threats. Inaccessibility of the habitat protects the species from collecting or possible grazing. Potential threats can be certain recreational activities (rock climbing), as well as the possible impacts of future drastic climate changes.

***Helichrysum zivojinii* Černjavski & Soška (Asteraceae)** (Fig. 5a)

Distribution. North Macedonia [9].

Endemics species known for the Galichica NP, described by Černjavski & Soška [9].

North Macedonia: Galichica NP – Lako Signoj, Kosta Bachilo – ski center, Bugarska Chuka, Tomoros, Bajrache, Dva Javora, Prechna Mountain (between the villages Stenje and Konjsko) and Preslap (Fig. 5b).



a)

b)

Figure 5. *Helichrysum zivojinii*: a) Inflorescence (photo Vlado Matevski); b) Distribution map

Habitat and ecology. The species prefers open grassland habitats on limestone, between 1000-1900 m, but most of the sites are located above 1500 m, with dominant vegetation that belongs to class *Elyno-Seslerietea*, order *Onobrychido-Seslerietalia* and alliance *Seslerion nitidae*. At lower altitudes, the species is much rarer and typically occurs in forest clearings within oak and juniper communities. Its habitat corresponds to several types under the Habitats Directive (HD) – 4060 Alpine and Boreal heaths; 6170 – Alpine and subalpine calcareous grasslands; 9650 – Endemic forests with Juniperus spp.

Threats. The main threat to the subalpine subpopulation is the intensive succession with *Juniperus communis* and the impact of different tourist activities. Canopy closure is the most serious threat to the lower subpopulation. The local population collects it in small quantities as a medicinal plant.

Assessment of the species according to the IUCN Methodology

Based on the information obtained in the field and the literature data of the species, assessments of the threatened status of all 5 plant endemic and subendemic species were made using all applicable criteria. The parameters that were used in the assessment of the species are shown in Table 2. The criterion with the highest threatened status was chosen as the final.

Table 2. Important parameters for assessing of threatened status

Species	EOO	AOO	Population size = No. of mature individuals	Number of locations	Population trend	Decline on EOO and AOO	Habitat quality
Dianthus galicicae	4km^2	4km^2	500	1	Decreasing	Unknown	Exposed to successional processes
Centaurea galicicae	16km^2	16km^2	230	1	Stable	Unknown	Good
Centaurea soskae	4km^2	4km^2	100	1	Stable	Unknown	Good
Rindera graeca	4km^2	4km^2	75	1	Stable	Unknown	Good
Helichrysum zivojinii	44km^2	149km^2	16000	2	Decreasing	YES	Exposed to successional processes

The species *Dianthus galicicae* is assessed as Critically Endangered according to Criteria B1 and B2 (Table 3). The distribution of the species is highly limited. EOO (B1) and AOO (B2) are 4km^2. The process of succession of the species habitat (semi-natural grasslands) could be intensified in the future due to the absence of human activities that are crucial for its maintenance. The species exists at only one location and a decline in the quality of habitat was observed (3rd condition of b – decline in (iii) area, extent and/or quality of habitat).

The species *Centaurea galicicae* is assessed as Endangered according to Criterion D (Table 3). EOO and AOO are very small and restricted, but two conditions are not fulfilled (there are no continuing decline and/or extreme fluctuations in any of: (i) extent of occurrence; (ii) area of occupancy; (iii) area, extent and/or quality of habitat; (iv) number of locations or subpopulations; (v) number of mature individuals). However, the population size remains small, with approximately 230 mature individuals, allowing the application of Criterion D for the Endangered status.

The situation with *Centaurea soskae* is similar to *Centaurea galicicae*. EOO and AOO are very small and restricted, referred to CR, but two requisite conditions for such a status are not met. The species inhabits highly inaccessible terrain, providing a degree of protection against potential threats. Since the population size is very small and restricted, consisting of approximately 100 mature individuals, the species is assessed as Endangered according to Criterion D.

Rindera graeca develops on strictly protected zone, safeguarding it from any immediate risk of decline in EOO, AOO, quality of habitat etc. Although the distribution area refers to CR according to Criteria B1 and B2, 2 conditions are no fulfilled. The population size is very small (about 75 mature individuals) and the species is assessed as Endangered according to Criterion D.

The population size of the species *Helichrysum zivojinii* is significantly larger compared to the other plants that are the subject of this research. However, several threats, such as succession and the collection of live individuals, have been observed in this species, indicating its potential endangerment. The species is assessed according to Criteria B1 and B2 (Table 3). AOO and EOO refer to status EN. Ongoing declines in AOO, EOO, habitat quality, and the number of mature individuals have been observed, primarily due to the progressive encroachment of shrubs, resulting from the absence of livestock grazing.

Table 3. Final assessments of the species according to the IUCN methodology at the national level

SPECIES	FINAL ASSESSMENT
Dianthus galicicae	CR B1ab(iii) + 2ab(iii)
Centaurea galicicae	EN D
Centaurea soskae	EN D
Rindera graeca	EN D
Helichrysum zivojinii	EN B1ab(i,ii,iii,v)+2ab(i,ii,iii,v)

The proposed national assessments of the species (Table 3) can serve as a valuable baseline for regional assessments, given that these species are stenoendemic with very limited distributions (some are found only on both sides of Galichica Mt.). Considering their highly endangered status, it is crucial to implement appropriate conservation measures to prevent their extinction from natural habitats. Research findings indicate that it is essential to continue the evaluation process, particularly for endemic plants, to ensure their protection at both the national and international levels.

Acknowledgment. The investigations were part of a project supported by the Critical Ecosystems Partnership Fund (CEPF), the Prespa-Ohrid Nature Trust (PONT), and the Macedonian Academy of Sciences and Arts (MASA). Academician Vlado Matevski played a pivotal role in the comprehensive species assessment process as the project coordinator. We would like to express our profound gratitude for his altruistic contribution in sharing his extensive experience and deep knowledge of the Macedonian flora. It is both an honor and a privilege to have had the opportunity to learn from and collaborate with him. We would also like to thank the representatives of the Galichica National Park, Andon Bojadzi, Kliment Nanev and Dejan Dimidzievski, for their support in the field activities and the assessments of the species.

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ПРВА НАЦИОНАЛНА ПРОЦЕНКА СПОРЕД IUCN НА НЕКОИ РЕТКИ И ЕНДЕМИЧНИ ВИДОВИ ОД ГАЛИЧИЦА ВО РЕПУБЛИКА СЕВЕРНА МАКЕДОНИЈА

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РС Македонија

Во рамките на овој труд се прикажани првичните резултати од утврдувањето на статусот на засегнатост на национално ниво за неколку ретки и ендемични растенија од Националниот парк „Галичица“ во Република Северна Македонија, и тоа: *Dianthus galicicae* Micevski, *Centaurea galicicae* Micevski, *Centaurea soskae* Košanin, *Rindera graeca* (DC.) Boiss. & Heldr. и *Helichrysum zivojinii* Černjavski & Soška. Оцената беше предложена согласно со најновите насоки на IUCN-методологијата. Со примената на параметрите зададени од методологијата, се утврди дека *Dianthus galicicae* има критично загрозен статус, а *Centaurea galicicae*, *Centaurea soskae*, *Rindera graeca* и *Helichrysum zivojinii* се загрозени по различни критериуми кои се детално образложени во овој труд.

Клучни зборови: ендемити; флора; критично загрозени; загрозени; IUCN; Национален парк „Галичица“