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TAXONOMY AND HOROLOGY OF SECT. *ESKIA* WILLK. FROM THE GENUS *FESTUCA* (POACEAE) IN THE REPUBLIC OF NORTH MACEDONIA

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The genus *Festuca* is one of the largest genera in the family Poaceae. This article focuses on the basal group of narrow-leaved species within the genus, *Festuca* sect. *Eskia*, which is represented in Macedonia by several micro-species: *Festuca adamovicii* (St-Yves) Markgr.-Dannenb., *F. bosniaca* Kumm. & Sendtn., *F. galicicae* Horvat ex Markgr.-Dannenb., *F. kozanensis* Foggi & J. Müller, *F. valida* (Uechtr.) Penzes, and *F. jakupicensis* Kostadinovski. For each species, descriptions are provided, along with data on their distribution and ecology.

Key words: *Festuca*; *F. sect. Eskia*; North Macedonia; taxonomy; distribution

INTRODUCTION

The genus *Festuca* is one of the largest genera in the Poaceae family, distributed worldwide. It inhabits a variety of habitats, although it is predominantly found in grasslands, where it constitutes one of the most significant plant groups, both phytosociologically and economically. The number of species in the genus is estimated to range between 400 [1] and 500 [2–5], while according to POWO [6], there are 661 accepted species. One of the earliest and most comprehensive treatments of the genus in Europe is Hackel's *Monographia Festucarum europaearum* [7], which provides a critical synthesis of the knowledge about this genus in Europe up to that time. Hackel divided the genus into six sections—Sect. *Ovinae*, Sect. *Bovinae*, Sect. *Subbulbosae*, Sect. *Variae*, Sect. *Scariosae*, and Sect. *Montanae*—which included 28 species, 27 subspecies, 58 varieties, and 98 subvarieties, amounting to about 190 lower taxa. In this classification, species were considered in a broad sense (species *collectiva*), meaning some had quite complex taxonomic structures.

According to the results of numerous studies over the past two decades [5, 8–12], the genus is placed within the subtribe *Loliinae*, which comprises two major lineages: the "narrow-leaved" and "broad-leaved" taxa. Recent molecular-based taxonomic studies have recognized five subgenera, 10 sections, and two subsections within *Festuca*: subgen. *Festuca* (sect. *Festuca*, sect. *Aulaxiper*, sect. *Eskia*), subgen. *Schedonorus* (sect. *Schedonorus*, sect. *Plantynia*), subgen. *Leucopoa* (sect. *Leucopoa*), subgen. *Drymanthele* (sect. *Phaeochloa*, sect. *Scariosae*, sect. *Pseudoscariosa*), and subgen. *Subbulbosae* (sect. *Amphigenes*, sect. *Breviaristatae*) [10]. The taxa from subgen. *Festuca* are classified in the narrow-leaved lineage, while the taxa from the other subgenera are included in the broad-leaved phylogenetic line of the subtribe *Loliinae* [10, 13]. Some phylogenetic studies [12] have not confirmed the monophyly of certain sections, leading to the use of informal names for the major phylogenetic lineages.

This article provides an overview of the taxa from Sect. *Eskia* that have been recorded in North Macedonia. It includes basic nomenclatural data, a brief description of key characters, ecological data,

information on the ecological preferences of the individual taxa, and details on their geographical distribution, particularly within North Macedonia.

Sect. *Eskia* was first introduced by Willkomm [14] and initially included four *Festuca* species from the Iberian Peninsula, along with *Bellardiochloa variegata* (formerly *Festuca rhaetica*). Defined this way, the section comprises taxa whose lemmas feature a scarious apex that encloses the fruit, with an elongated ligule and thin basal leaf laminas. Some of these species, along with about ten others, were later incorporated by Hackel [7] into Sect. *Variae*, which contains taxa characterized by leathery-edged ligules that enclose the fruit, hairy ovaries, caryopses not fused with the palea, hilums exceeding the length of the caryopsis, conduplicate or convolute basal leaves, and a variety of ligule forms. Torrecilla et al. [15], based on phylogenetic data and morphological similarity, suggested that Sect. *Eskia* and Sect. *Varia* should be treated as synonyms. Ultimately, the Eurasian *F. sect. Eskia* and *F. sect. Dimorphae* were merged into the *Eskia-Dimorpha* group, which is considered the basal group of narrow-leaved species in the subtribe *Loliinae* Dumort. (FL *Loliinae*) [12].

Sect. *Eskia* is phylogenetically closest to Sect. *Amphigenes*, from which it is distinguished by the intravaginal type of sterile shoots. In Hackel's system, these two sections correspond to the series *Intravaginales* (synonymous with Sect. *Eskia*) and *Extravaginales* (synonymous with Sect. *Amphigenes*) within Sect. *Variae*. Sect. *Eskia* is also closely related to the Asian-American Sect. *Breviaristata* from the subgenus *Leucopoa*, with which it likely evolved in parallel in Europe until the early stages of the Alpine orogeny. Subsequently, Sect. *Breviaristata* disappeared from Europe, and the two groups became spatially separated [16]. During glaciation, northern species of Sect. *Eskia* were likely eradicated, while species from southern Europe persisted, descending to lower elevations where they interbred and hybridized. Due to their specific ecological requirements, taxa from this section were unable to spread into the plains [16].

According to Flora Europaea [17], 24 species of Sect. *Eskia* are recognized in Europe, with around 13 species and several subspecies recorded on the Balkan Peninsula, some of which are endemic to the region [17–23]. Tzvelev [16] suggests that the morphological and ecological differentiation of these species results from their affinity for higher mountain areas, which have been isolated for long periods. These taxa show pronounced morphological similarity, which can largely be at-

tributed to frequent hybridization, particularly polyploidization [24, 25]. As a result, there is some debate in the floristic and taxonomic literature regarding the status and extent of taxa within Sect. *Eskia* on the Balkan Peninsula. While some researchers support the recognition of micro-species [17, 20, 22, 23, 26–29], others argue that many of them are subspecies or even synonyms of one or a few broadly defined species [21].

In the floristic literature for North Macedonia, several taxa from Sect. *Eskia* are recorded, including *F. xanthina* R. et Sch. [30], *F. varia* Haenke [31–36], *F. varia* subsp. *cylleonica* Boiss. et Heldr. [37], *F. varia* subsp. *eu-varia* Hay. [38], *F. balcanica* (Acht.) Mgf-Dbg [36], *F. bosniaca* Kumm. & Sendtn. [36, 39], *F. bosniaca* subsp. *bosniaca* and *F. bosniaca* subsp. *jakupicensis* Kostadinovski [23], *F. pungens* Kit. [36], *F. galicicae* Mgf-Dbg [17, 40], *F. rechingerii* Mgf-Dbg [17, 23], *F. adamovicii* (St-Yv.) Mgf-Dbg [41, 23], *F. adamovicii* subsp. *bistrae* [39, 42], *F. valida* (Uechtr.) Penzes [23, 43], and *F. jakupicensis* Kostadinovski [44]. The latest revision of the genus *Festuca* in Macedonia [23] confirmed the presence of *F. adamovicii* (St-Yves) Markgr.-Dannenb., *F. bosniaca* Kumm. & Sendtn., *F. galicicae* Horvat ex Markgr.-Dannenb., *F. kozanensis* Foggi & J. Müller, and *F. valida* (Uechtr.) Penzes, and later described *F. jakupicensis* Kostadinovski [44].

MATERIALS AND METHODS

These studies included herbarium specimens deposited in the Herbarium of the Biological Institute, Faculty of Natural Sciences and Mathematics, in Skopje (MKNH). A wide range of Floras and Monographs on the genus *Festuca* were consulted during the identification process [3, 7, 17–21, 26, 27, 45, 47]. The taxonomic status of the taxa follows Flora Europaea (Markgraf-Dannenberg, 1980) [17]. Binomial nomenclature is based on the Global Names Verifier.

Macroscopic measurements of the specimens were conducted using an Optica stereomicroscope. The anatomy of the leaf laminas was examined through cross-sections, which were manually prepared at the upper part of the first third of the laminas. The sections were then drawn and analyzed under a Reichert microscope equipped with an Abbe prism. The drawings were affixed to the herbarium sheet of the specimen from which the corresponding section was obtained. The taxonomic characters analyzed and the methods employed for their measurement are based on widely accepted techniques in studies of the genus *Festuca* [7, 48–51].

The abbreviations for the names of the collectors are as follows: KM – K. Micevski; VM – V. Matevski; MK – M. Kostadinovski; RK – R. Kjushterevska; AI – A. Ivanova; VV – V. Vezenkova.

RESULTS

Festuca L., Sp. Pl.: 73 (1753) [Gen. Pl. ed. 5: 33 (1754)]

Typus: *Festuca ovina* L. [Nash, 1913: 269]
subgen. *Festuca*

Sect. *Eskia* Willk. in Willk. & Lange, Prodr. Fl. Hispan. 1: 95 (1861)

Typus: *Festuca eskia* DC. (Catalán & al., 2007)

Festuca bosniaca Kumm. & Sendtn., Flora, 32:756 (1849)

=*Festuca pungens* Kit., Oesterr. Fl., ed. 2: 237. 1814 [non *Festuca pungens* Lam. 1779]
=*Festuca duriuscula* var. *pungens* Lamotte, Catal. Pl. Vasc. : 99. 1847
=*Festuca varia* var. *croatica* Hack. In Acta Mus. Nat. Hung. 2: 295. 1878
=*Festuca varia* var. *pungens* Hack. in Bot. Centralbl. 8: 408 (1881)
=*Festuca varia* subsp. *pungens* (Lamotte) Nyman, Consp. Fl. Eur.: 827. 1882

=*Festuca pungens* var. *chlorantha* Beck in Wiss. Mitt. Bosnien & Herzegovina 9: 451 (1904)
=*Festuca pungens* f. *albanica* Hayek in Denkschr. Akad. Wiss. Wien, Math.-Naturwiss. Kl. 99: 220 (1924)
=F. *varia* subsp. *pungens* (Kit.) Hay. Prodr. 3:286 (1933+)

=*Festuca varia* subsp. *pirinensis* Acht. in Izv. Tsarsk. Prir. Inst. Sofiya 11: 71 (1938)
=*Festuca pirinensis* (Acht.) Acht. in Izv. Bot. Inst. (Sofia) 3: 42 (1953)

=*Festuca bosniaca* subsp. *pirinensis* (Acht.) Markgr.-Dann. in Bot. J. Linn. Soc. 76: 327 (1978)
=*Festuca bosniaca* subsp. *chlorantha* (Beck) Markgr.-Dann. in Bot. J. Linn. Soc. 76: 326 (1978)

Description

A densely tufted plant with intravaginal sterile shoots. Stem 30–78 cm in height, rough below the panicle. Leaves (0.65) 0.7–1.15 mm, rush-like, ± pointed, glabrous, slightly rough toward the tip. The cross-section is elliptical to elliptic-oval, with a continuous subepidermal ring; veins (7–) 9; ribs

(5–) 7, protruding, rounded, with well-developed sclerenchyma in all or sometimes absent in the middle rib; ribs are hairy. The ligule is 0.2–0.5 (1) mm, with small bristles. Sheaths are completely glabrous or with fine hairs, cut almost to the base. The panicle measures (5) 7–9 (10) cm in length, almost erect or drooping, with rough branches. Spikelets are 9.0–12 mm long, elongated-lanceolate, violet-streaked. The upper glume is (4.5) 5–6.5 mm long, 2–2.2 mm wide, ovate-lanceolate to lanceolate, acuminate at the apex, glabrous. Lemma (5) 6–8.5 mm long, about 3 mm wide, ovate-lanceolate, glabrous; the awn is 1–2 mm long. Palea is approximately as long as the lemma, with cilia $\frac{1}{3}$ – $\frac{1}{2}$ the length of the lateral keels, slightly hairy in the upper part. Lodicules measure 0.8–1 mm, incised, with the smaller segment sometimes divided into two parts. Anthers measure 2.5–3.5 mm.

Global Distribution: Southern Italy, the mountains of the Balkan Peninsula (Albania, Bulgaria, former Yugoslavia) [7, 17, 27, 45, 52].

Distribution in North Macedonia:

• **Literature data:** Jablanica [38] (sub *F. varia* Haenke ssp. *eu-varia*); Korab; "Macedonian mountains" [36]; Jakupica [41]; sub *F. bosniaca* subsp. *bosniaca*; Bistra: Kjurkov Dol – Kosenica [42]; Stogovo (Gari); Jablanica (Vevchansko Ezero, Krivi Virovi, Crn Kamen, Strizak) [23].

Herbarium specimens (MKNH):

• Bistra: Rusin Brdo, on limestone, 1810 m, 21.07.1984 (KM); Kosenica, below the peak, on limestone, 1850 m, 16.07.1985 (KM); Kosenica, on limestone substrate, 1610 m, 16.07.1985 (KM); Maskarovec, on limestone, 1910 m, 20.07.1985 (KM); Skrka, on limestone, 1625–1650 m, 22.07.1985 (KM); Bistra peak, on limestone, 2100 m, 15.07.1987 (KM); Bistra peak, on limestone, 2050–2060 m, 21.07.1987 (KM).

• Stogovo: above the village Gari, on mountain pastures and scree, 1400–1500 m, 23.06.1998 (MK).

• Jablanica: "Chuma", on limestone scree and rocky terrain, 2000 m, 07.08.1986 (KM); Strizak – on the slopes of the peak and along the dried river between Strizak and Pupljak, 19.06.1993 (MK); high mountain pastures between Krivi Virovi, Vevchansko Ezero, and Crn Kamen, 18.06.1993 (MK).

Ecology

F. bosniaca is a cespitose plant typically found in high mountain pastures at elevations rang-

ing from 1900 to 2200 meters. It primarily grows on limestone substrates (such as Bistra, Stogovo, Jablanica – Chuma) and silicate rocks (e.g., Jablanica – Strizak, and between Krivi Virovi and Crn Kamen), especially on slabby and massive limestones with varying slopes and exposures. This species is commonly found in scree communities or clearings dominated by *Juniperus communis* subsp. *nana*. *F. bosniaca* is a characteristic species of the *Festucetum bosniaceae* community (Ht. 1930), which often occupies large areas throughout the Dinarides [52]. In Macedonia, *F. bosniaca* has been identified in the associations *Drypetum spinosae* (for the Macedonian mountains), *Linario-Valerianetum betrisceae* (Korab) [36], and as a characteristic species of *Senecio-Festucetum bosniaceae* [39], within the *Onobrychido-Festucion* alliance [36]. This community has been documented in the Bistra and Šar Mountains [36, 39], though it has only been confirmed in Bistra thus far.

Note

F. bosniaca is distributed across the western Balkans and southeastern parts of the Apennine Peninsula [7, 17, 27, 45]. Its range in the Balkans extends from the Slovenian-Croatian border region to Albania, following a northwest-southeast direction [52]. The majority of *F. bosniaca* populations are located in the Dinarides, with population density decreasing toward the northern and southern edges of the species' range. In the north, populations of *F. bosniaca* are gradually replaced by *F. calva*, while the southern populations, particularly those towards Albania, remain under-studied [52]. According to *Flora Europaea* [17], *F. bosniaca* is classified into three subspecies: subsp. *bosniaca*, subsp. *chlorantha*, and subsp. *pirinensis*. The typical subspecies is found in the western Balkans and southeastern Apennines, subsp. *chlorantha* is present in the former Yugoslavia and northern Albania, and subsp. *pirinensis* is an endemic taxon in Bulgaria. Specimens from Jakupica, previously identified as *F. bosniaca* subsp. *jakupicensis* [23], were later recognized as a distinct species, *F. jakupicensis* Kostadinovski [44].

Festuca jakupicensis Kostadinovski, Collection of Papers Devoted to Academician Kiril Micevski, MASA, 209–222 (2007)

≡ *F. bosniaca* subsp. *jakupicensis* Kostadinovski 1999

Holotype: Jakupica: Jurukova Karpa, calcareous soil, 1 July 1997 (leg. & det. M. Kostadinovski) (SKO).

Description

The stem is 28–44 cm tall, rough below the panicle. The laminas of the basal leaves are 0.65–1 mm in diameter, rush-like, spiny, glabrous, and smooth in the upper part, with dense, stiff retrorse hairs at the base. The leaves exhibit (8–) 9 (–10) nerves and 7–8 ribs, which are adorned with sparse papillae and lack trichomes. The ligule is about 0.5 mm long, and the leaf sheaths are densely covered with short hairs. The panicle measures 4–6 cm long and is loose, with 6–8 (14) spikelets. Spikelets are green or slightly streaked with violet, 7–9.5 mm long, and elliptically elongated before flowering. The upper glume is lanceolate, 5–6.5 × 2 mm, usually acuminate with a mucronate apex. The lemma is ovate-lanceolate, 5–6.5 × 2.8 mm, gradually acuminate, with an awn 1–2 (–4) mm long. The palea is as long as the lemma, with dense cilia along the longitudinal keels, longer in the upper third. The anthers measure 2.2–3 mm.

Global Distribution: North Macedonia [44]

Distribution in North Macedonia:

- Literature records: Jakupica – Jurukova Karpa [41] (as *F. bosniaca* subsp. *bosniaca*), Shilegarnik [23].
- New records: Jakupica – Solunska Glava; Rada Planina; between Ubava and Ostri Vrv.

Herbarium Specimens (MKNH):

- Jakupica: Jakupica Mountain, 10 July 1964 (KM); Solunska Glava, near the peak, on karst scree, 2450 m, 28 August 1981 (VV); Rada Planina, on limestone scree, 1750–1880 m, 25 July 1987 (KM & VM); Shilegarnik, above Vraca, on limestone scree and rocks, 1 July 1997 (VM & MK); Jurukova Karpa, limestone scree and rocks, 2000 m, 1 July 1997 (VM & MK); between Ubava and Ostri Vrv, mountain pastures, 2000–2250 m, 17 July 2011 (VM & MK).

Ecology

Limestone screes and rocks, less frequently found on mountain pastures. While precise data on its phytosociological affiliation is lacking, Horvat [37] mentions two provisionally identified taxa from sect. *Eskia* in Jakupica: "*F. varia* ssp. u.a." and "*F. cyllenica* (?)." These taxa are located in subalpine (the former) and alpine (the latter) pasture zones, within communities classified under the order *Seslerietalia coerulae* Br. Bl. It is reasonable to assume that one of these records pertains to *F. jakupicensis*, and the other to *F. kozanensis*.

Note

F. jakupicensis is closely related to *F. bosniaca*, with distinguishing features such as the length of the awn (typically over 1 mm) and the ribs on the adaxial side of the basal leaves, which are rounded and always contain sclerenchyma cells. Despite these similarities, *F. jakupicensis* is clearly differentiated from the typical subspecies of *F. bosniaca* by several key traits: shorter stems, more compact inflorescences, proportionally thinner laminas, as well as smaller, green spikelets and reduced glumes. Furthermore, *F. jakupicensis* is notably distinct from all species in sect. *Eskia* in Macedonia due to the spiny outgrowths on the upper side of the basal laminas, rather than the typical trichomes along the ribs. Similar to subsp. *chlorantha*, *F. jakupicensis* shares some characteristics, such as inflorescence length, basal leaf diameter, and ligule length. However, according to Flora Europaea [8], these subspecies are distinguishable by the greater number of veins in *F. jakupicensis*, which is a significant intraspecific differentiator. Compared to subsp. *pirinensis*, *F. jakupicensis* also differs by the consistent presence of sclerenchyma in the ribs, unlike subsp. *pirinensis*, whose ribs lack sclerenchyma.

F. valida (Uechtr.) Penzes, Borbasia 3:13 (1941)

≡ *Festuca varia* subsp. *valida* R.Uechtr. in J.Velenovsky, Fl. Bulg.: 620 (1891)

≡ *Festuca varia* var. *valida* Uechtr. ex St.-Yves Rev. Bretonne Bot. Pure Appl. 2: 101 1927

= *Festuca valida* subsp. *leilaensis* Markgr.-Dann. in Veröff. Geobot. Inst. ETH Stiftung Rübel Zürich 56: 167 (1976)

Description

Densely tufted plants with intravaginal sterile shoots. Stems are 40–68 cm tall. Leaves are rush-like, glabrous, with a diameter of (0.78) 0.90–1.30 (1.70) mm. The shortest leaves are 1/5–1/25 the length of the longest leaves within the tuft. Subepidermal sclerenchyma forms a strong ring, slightly thickened at the arms. Veins number (7–) 8–9 (–11), and ribs (5–) 7–8 (–9) are well-defined, rounded or slightly flattened, and usually all contain sclerenchyma cells. The ligule is 0.5–2.0 mm long, truncate or, rarely, rounded, with ciliate margins. Sheaths are glabrous or slightly hairy and open to the base.

The panicle is loose, drooping, and measures (6–) 8–11 (–12) cm in length. Spikelets are 11–14

(–16) mm long, containing 4–5 flowers. They are elongated, green, and slightly violet-streaked. The upper glume is lanceolate, 5–7 (8) mm long and 2.5 mm wide, gradually narrowing in the upper third, with a rounded or almost acuminate apex. Lateral veins extend to 2/3 of the glume length, and the glume margin is broadly hyaline in the upper section.

The lemma is 7–10 mm long and approximately 3 mm wide, lanceolate, acuminate, with a broad hyaline margin and slight violet streaking. The awn measures 0.2–1 (1.5) mm in length. The palea is as long as or slightly shorter than the lemma, with sparse hairs on the surface in the upper part. The keels of the palea are densely haired in the upper 1/2–2/3 and sparsely ciliate in the lower third. Anthers are (2–) 3–3.5 mm long.

Global Distribution: Bulgaria, Greece, North Macedonia [20, 26, 43, 45].

Distribution in North Macedonia:

- Literature data: Belasica – above the village Smolare (22 Karaula) [43].

- New data: Tumba, Sechena Skala; Osogovo – above the Sasa mine; Sokol – Gorna Bachija; Ruen; Toranica.

Herbarium specimens:

- *Osogovo*: "Sasa", mountain pastures, 17.07.1967 (KM); above "Sasa" mine, wet places, 1700 m, 18.07.1967 (KM); above "Sasa" mine, mountain pastures, 1690 m, 18.07.1973 (KM); Ruen slopes, mountain pastures, 2050 m, 19.07.1973 (KM); Makedonska Kamenica – below Sokol – Gorna Bachija, 1698 m, 29.08.2009 (VM); Ruen, mountain pastures and scree, 2250 m, 29.08.2009 (VM); above Toranica, high mountain pastures on silicate substrate, 1700–1900 m, 03.07.2004 (MK); between "Sokol" and "Ruen", high mountain pastures and scree on silicate substrate, 1760–2252 m, 03.07.2004 (MK);

- *Belasica*: village Smolare – "22 Karaula", upper boundary of beech forest, 14.07.1994 (MK); high mountain pastures between "Tumba" and "Sechena Skala", 23.07.2010 (MK)

Ecology

F. valida is found in high mountain pastures and habitats with large granite blocks, typically above the forest belt (1690–2250 m a.s.l.).

Note

F. valida (Uechtr.) Penzes stands out within sect. *Eskia* for its robust morphology, not only in

stem size but also in other morphological and anatomical features. It is differentiated into two subspecies: subsp. *valida* and subsp. *leilaensis* Markgraf-Dannenberg, based on differences in basal lamina diameter, spikelet length, and anther size [17]. Preliminary data suggests that the typical subspecies occurs in Belasica, while in Osogovo, subsp. *leilaensis* predominates; this hypothesis requires further validation. Notably, *F. valida* is the only species from Sect. *Eskia* found in the eastern mountains (east of the Vardar River) of North Macedonia, with other taxa occurring exclusively west of the river, in geologically younger mountain massifs.

F. kozanensis Foggi & J. Müller, *Willdenowia* 35: 242 (2005)

≡ *Festuca rechingeri* Markgr.-Dann., *Veröff. Geobot. Inst. ETH Stiftung Rübel Zürich* 56: 166 (1976) [non E. B. Alexeev, *Bjull. Moskovsk. Obsc. Isp. Prir.*, Otd. Biol. 80(2): 122 (1975)]

Holotype: Macedonia occidentalis, distr. Kozani, in the mountains of Pieria, on Mount Phlambouron, at an altitude of approximately 2000–2190 m, growing in pine forests. Collected by Rechinger, No. 18024, 1956 [20].

Description

A densely tufted plant characterized by intravaginal sterile shoots. The shortest laminas of the sterile shoots are 4–14 (18) times shorter than the longest ones. The stem is (30–) 54–80 cm in height, typically twice as tall as the basal leaves. The leaves measure 0.7–1.2 mm, with a continuous subepidermal sclerenchyma ring on the abaxial side, and 5–7(–9) ribs on the adaxial side, which are rounded or somewhat angular in shape and almost always contain sclerenchyma. The veins are 7–10 (–13) in number. The leaf sheaths are short-haired and closed for the lower 1/3–1/5 of their length. The ligule is (0) 0.2–1.2 mm long, rounded at the tip, with cilia along the edge. The panicle measures (5–) 6–9 (10) cm in length. The spikelet is 8–11 (12) mm long and contains 4–6 flowers. The upper glume is 4–6 × 1.8–2.2 mm, usually ovate-lanceolate to lanceolate, slightly rounded or gradually acuminate, with a rarely rounded apex. The lemma measures (5.5) 6–8 × 2.5–3 mm, ovate to ovate-lanceolate with a shortly acuminate apex; the awn is 0–1 mm long. The palea is equal to or slightly shorter than the lemma, with roughness along the keels up to 3/4 or fully, rough-haired on the dorsal side below the apex, and glabrous in the lower half. The anthers are 3–3.5 mm long.

Global Distribution: Greece [20]; Bulgaria [29]; North Macedonia [23]

Distribution in North Macedonia:

• **Literature Data:** Pelister (Muza, Shiroka); Nidze (peaks Kajmakcalan and Nidze; Belo Grotlo); Jakupica (Shashkovica, Jurukova Karpa) [25].

• **New Data:** Kozuf (Dve Ushi, Mala Rupa, Alchak, Kichi Kaja).

It is likely that all the data from Horvat (1933/34) [55] on Pelister and Nidze, and certainly some of the data from Jakupica, which mention *F. varia* s.l., actually refer to *F. kozanensis*.

Herbarium Specimens (MKNH):

• Pelister: Golemo Ezero, on pastures and peat bog. 12.07.1968 (KM); - in the vicinity of Golemo Ezero. 13.07.1968 (KM); - among the rocks near Golemo Ezero. 14.07.1968 (KM); Golemo Ezero, near silicate rocks. 2200–2270 m. 20.07.1995 (VM & MK); Golemo Ezero, on silicate scree and rocks near the lake. 2250 m. 08.07.2000 (VM & MK); along the path from Golemo Ezero to Orlovi Bari and Sapundzica; high mountain pastures. 11.07.1919 (VM, MK & RK); - below the peak Griva, on the way to Muza. 2150 m. 28.07.1989 (VM); - high mountain pastures on Muza and Baba. 25.07.1992 (MK); - above the village Nizhepole – Debel Rid. 08.07.2000 (VM & MK); - between the hunting lodge and Shiroka, in a community with *Bruckenthalia spiculifolia*. 1700–2000 m. 20.07.1995 (VM & MK); - between Kopanki and Jorgov Kamen, in a forest of Macedonian pine (*Pinus peuce*), near and on silicate rocks. 21.07.1995 (VM & MK)

• Nidze: Kajmakcalan, on mountain pastures near the monument of Dr. Reis, on silicate substrate. 2200–2270 m 23.08.1995. (VM & MK); - on mountain pastures on the peak Nidze, on silicate substrate. 2100–2360 m 24.08.1995. (VM & MK)

• Kozuf: on the peak of Dve Uši, on limestone. 1740 m 05.07.1961 (KM); Dve Uši, high mountain pastures and scree. 22.06.2002 (MK); - Kiči Kaja, clearings in beech forest. 04.08.2000 (MK); - Kiči Kaja, on limestone. 04.08.2000 (MK); - Kiči Kaja, mountain pastures on limestone. 18.07.2023 (MK & RK); - in beech forest along the road Smrdliva Voda – Alchak. 21.06.2002 (MK); Mala Rupa, high mountain pastures. 21.06.2002 (MK)

• Jakupica: Jurukova Karpa, below the rock, limestone scree and rocks. 1900 m. 01.07.1997. (VM & MK); - southern edge of Begovo Pole, limestone scree and rocks in the belt of *Pinus mugo*. 01.07.1997. (VM & MK); - Shashkovica, mountain pastures. 1800–1900 m. 28.06.2003. (VM & MK).

Ecology

Festuca kozanensis is a high-altitude species, typically found between 1600–2400 m, with a primarily oromediterranean distribution. On Mount Pelister, it occurs on silicate substrates, whereas on Nidže, Jakupica, and Kožuf, it inhabits both silicate and limestone geological substrates. The species thrives in open grassy habitats on deep soils and rocky terrain.

Note

This species was initially described under the name *Festuca rechingerii* Mgf-Dbg. However, as that name was already in use, the taxon was renamed *F. kozanensis* in reference to the mountain in Greece where it was first identified [53]. Similar to its closely related species *F. galicicae*, *F. kozanensis* is an oromediterranean element, extending its range as far north as Mount Jakupica. This northern reach aligns with Horvat's [37] observation that Mount Jakupica shares greater ecological similarity with Kajmakčalan than with Šar Planina.

F. adamovicii (St.-Yves) Mgf-Dbg., Bot. Jour. Linn. Soc. 76:326 (1978)

≡ *F. varia* Haenke subsp. *xanthina* Hack. var. *adamovicii* St.-Yves, Bull.Soc.Bot. France. 71:131(1924)

= *F. xanthina* R.S. var. *adamovicii* (St.-Yves) Mgf, Prodr.Fl.Pen.Balc. 3:231 (1933)

Description

Densely tufted plants with intravaginal shoots. Stems are 38–75 (-80) cm tall. The ratio between the shortest and longest basal leaves ranges from 1/4 to 1/17 (or as extreme as 1/24). Leaves are (0.6–) 0.7–1.16 (–1.25) mm in diameter, bristle-like to rush-like, glabrous, smooth, and slightly acuminate at the apex. In cross-section, the leaves are elliptical, with a continuous sclerenchyma ring that is uniformly thickened. The veins number (7–) 8–10 (–11), with ribs (5–) 6–8 (–9). Lateral ribs typically contain sclerenchyma, though some may lack it; the ribs are covered with long, dense hairs. Ligules measure (0.5–) 1.2–2.5 mm, lack auricles, and have glabrous or short, densely hairy sheaths that are open almost to the base.

The panicle is 5–9 (–11) cm long, slightly erect. Spikelets measure (9–) 10–12 (–13) mm, with 4–7 flowers that are often violet-streaked. The upper glume is 5–6.5 (–7.2) mm long, (1.6–) 2–2.5

mm wide, ovate-lanceolate, gradually acuminate, typically ± rounded at the apex, glabrous, with sparse bristles on the upper part of the keel. Lemma measures (5–) 6.5–8 (–9) mm by 2.2–3 (–3.2) mm, lanceolate, long-acuminate, with a short awn (0–1 mm). Palea is 5–7 mm long, usually shorter than the lemma or occasionally equal in length, with sparse hairs on the upper side below the apex, and glabrous or sparsely rough below; the keels have dense cilia extending up to 2/3 of their length. Anthers are violet, 2.5–4.5 mm long.

Variability:

Festuca adamovicii subsp. *bistrae* Micevski & Kostadinovski, MASA, Contributions XIV 1–2, 1994 [42].

Global Distribution: This Balkan endemic species is found in Serbia [45], Albania [17, 45], and the former Yugoslavia [17], including North Macedonia [23, 39, 41, 42].

Distribution in North Macedonia

- Literature data: Jakupica [41]; Bistra – Medenica [39, 42]; Šar Planina – Mal Elak, Elak, along the road to Lešnica; Dešat – Krčin, Korab and Kožuf – Kiči Kaja [23].

- New data: Bistra – Rusin Brdo, Sultanica, Trebiška Rupa; Korab – Projžaba, peak Ploča; Šar Planina – Lukovo Pole.

Herbarium Specimens (MKNH)

- **Dešat:** Mountain pastures and rocks above the village Bituše (1850–2000 m, 13.07.1963, KM); on limestone (23.06.1968, KM).

• Bistra:

- Kosenica, on limestone (1620 m, 16.07.1985, KM); below the peak, on limestone (1850 m, 16.07.1985, KM).

- Medenica: Pasture on limestone scree (1970 m, 22.07.1981, VM & MK); on limestone scree and rocks (1700–2000 m, 14.07.1994, VM & MK); below the peak on limestone scree and rocks (16.07.1994, VM & MK).

- Rusin Brdo: On limestone (1810 m, 21.07.1984, VM & MK); on limestone (1845–1900 m, 22.07.1984, VM & MK).

- Sultanica (1850–1915 m, 13.07.1985, KM); Trebiška Rupa (1850–1915 m, 12.07.1985, VM & MK); (2100 m, 24.07.1985, VM & MK).

• Korab:

- Kobilino Pole: On limestone (27.07.1994, KM); between the sheepfold Gabrovo and Kobilino Pole, on limestone (26.07.1994, KM).

- Projžaba: Mountain pastures on silicate (1700–1800 m, 17.07.1999, VM, RK & MK).

- Mountain pastures near peak Ploča (41.688018, 20.535586; 1958 m, 20.07.2023, AI).
- Kobilino Pole: High mountain pastures on silicate (16.08.2023, VM, RK & MK).

• **Sar Planina:**

- Between Elak and Lešnica near beech forest (1700 m, 02.07.1968, KM).
- Ceripašina: Mountain pastures on silicate (2000–2450 m, 05.07.1990, MK).
- Along the road to Lešnica (04.07.1990; 07.07.1993, MK); on limestone (06.07.1993, MK).
- Above the road to Lešnica, on rocks near the waterfall (09.07.1993, MK); in a community with *Vaccinium myrtillus* (09.07.1994, MK).
- On scree along the road to Lešnica, on silicate (08.07.1994, VM & MK); on limestone scree (08.07.1994, VM & MK).
- Above the waterfall along the road to Lešnica, in a community with *Festuca paniculata* (12.07.1996, VM & MK); spruce forest along the road to Lešnica (12.07.1996, VM & MK); on limestone (12.07.1996, VM & MK).
- Mal Elak (07.07.1994, VM & MK).
- Lukovo Pole: Subalpine pastures of the *Poion violaceae* alliance (41.8551910, 20.6276240; 11.07.2023, VM, RK & MK).

Ecology

The primary habitat of the species consists of high mountain pastures (1700–2500 m), typically located on limestone and silicate geological substrates. It is commonly found in heathlands with various shrub species, including *Vaccinium myrtillus*, *Bruckenthalia spiculifolia*, *Juniperus communis* subsp. *nana*, and others. *F. adamovicii* is a characteristic species within the *Festucetum bistriae* association (Micevski 1994), which develops on steep slopes of Rusin Brdo, located on limestone scree with a very shallow soil layer at altitudes between 1850 and 1950 m [39]. Additionally, the species is present in the *Seslerietum wetsteinii* association (Horv. 37), where it forms part of the *Onobrychido-Festucion* alliance, within the *Elyno-Seslerietea* class. Its notable cover value in certain areas, such as Maskarovec (Bistra), where it can reach 20–50 %, is also emphasized [39].

Note

The subspecies *F. adamovicii* subsp. *bistriæ* was described based on plant material collected from the Bistra mountain [42], where it is a signifi-

cant element in the vegetation of high mountain pastures [39]. This subspecies differs from the typical form in several morphological traits, mainly quantitative characteristics such as the diameter of the basal leaf laminae, the length of the ligules, spikelets, and glumes. The separation of this subspecies from the typical *F. adamovicii* is based on a limited number of traits that are not considered to have significant taxonomic value. Consequently, Kostadinovski [23] regards it as a synonym of *F. adamovicii*.

F. galicicae I. Horvat ex Markgr. Dannenb., *Bot. Journ. Linn. Soc.* 76(4):322–328 (1978)

Holotype: Makedonija, Galičica Planina, 2210 m, 9.7.1939, I. Horvat (ZA)

Description

The stem of *F. galicicae* reaches 40–60 cm (–72 cm) in height and is rough beneath the panicle. Leaves range from 0.65 to 0.95 mm (1.14 mm) in diameter, glabrous, and prickly, with the lower leaves typically 1/3 to 1/10 (1/15) shorter than the upper leaves. The leaves have (8–) 9–10 veins, with (6–) 7–9 ribs, usually rounded, and sclerenchyma bundles in all lateral ribs, though sclerenchyma is absent in 1–2 ribs. The ligule measures (0.5–) 1–2.3 (–3) mm, often with hairs on the exterior. The panicle is 5.5–9 (–10) cm long, nearly erect, with branches that bear sparse or dense bristly hairs. The spikelets range from (8–) 9–12 mm in length and contain 3–4 flowers, frequently with violet streaks. The upper glume is 5–7 mm long, 1.6–2.2 mm wide, lanceolate to ovate-lanceolate, gradually narrowing to an acuminate apex. The lemma is 6–8.2 (–9) mm long, 2.2–2.8 (–3) mm wide, lanceolate, acuminate, and may have an awn 0–1 (–1.5) mm long. The palea is 5–7 (–8) mm long. The anthers range from (2.5–) 3–4 (–4.5) and are typically violet.

Global Distribution:

This species is endemic to Galičica Mountain, found in North Macedonia [17, 40] and eastern Albania [17, 40, 54].

Distribution in North Macedonia:

• Literature Data: Galičica (locus classicus) [17, 40], Tomoros, Preslap, Magaro [23] (sub *F. adamovicii*)

• New Data: Stara Galičica – Tepeno, Dava Livada, Propas, Tesan Kamen, Tavan; Mala Galičica – Lako Signoj, Krle Gola Buka, Bigla.

Herbarium Material (MKNH):

• Galičica: on limestone. 1860 m. 22.07.1974 (KM); – on limestone. 1980 m.

19.08.1980 (KM); – western side, on limestone. 1950 m. 24.07.1980 (KM); – on limestone. 1800–1900 m. 18.06.1980 (KM); – on the pass between Ohrid and Prespa Lake. 31.05.1968 (KM); – on the pass between Ohrid and Prespa Lake. 31.05.1968 (KM); above Preslap, opposite the sheepfold, on deep soil. 1670 m 17.07.1980 (KM); – above Preslap, on deep soil. 1745–1820 m. 18.07.1980 (KM); – above Preslap, on limestone. 1925 m. 24.07.1980 (KM); – north of Preslap, on rocks. 1810 m. 24.07.1980 (KM); – Preslap, along the asphalt road, on limestone. 1600 m. 16.07.1980 (KM); – Preslap; on forest clearings and along the edge of beech forest. 1550–1650 m 21.07.1996. (MK); – Stara Galičica, on the saddle, on limestone. 31.05.1968 (KM); - Stara Galičica, on limestone. 1920 m. 26.07.1980 (KM); – Stara Galičica – along the road to the peak, in beech forest. 1750 m. 05.08.1984 (KM); - Stara Galičica, on limestone. 2050 m. 05.08.1984 (KM); - Stara Galičica – Magaro, high mountain pastures. 21.07.1996 (MK); Petrino – above the village Velestovo, on pasture on limestone. 1500–1650 m. 18.06.1984 (KM); high mountain pastures near the upper forest boundary, near limestone scree and rocks. 21.07.1996. (MK); - near the forest house, on forest clearings in beech forest. 1650–1750 m. 21.07.1996 (MK); Bigla, on limestone. 1555 m. 41°07'07" N, 20°53'20" E. 19.07.2008 (VM & MK)

Ecology

This species is restricted to locations with limestone substrates at altitudes between 1500 and 2200 m. It predominantly inhabits high mountain pastures, heathlands, and clearings in beech forests. It is commonly an element of the *Stipo-Festucetum* community [55] and often occurs in stands with *Juniperus communis* subsp. *nana*.

Comment

An oromediterranean species endemic to Galičica Mountain, *F. galicicae* is morphologically very similar to *F. adamovicii*, with differences mainly in the dimensions and shape of the upper glume and the number of ribs in the basal leaf laminae. These morphological distinctions are minimal, leading Kostadinovski [23] to consider *F. galicicae* a synonym of *F. adamovicii*. The species also shares pronounced morphological similarities with *F. kozanensis*, another oromediterranean species found in Greece, Bulgaria, and North Macedonia. It is expected that these two species might

have overlapping distributions, although there is no conclusive evidence to support this so far.

The IUCN status of *F. galicicae* is listed as Vulnerable under criteria B1ab(ii,iii)+2ab(ii,iii).

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ТАКСОНОМИЈА И ХОРОЛОГИЈА НА СЕКТ. *ESKIA* WILLK. ОД РОДОТ *FESTUCA* (POACEAE) ВО РЕПУБЛИКА С. МАКЕДОНИЈА

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Родот *Festuca* е еден од најголемите родови во фамилијата Poaceae. Во овој труд е опфатена основната група теснолисни видови од родот *Festuca*, Sect. *Eskia*, која во Македонија е претставена од неколку микровидови: *Festuca adamovicii* (St-Yves) Markgr.-Dannenb., *F. bosniaca* Kumm. & Sendtn., *F. galicicae* Horvat ex Markgr.-Dannenb., *F. kozanensis* Foggi & J. Müller, *F. valida* (Uechtr.) Penzes, и *F. jakupicensis* Kostadinovski. За секој од наведените видови е даден детален опис, како и податоци за неговата распространетост и екологија.

Клучни зборови: *Festuca*; F. Sect. *Eskia*; Македонија; таксономија; дистрибуција