

Research Article

# Two New Records for China of the Lichen Genera *Anamylopsora* and *Lepraria*

Dolathan Toksun<sup>1, †</sup> , Muhammad Shahid Iqbal<sup>2, †</sup> , Anwar Tumor<sup>1, \*</sup> 

<sup>1</sup>College of Life Sciences and Technology, Xinjiang University, Urumqi, China

<sup>2</sup>Department of Botany, University of Layyah, Layyah, Pakistan

## Abstract

Xinjiang, also known as Xinjiang Uygur Autonomous Region (XUAR), with an area of over 1.6 million km<sup>2</sup> (0.64 million square miles), is the biggest province in China. Xinjiang is notable for its diversity and abundance of lichens. This study reports two lichen taxa newly recorded for China from the Barluk Mountain National Nature Reserve (BMNNR), Xinjiang, China, and provides morphological, anatomical, chemical, and Internal Transcribed Spacer (ITS) based molecular data. The lichen specimens used in this article were collected from (BMNNR) between 2022 and 2024. Two lichen species, *Anamylopsora pakistanica* and *Lepraria rigidula*, were discovered during a taxonomical study of the lichens from (BMNNR), Xinjiang, China. Both of these lichen species have never been reported from China before. Here, these are the new records for China. *Anamylopsora pakistanica* grows on well-lit bare rock surface, and is characterized by its having larger squamules, the margin of squamules is white; *Lepraria rigidula* grows on mosses attached to rocks, and is characterized by its dense long soredium and has atranorin. Descriptions in detail, comments with similar species, and morphological photographs of these two species are provided. The specimens of these two new records were deposited in the Herbarium of College of Life Sciences and Technology, Xinjiang University (XJU) (XUAR), China. These collections recommend a great potential for discovery of further unreported lichen species in Xinjiang Province.

## Keywords

*Baeomycetaceae*, Barluk Mountain National Nature Reserve, New Records, Phylogeny, Taxonomy, Xinjiang

## 1. Introduction

The genus *Anamylopsora* Timdal belongs to the phylum *Ascomycota*, class *Lecanoromycetes*, order *Baeomycetales*, and family *Baeomycetaceae* within the kingdom *Fungi*. Its type species is *A. pulcherrima* (Vain.) Timdal, originally described by Huneck & Elix [1]. Four species have been globally reported to date [2], including: *A. altaica* Ahat, A. Abbas, S.Y. Guo & Tumor [3], *A. pruinosa* D. L. Liu & X. L.

Wei [4], *A. pulcherrima* (Vain.) Timdal [5] and *A. pakistanica* Usman & Khalid [2]. Key morphological features include squamulose to crustose thalli that are crowded or overlapping, with upward-curved margins and stalked or sessile attachments. Thalli range in color from yellow to dark brown, loosely adhering to substrates with or without rhizines, and exhibit continuous or discontinuous algal layers. Apothecia

\*Corresponding author: [anwartumursk@xju.edu.cn](mailto:anwartumursk@xju.edu.cn) (Anwar Tumor)

† Dolathan Toksun and Muhammad Shahid Iqbal are co-first authors.

**Received:** 23 September 2025; **Accepted:** 9 October 2025; **Published:** 30 October 2025



Copyright: © The Author(s), 2025. Published by Science Publishing Group. This is an **Open Access** article, distributed under the terms of the Creative Commons Attribution 4.0 License (<http://creativecommons.org/licenses/by/4.0/>), which permits unrestricted use, distribution and reproduction in any medium, provided the original work is properly cited.

are typically aggregated on squamules, with carbon-black to brown discs lacking distinct margins. Each ascus contains 8 spores, which are subglobose to ellipsoid and hyaline [2].

The genus *Lepraria* Ach. is classified under the phylum Ascomycota, class Lecanoromycetes, order Lecanorales, and family Stereocaulaceae [6]. Its thalli are leprose to granular, forming powdery crusts of sorediate or non-sorediate globose granules that attach tightly or loosely to substrates. Lacking a cortex, the thalli have diffuse or delimited margins and range in color from whitish to dark gray or greenish, with a white or non-stratified medulla. Most species produce soredia, rarely isidia, and lack a hypothallus. Symbiotic algae are green, and neither ascomata nor pycnidia have been observed [7, 8]. Comprising 87 species worldwide, *Lepraria* is distributed globally, with 8 reported in China across Hebei, Shanxi, Shandong, Sichuan, Yunnan, Shaanxi, Guizhou, Gansu, and Xinjiang [9].

Notable taxonomic records in China include: *Lepraria incana* (L.) Ach., first reported from Shaanxi [10]. *L. yunnaniana* (Hue) Zahlbr., documented from Yunnan [11]. [12] recorded *L. incana* in Shaanxi, Sichuan, and Jiangxi in *Illustrated Flora of Chinese Lichens*. [13] validated these two species in A Synopsis of Chinese Lichens. [14] described three new Chinese records: *L. lobificans* Nyl., *L. caesioalba* (B. de Lesd.) J. R. Laundon, and *L. eburnea* J. R. Laundon. [9] reported three new provincial records in Hubei: *L. membranacea* (Dicks.) Vain., *L. incana*, and *L. caesioalba*. [15] newly recorded *L. harrisiana* Lendemer in China.

## 2. Materials and Methods

### 2.1. Lichen Collections

The specimens of *Anamylopsora* and *Lepraria* in this study were collected from (BMNNR) of Xinjiang, China and are preserved in the Herbarium of College of Life Sciences and Technology (XJU, XUAR), China.

### 2.2. Phenotypic Analyses

The specimens were examined using a Nikon ECLIPSE E200 stereo-microscope. Sections were cut by hand using a razor blade and were mounted and observed in water and iodine. The structure and hymenial characters were studied with a Zeiss Axioskop two-plus light microscope. Photographs were taken with a Nikon Digital Camera D50. Thin-layer chromatography (TLC) [16-19] was employed for the detection of lichen substances.

#### 2.2.1. DNA Extraction

Thallus fragments with ascomata were removed from the specimen for DNA extraction using the DNA secure Plant DNA Kit (Tiangen, China) following the manufacturer's protocol.

#### 2.2.2. Amplification and Sequencing

Amplification of the ITS region followed the methods described in [20] with the modification noted in [21]. The nrITS region (ITS1 and ITS4) of the nrDNA repeat tandem was targeted with the polymerase chain reaction using the primers ITS1F [22] with ITS4 [23] directly.

The amplification reaction was performed in a the 25 µL PCR reaction system, consists of the following components: 12.5 µL of 2×Taq PCR Master Mix, 9.5 µL of dd H<sub>2</sub> O, 0.5 µL each of the upstream primer ITS1F and downstream primer ITS4, and 2 µL of DNA template. The conditions for thermocycling of nrITS were: 95 °C for 4 min; linked to 30 cycles of denaturation at 94 °C for 30sec, annealing at 56 °C for 30sec, extension at 72 °C for 60 secs and with a final extension at 72 °C for 10 min [23]. PCR products were screened on 1% agarose gels stained with ethidium bromide, and were sequenced by the Shenggong Inc. (Shanghai, China).

### 2.3. Analyses of Molecular Systematic

Use the SeqMan (DNASTAR) software (<https://www.dnastar.com/software/lasergene/seqman-ngen/>) to assemble and edit the raw sequence data that meets the criteria. Submit the processed data to GenBank (<https://www.ncbi.nlm.nih.gov/genbank/>), perform a BLAST (<https://blast.ncbi.nlm.nih.gov/Blast>) search to obtain the closely related species of the sequence's species, and preliminarily determine the genetic relationship between them. Download the appropriate sequences, use ClustalW and Muscle in MEGA 11.0 software (<https://www.megasoftware.net/pdfs/TamuraStecherKumar>) for sequence alignment, manually correct any obvious alignment errors, construct a phylogenetic tree using the Maximum Likelihood (ML) method, and finally adjust and beautify the resulting phylogenetic tree with Figtree software (<https://tree.bio.ed.ac.uk/software/figtree/>). The newly recorded sequences were submitted to GenBank and included in the analysis (<https://www.ncbi.nlm.nih.gov/genbank/>) (Table 1).

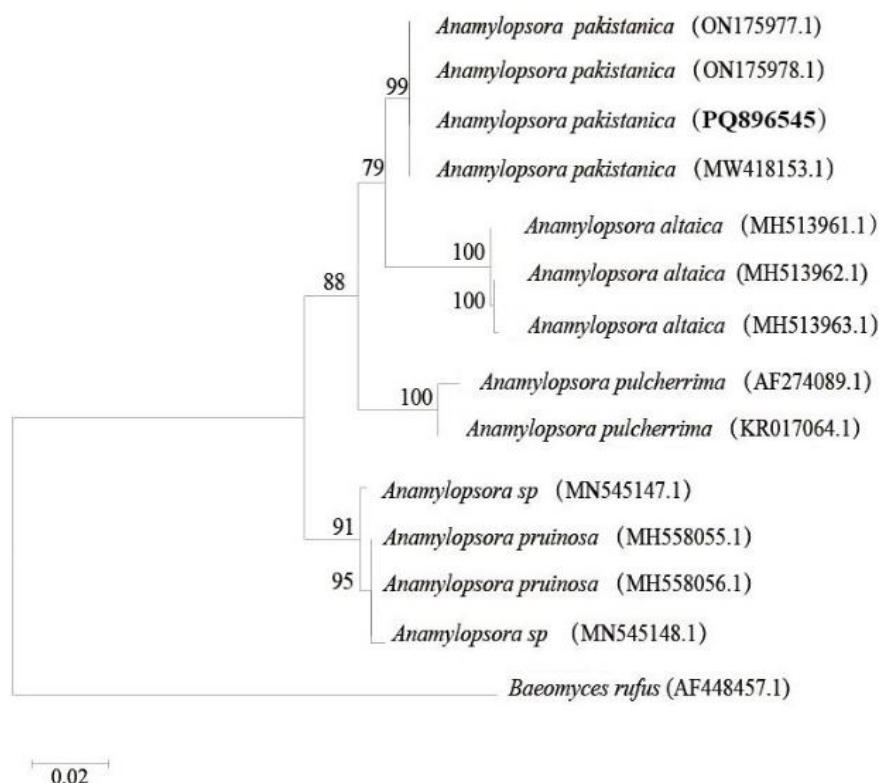
Phylogenetic trees constructed based on ITS sequences revealed that the newly obtained sequences of *Anamylopsora pakistanica* clustered together in a single clade with the corresponding sequences downloaded from the database (Figure 1), with a bootstrap support value of 99%. The Chinese specimens in this study were highly consistent with the previously reported overseas specimens of *A. pakistanica* in terms of both external morphological characteristics and internal anatomical characteristics. Molecular phylogenetic analysis further confirmed that these specimens belong to the same species.

The BLAST results indicated that our specimens are closely related to the existing sequence of *Lepraria rigidula* (GenBank accession number: KX132961). Furthermore, the phylogenetic tree also shows clear interspecific phylogenetic relationships between the newly recorded species from China

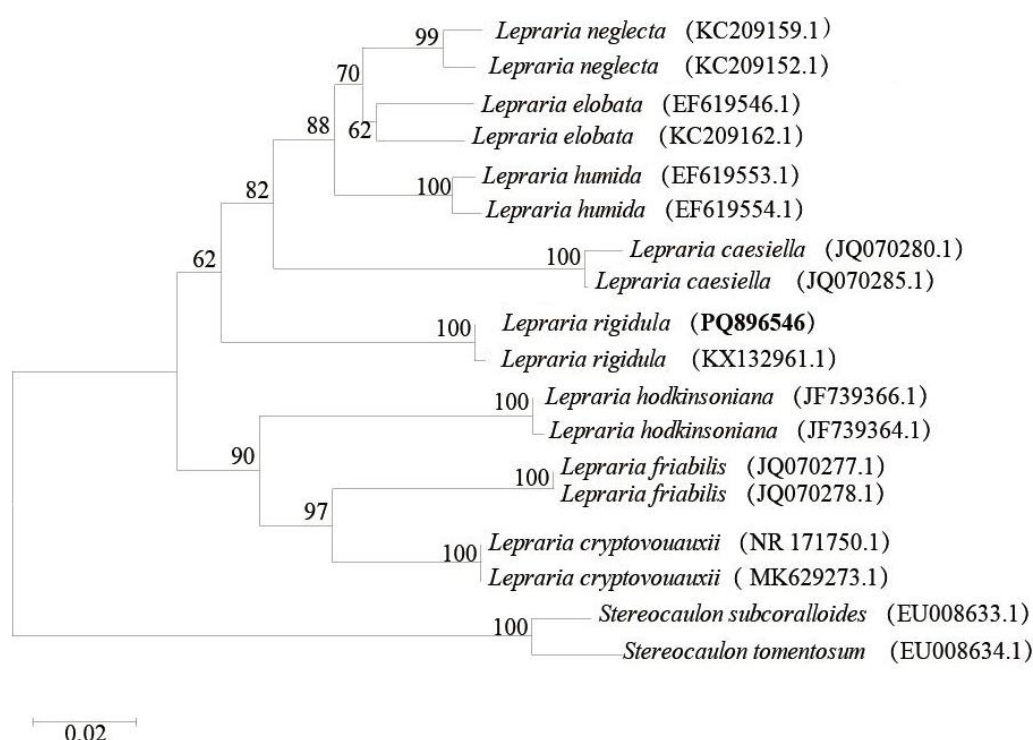
and the *L. rigidula* previously reported overseas. Notably, the sequences of the two specimens cluster into a single

monophyletic clade (Figure 2) with 100% bootstrap support.

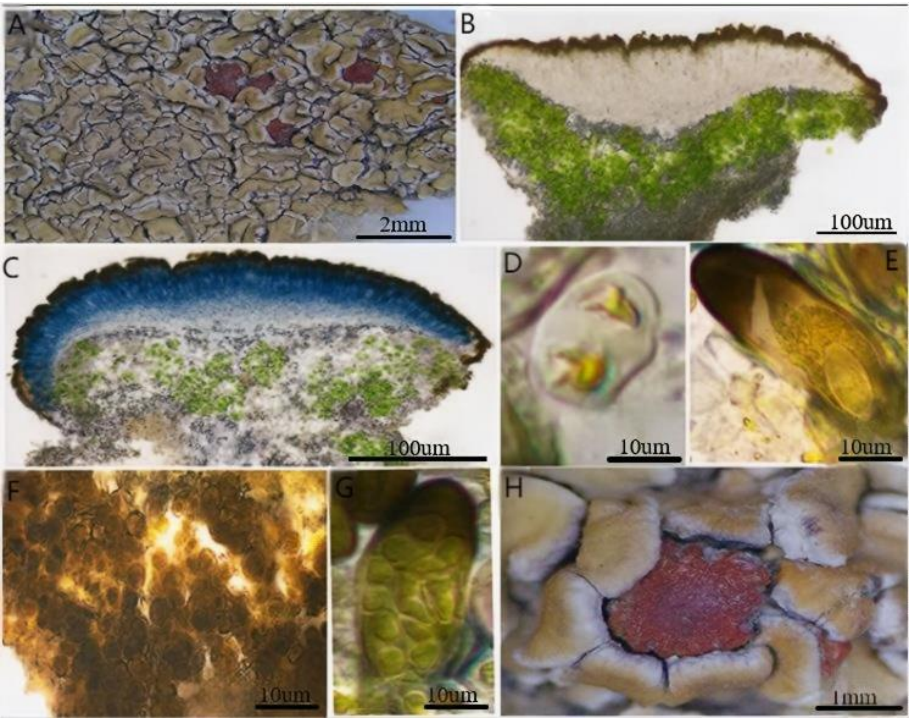
## 2.4. Figures



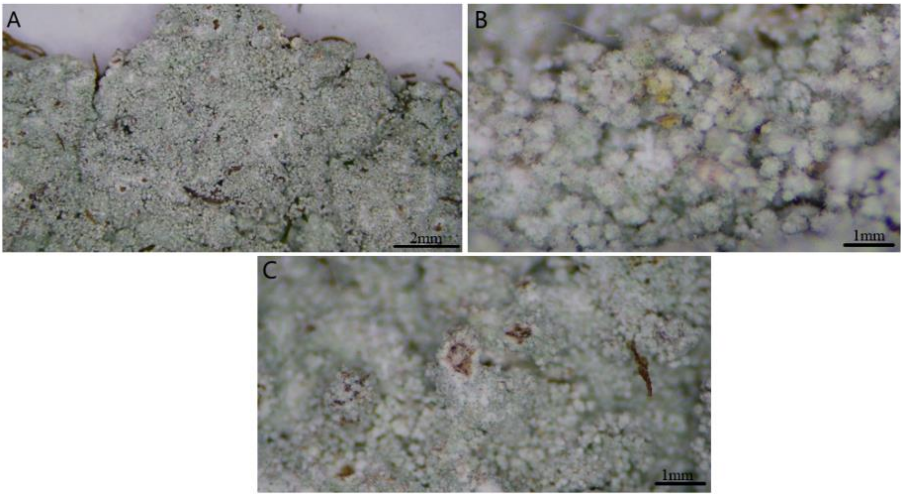
**Figure 1.** ML phylogenetic tree constructed from partial species of *Anamylopsora* based on ITS sequence.



**Figure 2.** ML phylogenetic tree constructed from partial species of *Lepraria* based on ITS sequence.



**Figure 3.** *Anamylopsora pakistanica* (XJU 202207509) (A-H): A. Morphological structure of thallus and apothecia; B. Cross section of apothecium; C. Cross section of an apothecium after adding I solvent; D. Ascospore; E. Ascus after adding I solvent; F. Algal cells after adding I solvent; G. Asci after adding I solvent; H. Morphological structure of apothecia.



**Figure 4.** *Lepraria rigidula* (XJU 202406040) (A-C): A, B. Morphological structures of *Lepraria rigidula* thallus; C. Soredia.

2.5. Tables

**Table 1.** ITS sequences used to construct phylogenetic trees. Local collections are marked with red color.

| Species                         | Country  | Voucher number | GenBank accession |
|---------------------------------|----------|----------------|-------------------|
| <i>Anamylopsora pakistanica</i> | China    | 202207509      | PQ896545          |
| <i>Anamylopsora pakistanica</i> | Pakistan | LAH37090       | ON175977          |
| <i>Anamylopsora pakistanica</i> | Pakistan | LAH37091       | ON175978          |

| Species                            | Country       | Voucher number                | GenBank accession |
|------------------------------------|---------------|-------------------------------|-------------------|
| <i>Anamylopsora pakistanica</i>    | Pakistan      | LAH37092                      | MW418153          |
| <i>Anamylopsora altaica</i>        | China         | Anwar & Abbas 20140041        | MH513961          |
| <i>Anamylopsora altaica</i>        | China         | Anwar & Abbas 20140032        | MH513962          |
| <i>Anamylopsora altaica</i>        | China         | Anwar & Abbas 20150068        | MH513963          |
| <i>Anamylopsora pulcherrima</i>    | Russia        | Zhurbenko (ESS)               | AF274089          |
| <i>Anamylopsora pulcherrima</i>    | Russia        | P108                          | KR017064          |
| <i>Anamylopsora pruinosa</i>       | China         | XL2017133                     | MH558055          |
| <i>Anamylopsora pruinosa</i>       | China         | ZW-64                         | MH558056          |
| <i>Anamylopsora</i> sp.            | China         | 18-59337                      | MN545147          |
| <i>Anamylopsora</i> sp.            | China         | 18-59321                      | MN545148          |
| <i>Baeomyces rufus</i>             | Switzerland   | BR982                         | AF448457.1        |
| <i>Lepraria rigidula</i>           | China         | 202406040                     | PQ896546          |
| <i>Lepraria neglecta</i>           | USA           | NY980                         | KC209159.1        |
| <i>Lepraria neglecta</i>           | USA           | NY603                         | KC209152.1        |
| <i>Lepraria cryptovouauxii</i>     | Bolivia       | Kukwa 14848a, Holotype (UGDA) | MK629273          |
| <i>Lepraria cryptovouauxii</i>     | Bolivia       | UGDA Kukwa 14848a             | NR 171750.1       |
| <i>Lepraria elobata</i>            | Ukraine       | 3528                          | EF619546.1        |
| <i>Lepraria elobata</i>            | Switzerland   | NY422                         | KC209162.1        |
| <i>Lepraria humida</i>             | Europe        | 15457                         | EF619553.1        |
| <i>Lepraria humida</i>             | Europe        | 15454a                        | EF619554.1        |
| <i>Lepraria caesiella</i>          | USA           | NY464                         | JQ070280.1        |
| <i>Lepraria caesiella</i>          | USA           | NY1024                        | JQ070285.1        |
| <i>Lepraria rigidula</i>           | USA           | LIFU052-16 (versA)            | KX132961.1        |
| <i>Lepraria hodkinsoniana</i>      | North America | NY552                         | JF739366.1        |
| <i>Lepraria hodkinsoniana</i>      | North America | NY671                         | JF739364.1        |
| <i>Lepraria friabilis</i>          | USA           | NY662                         | JQ070277.1        |
| <i>Lepraria friabilis</i>          | USA           | NY669                         | JQ070278.1        |
| <i>Stereocaulon subcoralloides</i> | USA           | 103                           | EU008633.1        |
| <i>Stereocaulon tomentosum</i>     | USA           | 104                           | EU008634.1        |

### 3. Results

*Anamylopsora pakistanica* Usman & Khalid, in Usman, Firdous, Dyer & Khalid, *Lichenologist* 55(3-4): 128 (2023) (New record for China)

**Description:** The thallus is irregularly squamulose to crustose, with small scales 0.5-4 mm in diameter, slightly overlapping. The upper surface is light-brown to brown, covered with a fine pruina. The edges of the scales are

white, slightly raised, and lack soredia and isidia. The lower surface near the edges is white to dirty white, without rhizines and stalks. epinecral layer hyaline, up to 22 µm thick, when single, the apothecia are circular to irregular in shape; when clustered, they are usually spherical, with a diameter of 0.5 mm (up to 1.7 mm when single). The disc is dark reddish-brown to black, glossy, covered with fine pruina, and sometimes cracked. The apothecia are of lecanorine type. The epithecium is yellowish-brown to brown, while the hymenium is colorless, thick, approximately

93.2-118.3  $\mu\text{m}$  in height. When I reagent is applied to the hymenium, it turns blue. The hypothecium and excipulum are colorless. The paraphyses are simple, with swollen apices. The asci are narrowly clavate to sub-cylindrical, colorless, and contain 8 ascospores. The ascospores are colorless, simple (aseptate), ellipsoid, thick walled with smooth surface, measuring approximately (8.7-12.2)  $\mu\text{m}$   $\times$  (5.2-8.1)  $\mu\text{m}$  (Figure 3).

**Chemical spot tests:** K + upper cortex of the thallus, it turns red; KC + turns black; C-; I + hymenium of the apothecium, it turns blue; K-, KC-, C-.

**TLC:** Atranorin and norstictic acid.

**Distribution and ecology:** Distributed in Gilgit-Baltistan, Pakistan, and Xinjiang, China. Grows on dry rocks in mountain forests (with rocks as the substrate).

**Specimens examined:** (BMNNR), Xinjiang, China (45°58'41"N, 83°04'42"E), altitude 1,781 m a.s.l., July 6, 2022, Dolathan Toksun and Anwar Tumur, No. 202207509 (XJU), accession No.: PQ896545.

*Lepraria rigidula* (B. de Lesd.) Diederich, Trav. Sci. Mus *é* National d'Histoire Naturelle de Luxembourg 14: 152 (1989) (New record for China)

**Description:** The thallus is squamulose, cottony to powdery, scurfy, or irregularly granular, with a spreading margin. It is not very conspicuous, closely adnate to the substratum. The upper surface ranges in color from pale bluish-gray to whitish-green. Soredia are abundant, relatively fine and hair-like, long projecting hyphae, up to 100  $\mu\text{m}$  in width and 75 (-120)  $\mu\text{m}$  in length; the lower surface is inconspicuous (Figure 4).

**Chemical spot tests:** upper cortex of the thallus K- yellow, KC-, C-.

**TLC:** Atranorin.

**Distribution and ecology:** Recorded in Asia, Africa, North America, Europe, and other regions. Domestically, it is distributed in Xinjiang, China. *Lepraria rigidula* is distributed on mosses growing on rocks in (BMNNR), Xinjiang. It occurs in mountain forests at an altitude of 1,178 m a.s.l., with mosses on rocks as the substratum.

**Specimens examined:** (BMNNR), Xinjiang, China (45°55'15"N, 82°44'21"E), altitude 1,178 m a.s.l., 2024-06-25, Dolathan Toksun & Anwar Tumur, No. 202406040 (Deposited at XJU), Accession No: PQ896546.

## 4. Discussion

This study identified *Anamylopsora pakistanica* as a new record for China, which is morphologically similar to *Anamylopsora altaica* in terms of thallus morphology and apothecium shape. However, it differs from *A. altaica* in the following aspects: it has larger squamules (up to 4 mm in diameter) with a light brown to brown upper surface, and its apothecia are reddish-brown to black. In contrast, *A. altaica* has small squamules ( $\leq 1$  mm in diameter), a yellowish thallus, and mostly black apothecia. The two species also differ

in their secondary metabolites (TLC): *A. altaica* produces psoromic acid, while *A. pakistanica* produces atranorin and norstictic acid. The morpho-anatomical features of our Chinese specimen agree with the already published description of *A. pakistanica* from Pakistan [2]. Our species can be different from *A. pulcherrima* in having 93-118  $\mu\text{m}$  thick hymenium, thick epinecral layer up to 22  $\mu\text{m}$ , and atranorin, norstictic acid (In contrast, *A. pulcherrima* has 60-100  $\mu\text{m}$  hymenium, only 5-10  $\mu\text{m}$  thick epinecral layer, and alectorialic acid [2]. The Chinese *A. pakistanica* shares some common characteristics with *A. pruinosa* in having pruinose thallus and clavate to sub-cylindrical asci. However, our taxon can be differing from *A. pruinosa* in having 93-118  $\mu\text{m}$  thick hymenium, larger squamules (up to 4 mm in diameter), ellipsoid ascospores with a thick-walled and smooth surface, ecology saxicolous, and atranorin, norstictic acid substances, (In contrast, *A. pruinosa* has 75-100  $\mu\text{m}$  hymenium, 2-3 mm squamules, thin-walled ascospores with a warty surface, ecology terricolous, and alectorialic and barbatolic acids substances) [2].

Lichen species of the genus *Lepraria* do not possess fruiting bodies or conidia, unlike those of other lichen genera, and they produce secondary metabolites (TLC) such as atranorin and nephrosteranic acid. Therefore, the type of secondary metabolites (TLC) has always been a key characteristic for the identification of *Lepraria* species [24]. Species of this genus mainly grow on substrates such as tree bark, decayed wood, rocks, and moss [25]. The *Lepraria rigidula* described in this study grows on moss attached to rocks. This species is characterized by slender soredia, produces the secondary metabolite (TLC) atranorin, and lacks nephrosteranic acid—these features serve as the main criteria for distinguishing it from other species [26]. The morpho-anatomical features of Chinese collections agree with the already published description of *L. rigidula* except having atranorin substance vs. (atranorin, nephrosteranic acid) [27].

## 5. Conclusions

*Anamylopsora pakistanica* and *Lepraria rigidula* are confirmed as new records for China based on a combination of morphology, anatomy, and molecular phylogeny. Based on external morphological characteristics, internal anatomical features, and phylogenetic tree analysis, the specimens in this study were found to be highly similar to the previously reported foreign species *Anamylopsora pakistanica* and *Lepraria rigidula*. Thus, *Anamylopsora pakistanica* and *Lepraria rigidula* were confirmed as new records for China.

## Abbreviations

ITS                      Internal Transcribed Spacer

|       |                                         |
|-------|-----------------------------------------|
| XJU   | Xinjiang University                     |
| BMNNR | Barluk Mountain National Nature Reserve |
| XUAR  | Xinjiang Uygur Autonomous Region        |
| TLC   | Thin Layer Chromatography               |
| DNA   | Deoxyribonucleic Acid                   |
| dNTP  | Deoxynucleotide Triphosphates           |
| PCR   | Polymerase Chain Reaction               |
| BLAST | Basic Local Alignment Search Tool       |
| ML    | Maximum Likelihood                      |

## Acknowledgments

We are grateful to Jinsiguli Bahenuer, Yong Hai Ying and Reyhangul Mamatali (graduate students of Xinjiang University, P.R. China) for their help with the fieldwork. We are also grateful to the Administration Office of Barluk Mountain National Nature Reserve for allowing us to conduct the field investigation.

## Author Contributions

**Dolathan Toksun:** Investigation, Methodology, Writing-original draft

**Muhammad Shahid Iqbal:** Formal analysis, writing - review & editing

**Anwar Tumor:** Formal analysis, Project administration, Supervision, Writing - review & editing

## Ethic Declarations

This research did not involve studies on humans or animals. The sample collection for this study was conducted in accordance with the guidelines of the national guidelines.

## Funding

This research was funded by grants from the National Nature Science Foundation of China (No. 32160046).

## Data Availability Statement

The data used to support the findings of this research work are included within the article.

## Conflicts of Interest

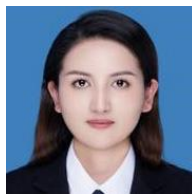
The authors declare no conflicts of interest.

## References

- [1] Huneck, S., Elix, J. A. The chemistry of the lichens *Anamylopsora pulcherrima* and *Tephromela armeniaca*, *Herzogia*. 1993, 9: 647-651.  
<https://doi.org/10.1127/Herzogia/9/1993/647>
- [2] Usman, M., Firdous, Q., Dyer, P. S., Khalid, A. N. A new species of the genus *Anamylopsora* (Baeomycetaceae; Ascomycota) from Deosai National Park, Gilgit-Baltistan, Pakistan, *The Lichenologist*. 2023, 55: 125-132.  
<https://doi.org/10.1017/S002428292300018X>
- [3] Ahat, P., Tumor, A., Guo, S. Y. *Anamylopsora altaica* sp. nov. from Northwestern China, *Mycotaxon*. 2019, 134: 147-153.  
<https://doi.org/10.5248/134.147>
- [4] Zuo, Y. B., Liu, D. L., Li, C. X., Chen, Y. H., Wei, X. L. A new species of the lichenised genus *Anamylopsora* (Baeomycetaceae, Baeomycetales) from Tengger Desert of China, *MycoKeys*. 2018, 41: 107-118.  
<https://doi.org/10.3897/mycokeys.110.28168>
- [5] Lumbsch, H. T., Lunke, T., Feige, G. B., Huneck, S. Anamylopsoraceae a new family of lichenized ascomycetes with stipitate apothecia (Lecanorales: Agryrineae), *Plant Systematics and Evolution*. 1995, 198: 275-286.  
<https://doi.org/10.1007/BF00984742>
- [6] Lendemer, J. C. A monograph of the crustose members of the genus *Lepraria* Ach. s. str. (Stereocaulaceae, Lichenized Ascomycetes) in North America north of Mexico, *Opuscula Philolichenum*. 2013, 12: 27-141.  
<http://sweetgum.nybg.org/philolichenum/>
- [7] Guzow-Krzemińska, B., Jabłońska, A., Flakus, A., Rodriguez-Flakus, P., Kosecka, M., Kukwa, M. Phylogenetic placement of *Lepraria cryptovouauxii* sp. nov. (Lecanorales, Lecanoromycetes, Ascomycota) with notes on other *Lepraria* species from South America, *MycoKeys*. 2019, 53: 1-22.  
<https://doi.org/10.3897/mycokeys.53.33508>
- [8] Lendemer, J. C. Perspectives on chemotaxonomy: Molecular data confirm the existence of two morphologically distinct species within a chemically defined *Lepraria caesiella* (Stereocaulaceae), *Castanea*. 2012, 77: 89-105.  
<https://doi.org/10.2179/11-042>
- [9] Li, P. Q., Liu, X. F., Yan, Q. One newly recorded Genera and three new recorded lichen species in Hubei Province [J]. *Hubei Forestry Science and Technology*, 2023. 52: 88-90.
- [10] Jatta, A. Chinese lichens collected at Shen-si in the years 1894-1898 by the rev. Missionary Father G. Giralddi, *Nuovo Giornale Botanico Italiano (in Italian)*. 1902, 9: 460-481.
- [11] Zahlbruckner, A. Lichenes in Handel Mazzetti, *Symbolae Sinicae*. 1930, 3: 185.
- [12] Wu, J. L. Iconography of Chinese Lichen, Zhanwang Press, Beijing. 1987.
- [13] Wei, J. An Enumeration of Lichens in China. Beijing, International Academic Publishers. 1991, 1-278.

- [14] Han, L. F., Liu, J. M., Zhang, X. P. Newly recorded species of the genus *Lepraria* from China, *Acta Botanica Boreali-Occidentalia Sinica*. 2006, 26: 1253-1255. <https://europepmc.org/article/cba/621348>
- [15] Zhang, C., Cai, Y. T., Zhou, S. N., Zhang, L. L. Three newly recorded species of lichens from China. *Acta Botanica Boreali-Occidentalis Sinica*. 2024, 44: 995-1002. <https://doi.org/10.7606/j.issn.1000-4025.20230634>
- [16] Culberson, C. F., Kristinsson, H. D. A standardized method for the identification of lichen products, *Journal of Chromatography A*. 1970, 46: 85-93. [https://doi.org/10.1016/S0021-9673\(00\)83967-9](https://doi.org/10.1016/S0021-9673(00)83967-9)
- [17] Culberson, C. F. Improved conditions and new data for the identification of lichen products by a standardized thin-layer chromatographic method, *Journal of Chromatography A*. 1972, 72: 113-125. [https://doi.org/10.1016/0021-9673\(72\)80013-X](https://doi.org/10.1016/0021-9673(72)80013-X)
- [18] Orange, A., James, P. W., White, F. J. *Microchemical methods for the identification of lichens*, 2nd ed. British Lichen Society, London. 2010.
- [19] Jiang, S. H., Wei, X. L., Wei, J. C. A new species and two new records of *Strigula* (lichenized Ascomycota) from China, *Mycoscience*. 2017, 58: 391-397. <https://doi.org/10.1016/j.myc.2017.05.003>
- [20] Han, L. F., Zhang, Y. Y., Guo, S. Y. *Peltigera wulingensis*, a new lichen (Ascomycota) from north China, *The Lichenologist*. 2013, 45: 329-336. <https://doi.org/10.1017/S0024282912000837>
- [21] Abbas, A., Guo, S. Y., Ababaikeli, G., Abdulla, A., Xahidin, H. *Diploschistes xinjiangensis*, a new saxicolous lichen from northwest China, *Mycotaxon*. 2015, 129: 465-471. <https://doi.org/10.5248/129.465>
- [22] Gardes, M., Bruns, T. D. ITS primers with enhanced specificity for basidiomycetes application to the identification of mycorrhizae and rusts, *Molecular Ecology*. 1993, 2: 113-118. <https://doi.org/j.1365-294X.1993.tb00005.x>
- [23] White, T. J., Bruns, T., Lee, S. J. W. T., Taylor, J. Amplification and direct sequencing of fungal ribosomal RNA genes for phylogenetics in: MA Innis & al. (eds), *PCR Protocols: A Guide to Methods and Applications*, San Diego, Academic Press. 1990, 18: 315-322.
- [24] Stepanchikova, I. S., Himelbrant, D. E., Prokopiev, I. A., Pankova, V. V., Zhukova, A. A., Gainetdinova, II., Zueva, A. S. Leprarioid lichens and associated lichenicolous fungi from the Commander Islands (Kamchatka Territory, Russia) including a new species *Lepraria tiinae*, *Folia Cryptogamica Estonica*. 2023, 60: 101-128. <https://doi.org/10.12697/fce.2023.60.11>
- [25] Czarnota, P. A. W. E. Ł., Kukwa, M., R. T. I. N. Lichens of the Genera *Lepraria* and *Leproloma* from the Gorce Mts [Western Carpathians, Poland] and note on lichenicolous fungus *Paranectria oropensis* found on *Leproloma membranaceum*, *Polish Botanical Journal*. 2001, 46: 199-206.
- [26] Hauck, M., Tønberg, T., Mayrhofer, H., Breuss, O. Lichen-forming and lichenicolous fungi new to Kazakhstan, *Herzogia*. 2013, 26: 103-116. <https://doi.org/10.13158/heia.26.1.2013.103>
- [27] Bayerová, Š., Kukwa, M., Fehrer, J. A new species of *Lepraria* (lichenized Ascomycetes) from Europe, *The Bryologist*. 2005, 108: 131-138. [https://doi.org/10.1639/0007-2745\(2005\)108\[131:ANSOLL\]2.0.CO;2](https://doi.org/10.1639/0007-2745(2005)108[131:ANSOLL]2.0.CO;2)

## Biography



**Dolathan Toksun** is a Master student of Xinjiang University, College of Life Sciences and Technology. She obtained her Bachelor of Science in Biological Sciences from Xinjiang University in 2022, and received her Master of Science in Biology from the same institution in 2025. Recognized for her exceptional contributions, Ms. Dolathan Toksun has been published 3 research articles in domestic Journals.



**Muhammad Shahid Iqbal** is a lecturer of Botany at Department of Botany, University of Layyah, City Campus, Layyah, Punjab, Pakistan. He completed his Ph.D. in Botany from University of the Punjab, Lahore, Pakistan in 2025, and his Master of Botany in Mycology from the same institution in

2021. Recognized for his exceptional contributions, Dr. Muhammad Shahid Iqbal has been published more than 35 research articles in different peer re-viewed International Journals. Dr. Iqbal does research in lichenology. In addition, he holds a Lichen book reviewer certificate from BP International. He has participated in multiple international research collaboration projects in recent years. Currently, He is serving as reviewer of many International Journals.



**Anwar Tumor** is a professor at Xinjiang University, College of Life Sciences and Technology. He completed his PhD in Ecology from Xinjiang University in 2008, and his Master of Ecology from the same institution in 1996. Recognized for his exceptional contributions, Prof. Dr. Anwar

Tumor has been published more than 50 research articles in different peer reviewed International and Domestic Journals. He has participated in multiple international research collaboration projects in recent years and presided over and completed 6 projects funded by the National Natural Science Foundation of China (NSFC). He currently serves as the Editorial Boards of *Journal of Plant Sciences*.

## Research Field

**Dolathan Toksun:** Lichenologist and researcher

**Muhammad Shahid Iqbal:** Lichenologist and researcher

**Anwar Tumor:** Lichenologist and researcher