

NEW RECORDS FROM THE MOSS FLORA OF IRAN

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Abstract

Despite Iran's climatic diversity, only 475 moss species have been reported from the country. The number of species increased to 476, including the species introduced here. So far, 59 species and three varieties of mosses have been reported from Lorestan Province; with the addition of the specimens presented in this research, this number rises to 60 species and four varieties. In this study, which focused on the diversity of mosses in Lorestan Province, a total of 120 moss specimens were collected through extensive field surveys during multiple trips. These specimens were subsequently identified using reliable references. In this paper, *Lewinskya tortidontia* and the *Pterygoneurum ovatum* var. *muticum* are reported for the first time from Iran. *Lewinskya tortidontia* differs from *L. affine* by the uniform distribution of hairs on the calyptra and the shape of the operculum, which is broad at the base and suddenly narrows into a short beak. *Pterygoneurum ovatum* var. *muticum* is distinguished from the other variety of this species *P. ovatum* var. *ovatum*, by the absence of a costa at the leaf apex.

Keywords: Biodiversity; Lorestan Province; mosses; *Lewinskya tortidontia*; *Pterygoneurum ovatum* var. *muticum*

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گزارش‌های جدید از فلور خزه‌ای ایران

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چکیده: علیرغم تنوع اقلیمی ایران، تا به حال فقط ۴۷۵ گونه خزه از ایران گزارش شده است. با احتساب

گونه‌های معرفی شده در این پژوهش، این تعداد به ۴۷۶ گونه افزایش می‌یابد. تاکنون، ۵۹ گونه و سه

واربته خزه از استان لرستان گزارش شده که با افزودن نمونه‌های معرفی شده در این پژوهش، تعداد این آرایه‌ها در استان به ۶۰ گونه و چهار واربته افزایش یافته است. در پژوهش حاضر که به بررسی تنوع خزه‌ها در استان لرستان پرداخته شده، با بررسی‌های میدانی و انجام سفرهای علمی متعدد، تعداد ۱۲۰ نمونه خزه جمع‌آوری و سپس با استفاده از منابع معتبر شناسایی شدند. در این مقاله گونه *Lewinskya tortidontia* و واربته *Pterygoneurum ovatum* var. *muticum* برای اولین بار از ایران گزارش می‌شوند. تفاوت *L. tortidontia* با گونه *L. affine* در توزیع یکنواخت کرک‌های موجود روی کلاهک (کالیپترا) و همچنین شکل درپوش (اپرکولوم) در اسپوروفیت است که در قاعده پهن و ناگهان به شکل یک منقارک تبدیل می‌شود. *P. ovatum* var. *muticum* از واربته دیگر این گونه *P. ovatum* var. *ovatum* در نداشتن سیخک در نوک برگ متمایز می‌شود.

INTRODUCTION

Mosses are small non-vascular plants, with more than 12,000 identified species worldwide, and they represent the most diverse group within the phylum Bryophyta (Buck & Goffinet 2000). Regarding the number of moss species reported from Iran, Kürschner & Frey (2011), in a comprehensive monograph that includes species identification keys, reported 426 moss species in the country as of 2011. Later, Ghahremaninejad (Ghahremaninejad & al. 2016) updated this number to 462 species, providing additional information about endemic mosses in Iran. According to Shirzadian (2022), the number has increased to 470 species, based on reliable sources and research reports. Recent publications have raised this figure to 475 species (Ahmadi & al. 2024). This ongoing increase highlights the remarkable moss diversity in Iran and underscores the need for detailed studies and conservation efforts for this plant group across the country, including Lorestan Province. So far, 59 species and three varieties of mosses have been reported from Lorestan Province (Ahmadi & al. 2004; Ahmadi & al. 2007; Ahmadi & al. 2024; Akhane & Kürschner 2004; Shirzadian 2022; Shirzadian 2008), which increases to 60 species and four varieties with the samples introduced in this study. In other words, the moss flora of Lorestan Province accounts for approximately 13.6% of all moss species recorded in Iran.

The Zagros Mountains predominantly cover Lorestan Province and exhibit diverse climates, including cold semi-humid in the northern, central, and parts of the south; highland climate in the southeast; temperate semi-arid in the west and southwest; and temperate semi-humid in parts of the south (Yarahmadi and Beiranvand 2014).

This geological and climatic diversity has provided a suitable environment for the growth of various moss species.

The family Pottiaceae in Iran comprises 17 genera, 69 species, seven varieties, and one subspecies. The

genus *Pterygoneurum* JUR. is present in Iran with one species.

The family Orthotrichaceae is recognized as the fifth largest moss family globally, comprising 24 genera and approximately 900 species with a worldwide distribution (Wilbraham 2022). This family has one genus and 11 species known in Iran (Ghahreman & al. 2003; Akhane & Kürschner 2004).

Among the mosses collected from Lorestan province between 2021 and 2023, *Pterygoneurum ovatum* var. *muticum* and *Lewinskya tortidontia* (F. Lara, Garilleti & Mazimpaka) F. Lara, Garilleti & Goffinet (Lara & al. 2016), are reported here for the first time from Iran.

MATERIALS & METHODS

Plant specimens were collected from different regions of Lorestan province between 2021 and 2023. Samples were collected in paper bags, and field data were recorded. The samples were air-dried at room temperature and stored in the standard paper packet. For morphological observations, the samples were soaked in hot water for a few minutes for their revival. The whole leaf and leaf sections were observed under the microscope (Olympus-BH2) and photographed. Identification of the specimen was made using Smith (2004), Kürschner (2007), Kürschner & Frey (2011), and the online flora at Floranorthamerica.org. The voucher specimens were preserved in the Herbarium of the Shahid Beheshti University (HSBU) and the Herbarium of the Iranian Research Institute of Plant Protection (IRAN). In addition, a species distribution map (Fig. 1) and a complete description of the species, along with their ecological information, are provided.

RESULTS & DISCUSSION

Lewinskya tortidontia (F. Lara, Garilleti & Mazimpaka) F. Lara, Garilleti & Goffinet. (Fig. 3).
Syn. Orthotrichum tortidontium F. Lara, Garilleti & Mazimpaka

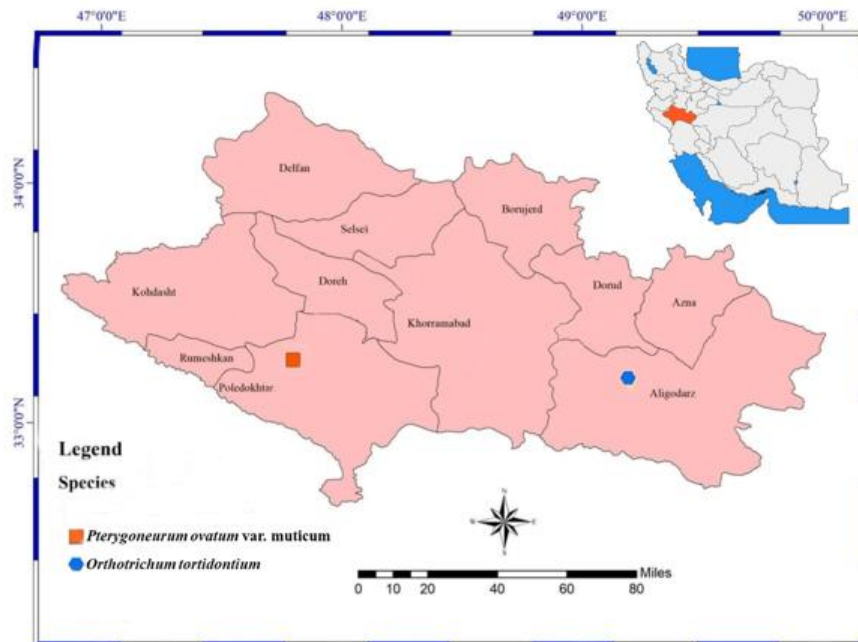


Fig. 1. Distribution map of the new records in Iran, Lorestan Province.

Subgenus *Gymnopus* (Braithw.) Limpr.,
Section *Affinia* Schimp (Lara & al. 1996).

An olive-green moss, up to 2 cm high. Stem branched, mostly in the upper parts. Leaves erect-appressed when dry, patent to erect-patent when moist, lanceolate, acute, carinate in cross section; costa strong and prominent; margins entire, slightly papillose-crenulate, recurved above, sometimes plane in the lower part; in young leaves, margins variable. Basal cells smooth, oblong with thick walls, cells towards the margin short, oblong to square, with thick and smooth walls, median cells elliptic or rarely isodiametric, with thick walls, and variously papillose with 1-3 large papillae. Seta 0.6 to 1 mm, capsule emergent, cylindrical when dry, ovoid-cylindrical when moist, narrowed to seta, ripe capsules pale yellow, turning brown when old, with 8 vertical striae; stomata in middle of the capsule, superficial, guard cells well differentiated; calyptra with scattered hairs; Operculum abruptly rostrate with plane base; peristome teeth double, exostome teeth pale yellow, eight pairs, after detachment of operculum divided into 16 independent teeth, irregularly twisted, reflexed and blunt in mature capsules, peristome teeth slightly or completely perforated.

Examined specimen: Aligodarz, Shulabad, July 2023, 1545 m. above sea level, on *Pterocarya fraxinifolia* trees, Ahmadi and Sepahvand (SBUH 2019999).

Lewinskya tortidontia was found in a very humid, cold climate at an altitude range of 1600 to 2000 m. on a slope of 10 to 20%. It was first described by Lara & al. (1996) from Spain and Morocco as an epiphyte growing on oak trees (*Quercus ilex* L. & *Q. canariensis* Willd.) and various species of conifers in the region (*Juniperus oxycedrus* L., *Cedrus atlantica* Manetti & *Abies pinsapo* Boiss.). In Lorestan, this species grows as an epiphyte on the trunks and branches of Larch trees (*Pterocarya fraxinifolia* (Lam.) Spach.).

Lewinskya tortidontia is very similar to *L. affine* and is sometimes confused with it. The difference is in the hairs on the calyptra, which are located on the upper part of the calyptra in *L. affine*, but are scattered almost throughout the calyptra in *L. tortidontia*. The second important difference is in the shape of the calyptra, which in *L. tortidontia* has a wide base that suddenly turns into a beak, but in *L. affine* it has a convex base that turns gradually into a long beak.

Geographical distribution: Turkey, Spain, and Morocco (Lara & al. 1996).

Threat: Like other native bryophytes and plants in Lorestan province, this moss species is highly vulnerable to climate change. Aridification trends and shifting rainfall patterns in the region's temperate semi-arid microclimate deplete water resources and alter soil structure, posing a threat to its survival. Protecting this species and its surrounding ecosystems is essential to ensure its persistence and maintain regional plant diversity.

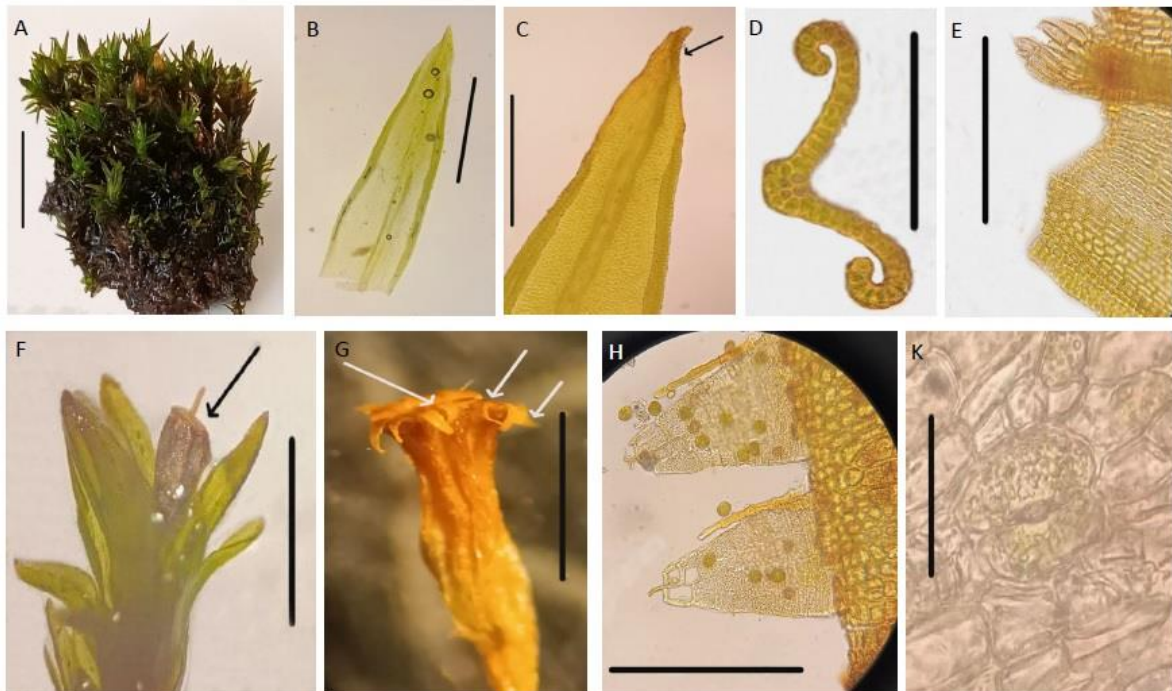


Fig. 2. *Lewinsky tortidontia*: A, Habit (1 cm.); B, leaf (1 mm); C, twisted leaf apex (5 mm.); D, transvers section of leaf; E, basal cells of the leaf (200 μ m); F, operculum, arrow indicates the plane base of it (2 mm.); G, capsule, Arrows indicate twisted teeth of the exostome (1 mm.); H, exstome and endostome teeth (200 μ m); K, stomata guard cells (20 μ m).

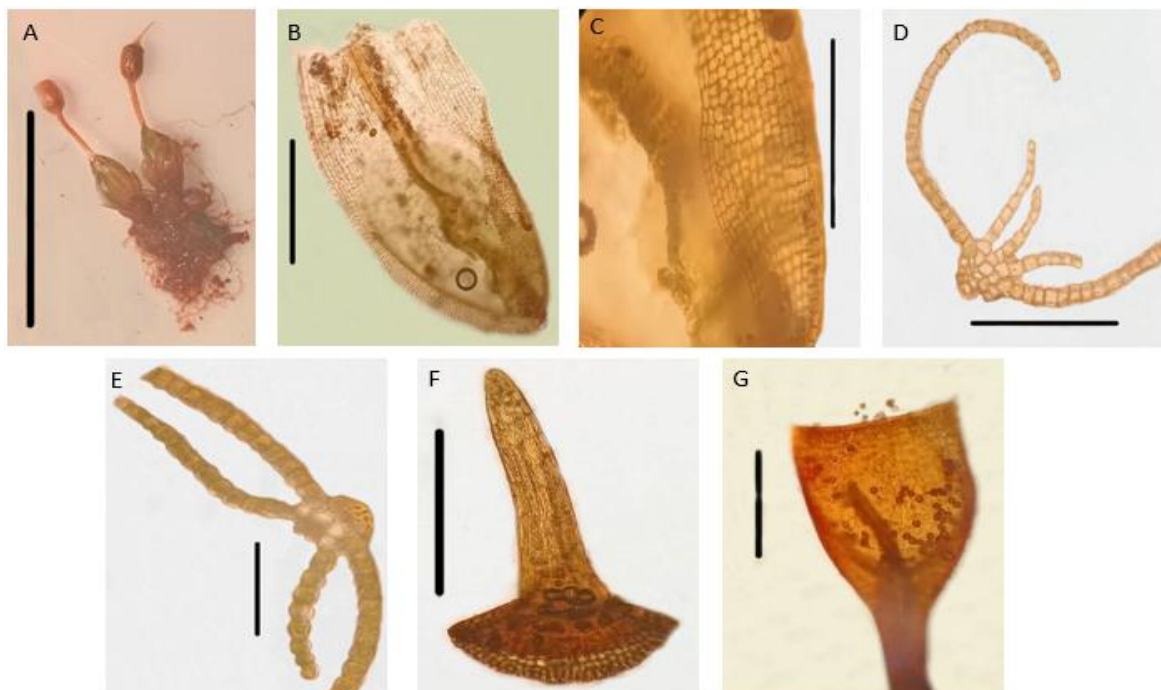


Fig. 3. *Pterygoneurum ovatum* var. *muticum*: A, habit (5 mm); B, leaf (400 μ m); C, cells in the middle and margin of the leaf (200 μ m); D & E, leaf section with its lamella (respectively 200 & 100 μ m); F, operculum; G, capsule (400 μ m).

Pterygoneurum ovatum (Hedw.) Dixon. var. *muticum* Schiffn. (Fig.3)

Small greenish or sometimes hoary patches, 1-2 mm high. Leaves imbricate when dry, \pm imbricate or erect-patent when moist, distinctly concave, ovate, obovate to obovate-spathulate, obtuse; margins \pm plane, entire; costa ending in apex, hair-point absent; upper part of leaf with 2-4 green lamellae on adaxial side; cells in lower part of leaf rectangular, hyaline, cells above quadrate-hexagonal, incrassate, slightly papillose, 10-18 μ m wide in widest part of leaf, smaller towards margins and apex. Setae 2-3 mm long; capsules ovoid or ovate-ellipsoid, erect, straight, dark purplish brown, sulcate when dry and empty; lid obliquely rostrate with cells in straight rows; peristome lacking.

Specimen examined: Lorestan, Khorramabad to Pol Dokhtar route, Malawi, on soil bed, altitude 766 m, February 2023, Ahmadi and Sepahvand (SBUH 2020000).

This region is semi-arid and has temperate microclimates and is geologically located in the Kashkan Formation, which has red conglomerate, sandstone, and siltstone.

Pterygoneurum ovatum var. *ovatum*, which has been reported from Afghanistan, Iraq, Iran, Jordan, Israel, Kuwait, and Turkey, has spines at the leaf tip, while *Pterygoneurum ovatum* var. *muticum*, which was identified and introduced in this study, lacks spines at the leaf tip (Kürschner & Frey 2011). The genus *Pterygoneurum* has 15 species (Brinda & Atwood 2025; Otnyvkova 2020), which are widely distributed in terrestrial habitats and have blades on the ventral surface of the leaf costa. According to current studies, this genus is known to have five to six species in Europe. *Pterygoneurum ovatum* is the most common species of this genus and is used for stabilizing dry soils (Flowers 1973).

Geographical distribution: Iran, Iraq, Syria, and Greece.

Threats: Due to its occurrence on slopes alongside the main Khorramabad to Pol-e Dokhtar road, its habitat is subjected to significant anthropogenic threats. The primary risk originates from road expansion and development activities, which are likely to induce soil erosion, compaction, and consequently, degradation of the species' natural habitat. Meanwhile, the ongoing vehicular traffic contributes to environmental pollution through emissions of air pollutants and the accumulation of particulate matter, resulting in alterations to local microclimatic conditions that can negatively affect the physiological health of the plant. Additionally, the site is vulnerable to recurrent severe

flooding events, which pose a risk to ecological disturbances to this species.

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