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A new species of *Circinaria* (*C. yiae*) from China revealed by morphological and molecular evidence, with the elevation of *C. hispidoides* to species rank

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ABSTRACT: A survey of lichen diversity in the eastern Inner Mongolia (Northeast China) has revealed a new species of the genus *Circinaria* described herein based on morphological and molecular evidence. The new species, *Circinaria yiae*, is characterized by its saxicolous, crustose, rimose to areolate, greyish olive-brown thallus surrounded by a white-grey prothallus. Peripheral lobes of thalli are enlarged and elongated, giving it a lobate appearance. Central areoles are moderately to strongly convex, producing pseudocyphellae and forming simple or branched suberect to prostrate projections. Thallus lacks secondary lichen metabolites. Phylogenetic analysis including other *Circinaria* species showed that the new taxon is phylogenetically close to *Aspicilia* (*Circinaria*) *wyomingensis* that differs from the newly described species by growing on soil and plant detritus, forming rhizomorphs, and containing aspicilin. *Aspicilia desertorum* var. *aspera* f. *hispidoides* Mereschk. is moved to *Circinaria* and raised to the species rank, *C. hispidoides*.

KEY WORDS: *Aspicilia*, *Circinaria aspera*, *Circinaria tortuosa*, Lecanoromycetes, lichens, Pertusariales, taxonomy.

INTRODUCTION

The genus *Circinaria* Link, comprising ca. 40 species, is the second largest after *Aspicilia* A. Massal. in the family Megasporaceae (Sohrabi *et al.*, 2024). In the last decade several new *Circinaria* species were described from China (Ismayil *et al.*, 2019; Ren *et al.*, 2025a,b), Greece (Sohrabi *et al.*, 2023), Iran (Sohrabi *et al.*, 2024), Italy (Nascimbene *et al.*, 2023), Pakistan (Iqbal *et al.*, 2024; Zulfiqar *et al.*, 2024) and the USA (McCune and Di Meglio, 2021).

Species within *Circinaria* represent a wide variety of growth forms, including fruticose, crustose and umbilicate taxa (Sohrabi *et al.*, 2013) and the same taxon can have a different morphology as it has been recently found in *C. tominii* (Oxner) Sohrabi (Paukov *et al.*, 2024). The most species-rich group are crustose species which have a primarily saxicolous habit. Truly fruticose *Circinaria* species are represented by three known species with two subspecies growing on soil in arid regions of Eurasia and North America (Rosentreter, 1998; Nordin *et al.*, 2010; Owe-Larsson *et al.*, 2011; McCune and Di Meglio, 2021). The intermediate morphological group in *Circinaria* which possesses simple or branching vertical projections on a residing crustose thallus is similarly not numerous and generally assigned to *Circinaria aspera* (Mereschk.) Sohrabi & Şenkard. Another species, *Circinaria tortuosa* (H. Magn.) Q. Ren similarly tends to produce branch-like protuberances in older parts of the thallus (Magnusson, 1940; Ren and Zhang, 2018).

Eastern Inner Mongolia is mainly dominated by temperate monsoon climate, and the annual rainfall of most region is between 300 and 800 mm. However, Xin Barag Youqi is the exception. It belongs to the arid area with the annual rainfall about 200 mm. This county is located in the Inner Mongolia of Northeast China, which shares borders with Mongolia and Russia. In July 2022, while returning from a lichen diversity survey of Ergun City, Ms. Liqin Yi took several short stopovers to investigate lichen resources along the National Way in Xin Barag Youqi. There, she found several lichen species on rock, and one of them was recognized as a *Circinaria* species with large thalline projections. After an analysis using the morphological and molecular evidence the initial supposition that the material belongs to *Circinaria tortuosa* had been declined and it represents a species new to science, that is described here.

MATERIALS AND METHODS

Samples, morphology and secondary chemistry: The specimens studied were collected from east region of Inner Mongolia in Northeast China, Russia and Kazakhstan, and are deposited in the herbaria of HMAS (Institute of Microbiology, Chinese Academy of Sciences), KUN (Kunming Institute of Botany, Chinese Academy of Sciences), LE (Komarov Botanical Institute

of the Russian Academy of Sciences), TAI (National Taiwan University), UFU (Ural Federal University) and W (Naturhistorisches Museum Wien).

Morphological characters of all specimens were studied using a Cnoptec SZ680 dissecting microscope and a Cnoptec BK6000 compound microscope and images were captured using an attached Cnoptec digital camera. Spot tests with K (10% aqueous solution of potassium hydroxide), C (saturated solution of calcium hypochlorite), Pd (solution of p-phenylenediamine in 95% ethyl alcohol) were performed on the cortex and medulla along with UV reactions. Lichen secondary metabolites were analyzed by using standardized thin-layer chromatography (TLC) with solvents A, B and C (Orange *et al.*, 2010).

To assess the phylogenetic relations among *Circinaria yiae* and other *Circinaria* species, nuclear internal transcribed spacer (ITS) sequences of *C. yiae* and other sequences retrieved from the NCBI database (GenBank) were used. Our sampling comprised 31 species of *Circinaria* and *Lobothallia pruinosa* Kou & Q. Ren was chosen as outgroup (Kou *et al*., 2013; Zhang *et al*., 2024). The information for all samples, including GenBank accession numbers, is given in **Table 1**.

DNA extraction, amplification and sequencing: Genomic DNA was extracted from the specimens using Plant Direct PCR kit (Tiangen, Beijing, China) according to the manufacturer's instructions. The partial region of the internal transcribed spacer (ITS) was amplified using the ITS5 and ITS4 primers. Methods used for DNA extraction, amplification and sequencing follow Yao *et al*. (2021), and Zhao and Jia (2022).

Phylogenetic analysis: DNA sequences were assembled and edited with the program Geneious v. 9.0.2 (Biomatters Ltd., Auckland, New Zealand). The assembled sequences were aligned with the online version of MAFFT V.7.505 (https://mafft.cbrc.jp/alignment/server/) and manually corrected in Bioedit v. 7.2.5 (Hall, 1999). The maximum likelihood analysis was conducted with the RAxML-HPC 2 on ACCESS v. 8.2.12 employing a GTRGAMMA approximation with a rapid bootstrap analysis of 1000 replicates on the CIPRES Scientific gateway portal (http://www.phylo.org/portal2/) (Miller *et al*., 2010; Stamatakis, 2014) for verification. In the Bayesian analyses, General time reversible (the GTR+I+G model) was selected as the optimal model according to Akaike Information Criterion (AIC) by ModelFinder V2.2.0 (Kalyaanamoorthy *et al.*, 2017). Bayesian analyses were performed with the Markov chain Monte Carlo (MCMC) method by using MrBayes v.3.2.7 (Ronquist *et al.*, 2012), with trees sampling every 1000 generations, and the run was automatically stopped when the average standard deviation of split frequencies reached below 0.01. The value of burn-in was set to discard 25% of trees when calculating the posterior probabilities. Bayesian posterior probabilities were obtained from the 50% majority rule consensus of the trees kept. Generated phylogenetic trees were visualized under Figtree v. 1.4.4, then edited in Adobe Illustrator CC2019 software. Bootstrap support values and Bayesian posterior probability were noted onto the best scoring tree (**Fig. 1**).

RESULTS

Two ITS sequences were successfully obtained from the specimens of *Circinaria yiae*. The maximum likelihood (ML) tree generated by RAxML has the same topology as the Bayesian inference analysis (BI) tree in the position of taxa; we therefore present only the ML tree, with bootstrap support ≥ 50% for the ML analysis and posterior probabilities ≥ 0.60 for the Bayesian analysis.

The phylogenetic tree (**Fig. 1**) shows that the target specimens (*Yi 8519* & *8522*) formed a well-supported clade in both Bayesian and ML analyses (BS = 100, BPP = 1.0), and were also revealed as morphologically different from all known species of the genus (see notes below) and therefore we describe *Circinaria yiae* here as new to science. The new species belongs to the same large supported group (BS = 89, BPP = 0.78) as *Circinaria aspera*, as well as some vagrant species like *C. affinis* (Eversm.) Sohrabi, *C. cerebroides* (Mereschk.) Sohrabi, *C. esculenta* (Pall.) Sohrabi, *C. lacunosa* (Mereschk.) Sohrabi, and fruticose *C. hispida* (Mereschk.) A. Nordin, S. Savić & Tibell but appears relative neither to *C. tortuosa* nor to other vagrant species, such as *C. alpicola* (Elenkin) Sohrabi, *C. fruticulosa* (Eversm.) Sohrabi and *C. gyrosa* Sohrabi, Sipman, V. John & V. J. Rico (**Fig. 1**).

TAXONOMIC TREATMENTS

Circinaria yiae Q. Ren, Paukov & Davydov, ***sp. nov.***
衣氏野粮衣 Fig. 2

MycoBank No.: MB 860706

Type: China, Inner Mongolia, Xin Barag Youqi, 15 km southwest of Hulun Town, to the west side of National Road 331, 49°16'3"N, 117°1'6"E, on the pebbles of rhyolite, alt. 850 m, 26 July 2022, *L.Q. Yi 8519* (holotype in HMAS, isotype in KUN and TAI).

Diagnosis: Differing from *Circinaria tortuosa* in thinner thallus, and lack of tortuous, lobe-like areoles with large parts of surface denudated.

Description: Thallus crustose, usually greyish olive-brown, grey-brown, ochre, whitish-grey, dull, and slightly pruinose, 1.8–4 cm diam., (0.1–)0.3–0.5(–2) mm thick, rimose to areolate. Areoles angular to irregular in form, flat to contiguous or rarely dispersed. Central areoles usually pruinose, moderately to strongly convex, rounded, (0.2–)0.4–0.7 mm diam., sometimes verrucose or papillate. Peripheral areoles different from the central areoles, usually elongated and enlarged, forming a lobate appearance, 1.2–1.8 × 0.5–0.8 mm. Prothallus well developed along the thallus edge, forming a white-grey

Table 1. GenBank accession numbers and voucher information of specimens used in this study. New sequences are in bold.

Species	GenBank Accession number	Voucher information (herbarium)
Aspicilia wyomingensis	MZ536768	USA, *McCune 37169* (OSC)
A. wyomingensis	MZ536769	USA, *McCune 37196* (OSC)
A. wyomingensis	MZ536771	USA, *McCune 37199* (OSC)
Circinaria affinis	OR900246	Russia, *Paukov 1983* (UFU)
C. affinis	OR681933	China, *Ren 3264* (SDNU)
C. alpicola	JQ797524	Kyrgyzstan, *Ringel & Jaschhof 5183* (H)
C. alpicola	JQ797552	Kyrgyzstan, *Ringel 5137* (H)
C. aschabadensis	GU289916	Turkmenistan, *Borisova s.n.* (LE)
C. aschabadensis	JQ797519	Turkmenistan, *Borisova s.n.* (LE)
C. aspera	**PX131113**	**Russia, Astrakhan oblast, *Paukov 3038* (UFU)**
C. aspera	**PX131114**	**Russia, Astrakhan oblast, *Paukov 3042* (UFU)**
C. calcarea	MN989228	Greece, *Sipman & Raus 63719* (B)
C. calcitrapa	JF703113	France, *Roux 24309* (MARSSJ)
C. cerebroides	JQ797529	Kyrgyzstan, *Ringel & Jashhof 5180* (H)
C. cerebroides	JQ797534	Kyrgyzstan, *Ringel 5138* (H)
C. contorta	LT671470	Sweden, *Fröberg 09–44i* (UPS)
C. digitata	HQ171230	Kyrgyzstan, *Ringel & Jaschhof 5185* (H)
C. digitata	HQ171236	Kyrgyzstan, *Ringel & Jaschhof 5185–B* (H)
C. elmorei	JQ797526	Iran, *Sohrabi 10405* (IRAN)
C. elmorei	JQ797542	Iran, *Sohrabi 10128* (IRAN)
C. esculenta	HQ406803	Russia, *Owe–Larsson 9824* (UPS)
C. esculenta	JQ797511	Russia, *Owe–Larsson 9796* (UPS)
C. fruticulosa	OR523872	China, *Ren 3251* (SDNU)
C. fruticulosa	HQ171229	China, *Abbas 940001* (H)
C. gyrosa	JQ797528	Iran, *Sohrabi 10401A* (Herb. M. Sohrabi)
C. gyrosa	JQ797539	Iran, *Sohrabi 9496* (Herb. M. Sohrabi)
C. hispida	OR523875	China, *Ren 3250* (SDNU)
C. hispida	OR900362	Russia, *Paukov 1959* (UFU)
C. hispidoides	**PX260296**	**Russia, Astrakhan oblast, *Paukov 3267* (UFU)**
C. hispidoides	**PX260297**	**Russia, Astrakhan oblast, *Paukov 3267-1* (UFU)**
C. hispidoides	**PX260298**	**Russia, Astrakhan oblast, *Paukov 3276* (UFU)**
C. hispidoides	**PX260299**	**Kazakhstan, *Ivanov s.n.* (UFU L-1749)**
C. hoffmanniana	LT671465	Sweden, *Nordin 5917* (UPS)
C. hoffmanniana	LT671466	Sweden, *Fröberg 09-44c* (UPS)
C. jussuffii	JQ797518	Algeria, *Esnault 2033* (GZU)
C. jussuffii	JQ797521	Morocco, Vězda: *Lich. Sel. Exs. No. 2381* (H)
C. lacunosa	OR523876	China, *Ren 4051* (SDNU)
C. lacunosa	JQ797520	Kazakhstan, *Peregoudov s.n.* (LE)
C. laxilobata	KP219719	China, *Ismayil & Abbas 20111099* (HMAS)
C. laxilobata	KP219720	China, *Ismayil & Abbas 20111049* (HMAS)
C. mansourii	OM273291	Russia, *Paukov 3285* (UFU)
C. ochracea	OQ073918	Italy, *Nascimbene SMNS-STU-F-0002797* (STU)
C. ochracea	OQ073919	Italy, *Nascimbene JN 72085* (BOLO)
C. persepolitana	OR365438	Iran, *Sohrabi 32109* (ICH)
C. persepolitana	OR365441	Iran, *Sohrabi 32099* (ICH)
C. reptans	MZ536721	USA, *Di Meglio 203* (OSC)
C. reptans	MZ536761	USA, *McCune 35788* (OSC)
C. rogeri	HQ171231	USA, *Rosentreter 16373* (SRP)
C. rogeri	HQ171232	USA, *Rosentreter 16333* (SRP)
C. rostamii	JQ797527	Iran, *Sohrabi 10212* (IRAN)
C. rostamii	JQ797541	Iran, *Sohrabi 9364* (IRAN)
C. tominii	OR625583	Russia, *Paukov 1972* (UFU)
C. tominii	OR625584	Russia, *Paukov 1988* (UFU)
C. tortuosa	PQ558660	China, *Ren 2974* (SDNU)
C. weii	KC509897	China, *Wang 20122557* (SDNU)
C. xiaowutaishanensis	KC509899	China, *Wang 20120970* (SDNU)
C. xiaowutaishanensis	KC509898	China, *Wang 20121441* (SDNU)
C. yiae	**PX132009**	**China, *Yi 8519* (HMAS, KUN, TAI)**
C. yiae	**PX132010**	**China, *Yi 8522* (HMAS, KUN)**
Lobothallia pruinosa	JX476028	China, *Wang 20123278* (SDNU)

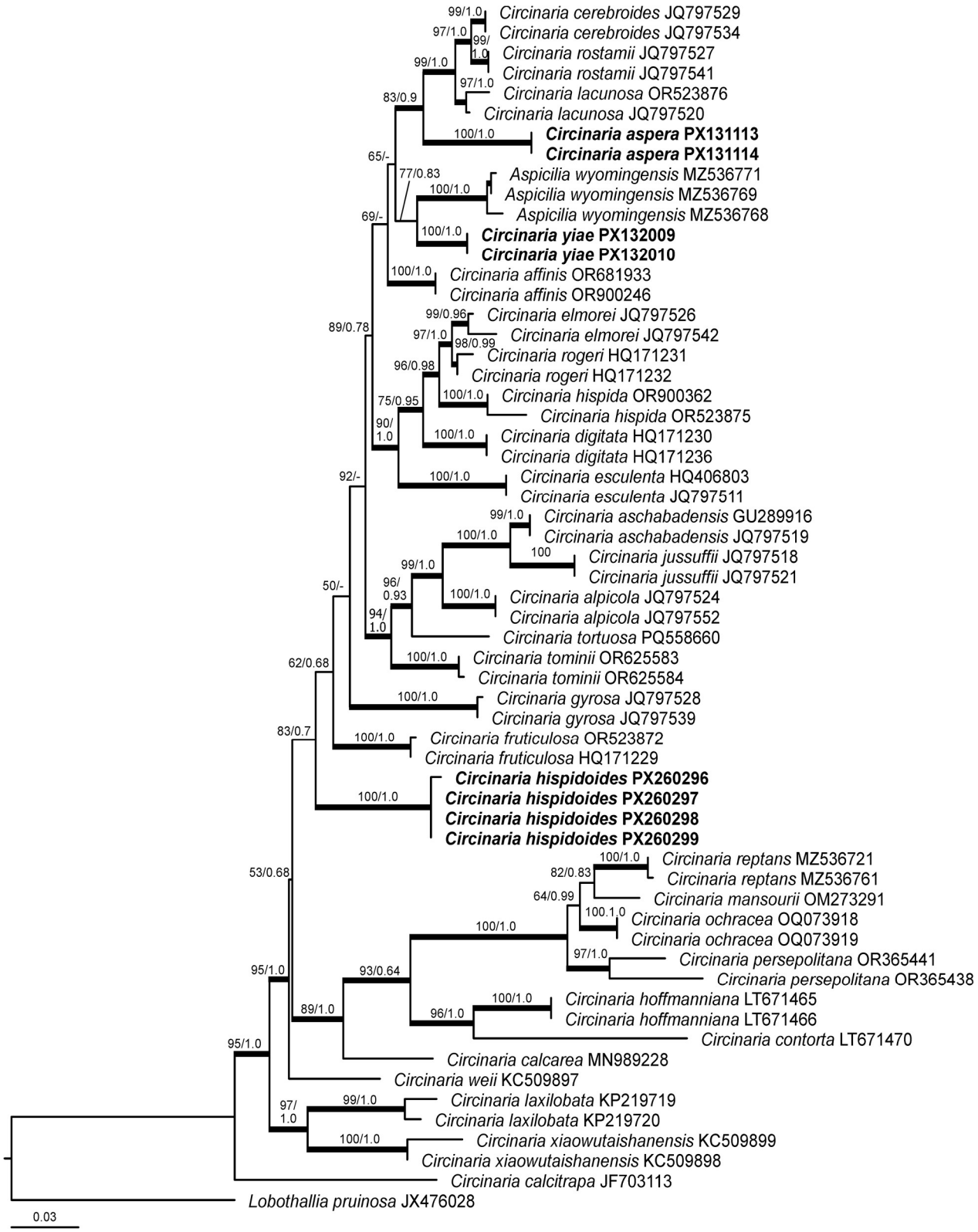

Fig. 1. Maximum likelihood (ML) phylogeny of selected ***Circinaria*** ITS sequences. The reliability of each branch was tested by ML and Bayesian methods. Numbers at tree branches indicate bootstrap values (BS ≥50%) / Bayesian Posterior Probabilities (BPP ≥0.60). Originally produced sequences are marked in bold. ***Lobothallia pruinosa*** was used as an outgroup.

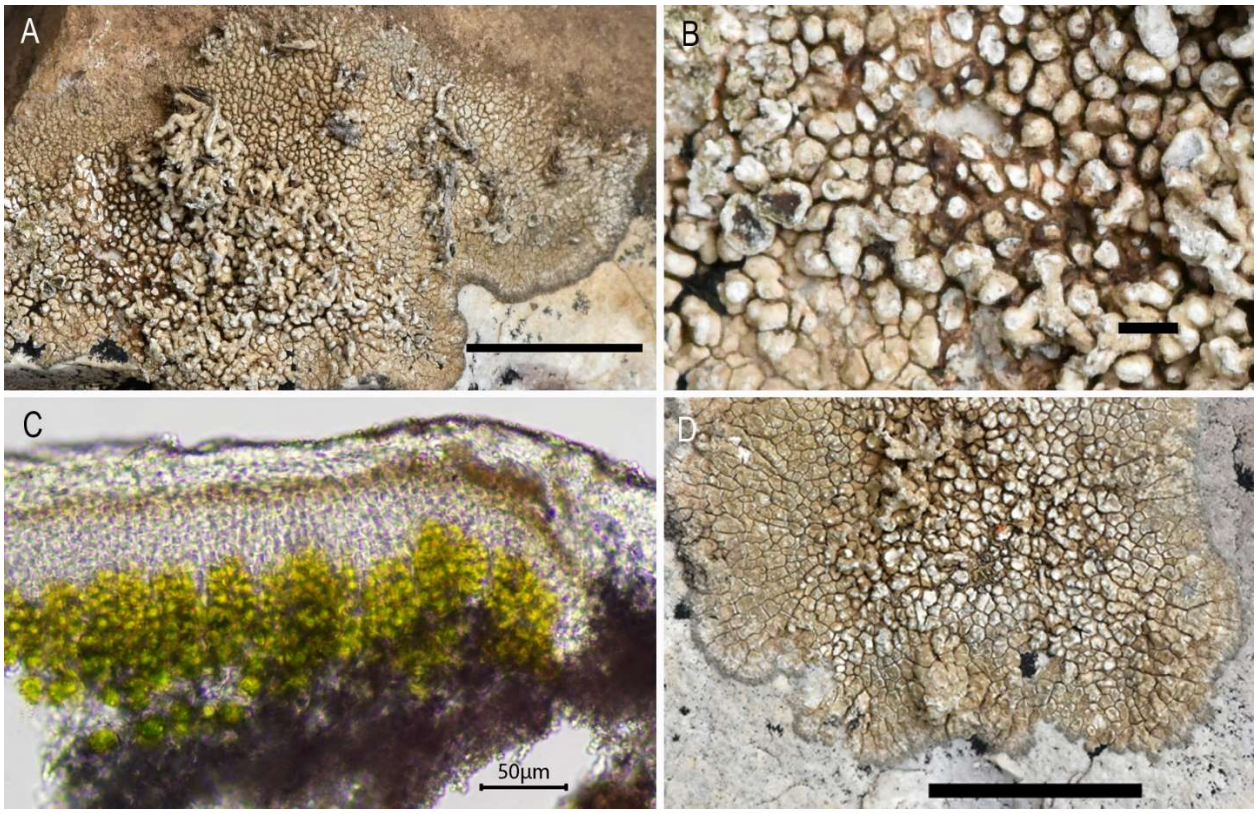

Fig. 2. Holotype of ***Circinaria yiae*** (*Yi 8519*). **A.** Thallus and habitat, showing simple to branched projections; **B.** thallus with apothecia; **C.** Section of thallus, showing hyaline epinecral layer, paraplectenchymatous cortex, and photobiont layer; **D.** Paratype (*Yi 8517*), showing the elongate and enlarged peripheral areoles and the white-gray prothallus. Scale bars: A, D=1 cm; B=1 mm; C= 50 µm.

margin, more or less fimbriate, 0.1–0.2 mm wide. Pseudocyphellae present on the top of older areoles. Soredia absent. Vertical projections occurring on the relatively older thallus, cylindrical, usually curved, simple to branched, scattered to locally crowded, older fusing together, 0.8–2.1 × 0.2–0.4 mm. Epinecral layer hyaline, without crystals, consisting of irregular cells, (4–)5–8(–10) µm (n = 20) thick. Upper cortex paraplectenchymatous, (20–)33–45(–65) µm thick (n = 10), uppermost part of which brownish, with cells (4–)5–8(–10) µm diam. (n = 10), without crystals. Medulla white, containing crystals, 1–4(–6) µm diam., I−, K–. Photobiont layer continuous, 55–85(–95) µm thick, rarely interrupted by a fungal tissue. Photobiont chlorococcoid, algae spherical to subspherical, (5–)8–12(–15) µm diam. (n = 20). Apothecia rare, 1 per areole, 0.5–0.8 mm diam., round, with cracked thalline margin; disc flat, dark brown to black, pruinose; epihymenium greenish-brown, N+ emerald-green; hymenium hyaline, 110–160 µm thick, I–; paraphyses branching, moniliform to submoniliform; hypothecium hyaline, I+ bluish, 50–80 µm thick; asci clavate, *Aspicilia*-type; ascospores 1–4 per ascus, wide-ellipsoidal or spheroid, hyaline, 19–28 × 10–20 µm (n=12). Pycnidia not seen.

Chemistry and spot tests*:* Cortex K–, C–, KC–, Pd–, UV–; medulla K–, C–, KC–, Pd–. TLC: no lichen secondary metabolites detected.

Etymology*:* The epithet of the new species honors Liqin Yi, the type collector and a biodiversity enthusiast. Ms. Yi collects multiple lichen specimens during field trips, and processes and incorporates them into the herbarium. She collected the type specimen during one of her expeditions to the east region of Inner Mongolia on 26 July 2022.

Distribution and habitat*: Circinaria yiae* may be common in the Hulunbuir Grassland of Northeast China, although it is currently known only from the type locality. This species was collected at the altitude of 850 m and grows on the pebbles of rhyolite on the ground in the Hulunbuir Grassland. It is accompanied by other lichen species typical of rocks in the area such as: *Candelariella vitellina* (Hoffm.) Müll. Arg., *Circinaria contorta* (Hoffm.) A. Nordin, Savić & Tibell, *Dimelaena oreina* (Ach.) Norman, *Lecidella carpathica* Körb., *Protoparmeliopsis muralis* (Schreb.) M. Choisy, and *Rusavskia elegans* (Link) S.Y. Kondr. & Kärnefelt.

***Additional specimens examined*:** CHINA, Inner Mongolia, Xin Barag Youqi, 15 km southwest of Hulun Town, to the west side of National Road 331, 49°16'3"N, 117°1'6E, on the pebbles of rhyolite, alt. 850 m, 26 July 2022, *L.Q. Yi 8510* (HMAS), *8517* (W), and *8522* (HMAS, KUN).

Notes: *Circinaria yiae* is characterized by a crustose thallus with simple or branching suberect to prostrate

projections. Morphologically, the new species most closely resembles *Circinaria tortuosa,* sharing several morphological characters. However, the thalli of the two species are characteristically different, *C. tortuosa* usually has thicker thalli, 1–2(–3) mm thick, and the tortuose, lobe-like areoles with large parts of its surface denudated (Ren and Zhang, 2018). In addition, *C. tortuosa* and *C. yiae* occur on pebbles in the arid area, however, *C. tortuosa* is known at higher altitudes of 1100–4200 meters above sea level in west China, and *C. yiae* is at an altitude of 850 m in Northeast China. Phylogenetic analyses with other *Circinaria* species showed that *C. yiae* is not closely related to *C. tortuosa*.

The new species represents the closest phylogenetic relationships with *Aspicilia* (*Circinaria*) *wyomingensis* McCune & J. Di Meglio. The latter is a terricolous lichen with the areolate thallus containing aspicilin and becoming lobate on the periphery, as well as areoles forming rhizomorphs on the lower side (McCune and Di Meglio, 2021).

Another well-known name to which specimens with outgrowths on thalli is *Circinaria aspera*. It is a widespread taxon in the Caspian region (Mereschkovsky, 1911; Sohrabi *et al.*, 2013) and found in arid steppes at low elevations. The species has a thick saxicolous thallus formed by the scale-like areoles 0.5–3 mm which in young thalli form a more or less continuous crust but soon the areoles enlarge and overlapping by their wavy margins. The vertical projections are sparse, small, 1–4 mm high, simple or irregularly branched. Pseudocyphellae are common, white, usually raised and crater-form or in the level of areoles. Apothecia are uncommon, but if developed, large, up to 2 mm in diameter, with a thick thalline margin divided by deep transverse cracks. This character is specific to the species and can be used in distinguishing it from other *Circinaria* taxa with large apothecia and thick margin, e.g. *C. elmorei* (Owe-Larsson *et al.*, 2011). Also, the length of conidia of *Circinaria aspera* is in the range (8–)11–17(–19) µm that is larger than in known similar species. The species was described from Bogdo mountain in Astrakhanskaya oblast (Russia) (Mereschkowsky, 1911) but the original material is probably not extant and the lectotype was selected from the material collected in Azerbaijan (Sohrabi *et al.*, 2013), studied by A. Elenkin and referred to *Aspicilia desertorum* var. *aspera* Mereshk. by Mereschkowsky (1911).

Aspicilia desertorum var. *aspera* f. *hispidoides* Mereschk., characterized by a larger, fruticose thallus, was described in the same publication by Mereschkowsky (1911). It was later moved to *Aspicilia aspera* var. *hispidoides* (Mereschk.) Tomin (Kopaczewskaja *et al.*, 1971), but this combination is illegitimate under art. 41.5 of the International Code of Nomenclature for algae, fungi, and plants (Turland *et al.*, 2018), same as *Aspicilia aspera* var. *evoluta* Oxn. (illegitimate under art. 40.1) proposed in the same publication. Molecular data proved the position of *Aspicilia desertorum* var. *aspera* f. *hispidoides* outside *Circinaria aspera* (**Fig. 1**). Here we propose a new combination and an updated taxonomic status for this taxon. Mereschkowsky noted that the original material of this form is kept in his herbarium in Kazan (KAZ), but our careful search gave no results, therefore we designate here a neotype from the specimen collected in the 'locus classicus' that gave molecular results.

Circinaria hispidoides (Mereschk.) Paukov, Davydov, Sohrabi & Q. Ren, ***comb.* et *stat. nov.***

MycoBank No.: MB861477

Basionym: – *Aspicilia desertorum* var. *aspera* f. *hispidoides* Mereschk. Trudy Obshch. Estestvoisp. Imp. Kazansk. Univ. 43: 37 (1911). ***Type***: – RUSSIA. Astrakhanskaya oblast, Bogdinsko-Baskunchakskiy nature reserve, Bogdo mt., *Paukov 3267*, V. 2019 (LE, UFU) (neotype, designated here). – *Aspicilia aspera* var. *hispidoides* [as '*hispidioides*'] (Mereschk.) Tomin (nom. illeg. art. 40.1), in Kopaczevskaja *et al*., Handbook of the lichens of the USSR 1: 199 (1971) – *Aspicilia aspera* var. *evoluta* Oxn. (nom. illeg. art. 41.5), ibid.

Circinaria hispidoides is a subfruticose species with cylindrical, irregularly branching brittle vertical lobes up to 2 cm high with an uneven, slightly pitted surface (**Fig. 3**). Pseudocyphellae are common, projecting, whitish. Areoles in fruticose thalli may be visible if the thallus grows on pebble. Young thalli can hardly be separated from *Circinaria aspera* but *C. hispidoides* has convex to bullate, not squamulose areoles. Apothecia and conidia are similar in morphology and size between the two species. Thalli of *Circinaria hispidoides* are usually attached to rock or pebbles but usually overgrow them attaching to soil.

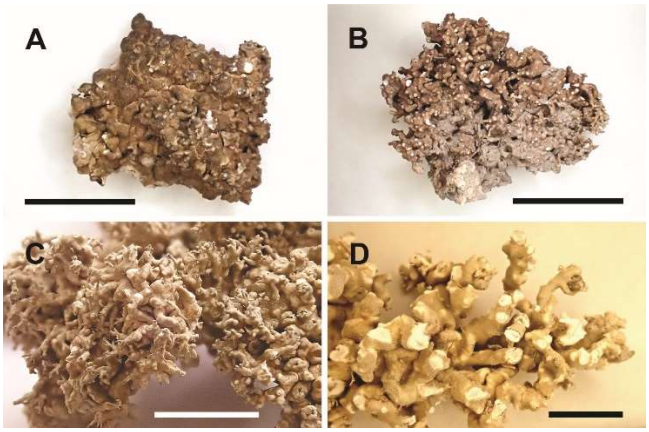

Fig. 3. ***Circinaria aspera*** and ***C. hispidoides***. **A.** Topotype of ***Circinaria aspera***, Astrakhanskaya oblast, Bogdo mt., *Tomin* s.n. (Krypt. Exs. Mus. Hist. Nat. Vindobon. 3157, LE L-7524); **B.** Topotype of ***C. hispidoides***, ibid., *Savicz* s.n. (LE L-1252); **C.** Neotype of ***C. hispidoides***, ibid., *Paukov* 3267 (UFU); **D.** ***C. hispidoides***, part of fruticose thallus, Kazakhstan, Kyzylorda region, *Ivanov* s.n. (UFU L-1749). Scale bars: A, B=1 cm; C, D=5 mm.

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LITERATURE CITED

Hall, T.A. 1999 BioEdit: A User-Friendly Biological Sequence Alignment Editor and Analysis Program for Windows 95/98/NT. Nucleic Acids Symp. Ser. **41**: 95–98.

Iqbal, M.S., Din, A.U., Khalid, A.N., Niazi, A.R. 2024 A new species in the lichen genus *Circinaria* (Megasporaceae) from Pakistan based on morphology and DNA sequence data. J. Bot. Res. Inst. Tex. **18(2)**: 333–340.

Ismayil, G., Abbas, A., Guo, S.Y. 2019 A new saxicolous *Circinaria* species (Megasporaceae) from northeast China. Bryologist **122(1)**: 23–31.

Kalyaanamoorthy, S., Minh, B.Q., Wong, T.K.F., von Haeseler, A., Jermiin, L.S. 2017 Modelfinder: fast model selection for accurate phylogenetic estimates. Nat. Methods **14(6)**: 587–589.

Kopaczewskaja, E.G., Makarevicz, M.F., Oxner, A.N., Rassadina, K.A. 1971 Handbook of the lichens of the USSR. 1. Pertusariaceae, Lecanoraceae and Parmeliaceae. USSR Academy of Sciences, Leningrad, 412 p.

Kou, X.R., Li, S.X., Ren, Q. 2013 Three new species and one new record of *Lobothallia* from China. Mycotaxon **123(1)**: 241–249.

Magnusson, A.H. 1940 Lichens from central Asia I. In: Hedin, S: Reports Scientific Exped. Nort-west. provinces of China (the Sino-Swedish expedition). 13, XI. Botany, 1. Aktiebolaget Thule, Stockholm, 168pp.

McCune, B., Di Meglio, J. 2021 Revision of the *Aspicilia reptans* group in Western North America, an important component of soil biocrusts. Monographs in North American Lichenology **5**: 1–94.

Mereschkowsky, C. 1911 Excursion lichénologique dans les steppes Kirghises (Mont Bogdo). Trudy Obshch. Estestvoisp. Imp. Kazansk. Univ. **43**(5): 1–42.

Miller, M.A., Pfeiffer, W., Schwartz, T. 2010 Creating the CIPRES Science Gateway for inference of large phylogenetic trees. 2010 Gateway Computing Environments Workshop, 1–8. New Orleans, USA.

Nascimbene, J., Nimis, P.L., Klüßendorf, J., Thüs, H. 2023 Freshwater Lichens, Including New Species in the genera *Verrucaria*, *Placopyrenium* and *Circinaria*, associated with *Lobothallia hydrocharis* (Poelt & Nimis) Sohrabi & Nimis from Watercourses of Sardinia. J. Fungi **9(3)**: 380.

Nordin, A., Savić S., Tibell L. 2010 Phylogeny and taxonomy of *Aspicilia* and Megasporaceae. Mycologia **102(6)**: 1339–1349.

Orange, A., James, P., White, F.J. 2010 Microchemical Methods for the Identification of Lichens. British Lichen Society, London, 101 pp.

Owe-Larsson, B., Nordin, A., Tibell, L., Sohrabi, M. 2011 *Circinaria arida* sp. nova and the '*Aspicilia desertorum*' complex. Bibl. Lichenol. **106**: 235–246.

Paukov, A.G., Davydov, E.A. Ren, Q., Sohrabi, M. 2024 *Circinaria tominii* (Megasporaceae, lichenized Ascomycota) is represented by two different growth forms. Plant Fungal Syst. **69(1)**: 69–76.

Ren, Q., Paukov, A.G., Sun, Z.S., Yan, Q.D. 2025a *Circinaria weii* sp. nov., a new lichen species from China. Bryologist **128**: 30–36.

Ren, Q., Sun, Z.S., Paukov, A.G., Yan, Q.D. 2025b *Circinaria xiaowutaishanensis* Q. Ren sp. nov. (Pertusariales, Megasporaceae), a new saxicolous species from China. Biology Bull. **52(1)**: 35.

Ren, Q., Zhang, L. H. 2018 Taxonomic studies on the genus *Circinaria* in northern China. Mycosystema **37**: 865–880.

Ronquist, F., Teslenko, M., Van Der Mark, P., Ayres, D.L., Darling, A., Höhna, S., Larget, B., Liu, L., Suchard, M.A., Huelsenbeck, J.P. 2012 MrBayes 3.2: Efficient Bayesian Phylogenetic Inference and Model Choice Across a Large Model Space. Syst. Biol. **61(3)**: 539–542.

Rosentreter, R. 1998 Notes on *Aspicilia reptans* complex, with descriptions of two new species. In: Glenn, M. G. *et al.* (eds.): Lichenographia Thomsoniana: North American Lichenology in Honor of John W. Thomson, 163–170. Mycotaxon Ltd., Ithaca, New York.

Sohrabi, M., Paukov, A., Pérez-Ortega S., Zamanian, H., Pérez-Ortega, S., Nourozi, H., Fadaie, H., Favero-Longo, S.E., de los Ríos., A. 2024 *Circinaria persepolitana* (Megasporaceae), a new lichen species from historic stone surfaces in Persepolis, a UNESCO World Heritage Site in Iran. Lichenologist **56(2-3)**: 93–106.

Sohrabi, M., Leavitt, S.D., Obermayer, W., Mayrhofer, H. 2023 *Circinaria nimisii* (Megasporaceae, lichenized Ascomycota), a new manna lichen from Greece. Lichenologist **55(5)**: 367–376.

Sohrabi, M., Stenroos, S., Myllys, L., Søchting, U., Ahti, T., Hyvönen, J. 2013.Phylogeny and taxonomy of the 'manna lichens'. Mycol. Prog. **12(2)**: 231–269.

Stamatakis, A. 2014 RAxML version 8: a tool for phylogenetic analysis and post-analysis of large phylogenies. Bioinformatics **30(9)**: 1312–1313.

Turland, N.J., Wiersema, J.H., Barrie, F.R., *et al.* (eds.) 2018 International Code of Nomenclature for algae, fungi, and plants (Shenzhen Code) adopted by the Nineteenth International Botanical Congress Shenzhen, China, July 2017. Regnum Vegetabile 159. Glashütten: Koeltz Botanical Books.

Yao, Z.T., Jiang, S.H., Jia, Z.F. 2021 *Mazosia weii* sp. nov. (Roccellaceae) from China, a new species supported by molecular data. Bryologist **124(3)**: 335–342.

Zhang, Y.Y., Wang, L, Yu, X.M., Cheng, S., Liu, J.L., Wang, X.Y. 2024 Three new taxa of the lichen genus *Lobothallia* (Megasporaceae, Ascomycota) from China. MycoKeys **108**: 351–369.

Zhao, Y. F., Jia, Z. F. 2022. *Astrothelium subsiamense* sp. nov. from Fujian, China. Mycotaxon **137(3)**: 477–484(8).

Zulfiqar, R., Habib, K., Asghar, H.S., Wahab, H., Sohrabi, M., Paukov, A.G., Ren, Q., Khalid, A.N. 2024 A new species in the genus *Circinaria* (Lichenized Ascomycetes: Megasporaceae) from Pakistan. Phytotaxa **652(2)**: 124–132.