



An updated checklist of the lichenized and lichenicolous fungi of Arasbaran, UNESCO-Man and Biosphere Reserve, Northwest of Iran

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Abstract: Based on revision of 533 herbarium specimens and literature review, 227 lichenized and 36 lichenicolous fungi belonging to 115 genera and 52 families (including 8 "incertae sedis" taxa) are reported from Arasbaran UNESCO-MAB Biosphere Reserve. In addition, 103 taxa are reported for the first time from Arasbaran. Of these nineteen lichenized fungi and two lichenicolous fungi were not known from Iran before, the lichenized fungi *Aspicilia pavimentans*, *Bryobilimbia hypnorum*, *Caloplaca phaeothamnos*, *Cetrelia monachorum*, *Circinaria elmorei*, *Cladonia borealis*, *L. populicola*, *Lecidea auriculata*, *Pertusaria flavicans*, *P. pluripuncta*, *P. pseudocorallina*, *P. xanthoplaca*, *Phaeophyscia poeltii*, *Rinodina trachytica*, *Scytinium aragonii*, *Usnea glabrata*, *Varicellaria lactea*, *Xanthocarpia tominii*, and the lichenicolous fungi *Rosellinula haplospora* and *Teloggalla olivieri*. ITS rDNA was used to confirm the identity of *Lecidea auriculata*. The history of floristic study and the diversity of lichen species in the region are briefly discussed.

Keywords: Azerbaijan, biodiversity, Caucasus region, forest-steppe, Irano-turanian region

INTRODUCTION

Arasbaran Biosphere Reserve is a mountainous area in the northern part of the province East Azerbaijan and belongs to the Iranian part of the Caucasian highlands situated between the Caspian and the Black Sea. The historical boundary of Arasbaran is ambiguous, but it is roughly defined here as the areas with intact forest and steppe-forest vegetation types. The area covers 160,000 hectares with a circumference

of 250 km (Ghorbani, 2013; Sagheb-Talebi et al. 2014). The importance of biological diversity in Arasbaran forests led to the declaration that c. 80,000 hectares would be protected under the Man and the Biosphere (MAB) programme of the United Nations Educational, Scientific and Cultural Organization (UNESCO) in 1972 and as an IUCN Arasbaran Biosphere Reserve in 1998, see IUCN Jalili & Jamzad (1999). Locally, the area is known as "Qaradaq Mohali" (black mountain area) due to the dark appearance of the mountains at a distance. Today the area is composed of the northern part of Ahar and the eastern parts of Jolfa, Kaleybar and Varzeghan counties and includes the largest forested parts of the East Azerbaijan province.

The biological and anthropological significance of the Arasbaran Biosphere Reserve is due to the diversity of flora and fauna, as well as local cultural practices. The Arasbaran area encompasses a variety of natural features, such as high mountains, deep valleys, dense forests and vast rangelands with a very rich environmental diversity. Arasbaran Biosphere Reserve is affected by three different types of climate resulting in a large diversity of ecosystems. Regional surveys have recorded c. 1000 vascular plant species, including 140 trees, the most important being *Quercus atropatana* ?*atropatena*?, *Juniperus communis*, *Pistacia utlanta* ?*atlantica*?, *Carpinus betulus*, *Fraxinus ratuntifolia* ?*rotundifolia*? and *Acer campestre*, see Sohrabi & Alstrup (2007).

The first Iranian lichen list was based on collections made by Buhse (1860) in his biological investigation of the Transcaucasus and Hyrcanian area and included over 50 lichen taxa from northern Iran, Armenia and some from Nakhchivan Autonomous Republic, an exclave of the Republic of Azerbaijan, but did not provide any lichenological records from along the Aras River, especially the valley between Jolfa and Kaleybar cited as "Gharadagh" (formerly named as the Arasbaran region). Based on the small collection made by the author, the first lichens, *Cladonia* and *Lepraria* spp., reported from the western part of the Arasbaran area, appear in Ahti & Sohrabi (2006) and Sohrabi & Orange (2006), respectively. Additional data on parmelioid lichens from Arasbaran were reported by

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Sohrabi & Alstrup, (2007) and Sohrabi et al. (2007), and further records from there referred to in Seaward et al. (2008); Seaward et al. (2004); Myllys et al. (2011); Myllys et al. (2014); Velmala et al. (2014); Boluda et al. (2015); Valadbeigi, Nordin, et al. (2011); Valadbeigi, Sipman, et al. (2011).

The present study has several primary objectives to (1) demonstrate the importance of baseline information provided by regional studies of lichenological biodiversity, (2) contribute to our knowledge of lichenized and lichenicolous fungi of Iran and the Caucasus region in general, (3) provide new information on the occurrence and distribution of lichens and lichenicolous fungi of SW Asia, and (4) increase our knowledge of lichenology at a regional level for conservation purposes.

Outline of the study area

The study area is located in NW Iran (38°33'–39°09'N & 46°09'–47°09'E), c. 90 km from Tabriz,

the capital city of the province of East Azerbaijan, close to the countries Azerbaijan and Armenia (Fig. 1). It comprises the Gharadaq Mountain range (250–2850 m) south of the Aras River, which includes high alpine meadows, semi-arid steppes, rangelands and occasional forested deep river valleys. Most of the visited localities in this study have been selected from forest areas due to their high diversity of lichens, particularly the trees and shrubs, which are rich in epiphytic species. The lichens recorded grow on soil, siliceous or calcareous rocks, and mossy siliceous rocks.

According to Talebi et al. (2014) and Sagheb-Talebi et al. (2001), forest types were distinguishable in accordance with the ecological adaptability of the tree species at different altitudes. *Quercus* spp. are widely distributed, and *Juniperus* stands to occur at 400–1800 m, both in mixed or pure stands. *Cornus* spp., show a very narrow distribution between 900 and 1000 m.

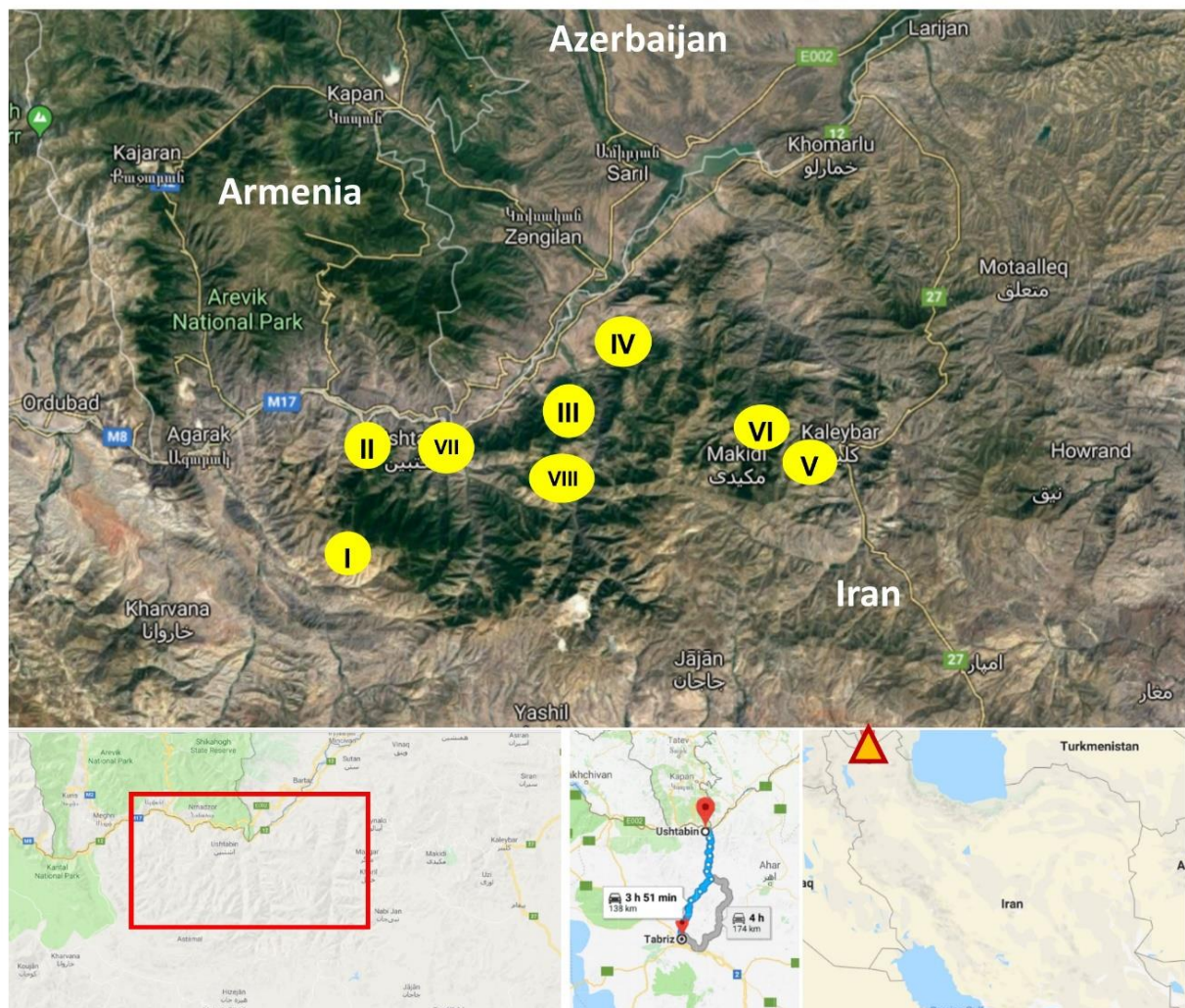


Fig. 1. Location of the collection sites (indicated by Latin numbers) in the Arasbaran area in NW of

Five forest types were described by Sagheb-Talebi et al. (2001):

1. Pure Oak (*Quercetum*), composed of *Quercus petraea* and *Q. macranthera*, mainly distributed from 650 to 1600 m.
2. Pure Hornbeam (*Carpinetum*), composed of *Carpinus betulus* and *C. orientalis*, widely distributed from 1000 to 1500 m. (It should be mentioned that the occurrence of *C. orientalis* in Arasbaran is doubtful.)
3. Mixed Oak-Hornbeam (*Querco-Carpinetum*), composed of *Carpinus* species and *Quercus* spp., mainly occurring from 1000 to 1800 m.
4. *Juniperetum*, composed of *Juniperus* spp. (mainly *J. communis*, *J. foetidissima* and *J. excelsa*), distributed from 1000 to 1400 m.
5. Mixed Oak-Hornbeam-Conifers, composed of *Carpinus*, *Quercus* and *Juniperus* spp., furthermore *Taxus baccata*, mainly distributed from 1000 to 1400 m.

According to FAO (2004), the Arasbaran forests are the most degraded forests of NW Iran. Studies such as Abbasloo (1996); Alijanpour & Mahmoudzadeh (2007); Sarhangzadeh & Makhdoum (2003); Shanjani (2001); Sagheb-Talebi et al. (2014); Sagheb-Talebi et al. (2001) based on aerial photographs from early 1945 estimate that the forests originally covered 500,000 ha before being reduced to a mere 60,000 ha today. A more conservative estimate by FAO (2004) gives the 1958 area as 300,000 ha, and the present one as 200,000 ha.

In the Arasbaran forest area c. 60,000 ha of open forests and 37,500 ha of closed forests are protected; they are dominated by oak (*Quercus macranthera*, *Q. petraea*), hornbeam (*Carpinus betulus*), maple (*Acer campestre*, *A. monspessulanum*), elm (*Ulmus glabra*), wild cherry (*Prunus avium*), ash (*Fraxinus excelsior*), junipers (*Juniperus communis*, *J. foetidissima*, *J. excelsa*) and yew (*Taxus baccata*). The main forest associations are pure oak (*Quercetum*), pure hornbeam (*Carpinetum*), mixed oak-hornbeam (*Querco-Carpinetum*), mixed broadleaved, and conifer forests (Sagheb-Talebi et al. 2001). Conversion of forest to pasture and logging has resulted in severe degradation and a decrease in forest cover.

A large part of the Arasbaran area is rangelands which cover the low elevations in the warmer regions, as well as higher elevations in Saygaram-daq. The vegetation of these areas can be roughly defined as either scrubland or grassland. Scrublands are found at elevations of 250 to 2200 m in different parts of the area. The most typical species are *Punica granatum*, *Paliurus spina-christi*, *Rhamnus paliurus*, *Cotoneaster* spp., and *Ephedra* spp., mixed with a large diversity of other plants. Grasslands can be found at elevations of 250 to 2800 m and are dominated by different species of Poaceae (e.g. *Agropyron* & *Stipa* spp.), and herbs such as *Astragalus*, *Stachys* and *Euphorbia* spp., together with many annual plants. According to Assadi (1988), the plant diversity of the rangelands is

exceptionally high, especially on steppe sites and in open areas in the mountain forests. It is an important source of food for local indigenous breeds of livestock kept by local nomads and subsequently settled villagers over thousands of years. Today the rangelands are deteriorating due to the excessive numbers of livestock grazing these areas.

MATERIALS AND METHODS

During several field trips in 2001, 2004, 2005, 2006 and 2007, ca. 1000 specimens were collected in eight localities in the Arasbaran UNESCO-MAB Biosphere Reserve, and incorporated into the author's personal herbarium in Daran village, Jolfa County (East Azerbaijan Province) and duplicated for ICH herbarium at the Iranian Research Organization for Science and Technology (IROST) in Tehran. So far ca. 200 specimens have been published in, e.g., Sohrabi & Sipman (2007); Seaward et al. (2008); Sohrabi & Alstrup (2007); Sohrabi & Orange (2006). The present report is based on the examination of ca. 533 further specimens. For the remaining ca. 250 specimens, the taxonomic status is still unsettled and awaiting revisional studies in groups such as *Acarospora*, *Circinaria*, *Lecanora*, *Lecidea*, *Pertusaria*, *Rinodina*, *Rhizocarpon*, *Staurothele*, *Verrucaria*.

The morphology and anatomy of specimens were studied with the aid of dissecting and compound microscopes and supported where necessary by chemical reactions (Ryan et al. 2002). Microcrystallography and thin-layer chromatography (TLC) were done for some selected group of lichens following Orange et al. (2001). The macrolichen v. microlichen concept followed that defined by Kirk et al. (2001). The principal identification keys used were Nash et al. (2007); Gaya (2009); Smith et al. (2009); Sliwa (2007); Temina et al. (2005); Nash et al. (2002); Krzemińska (2012); Awasthi (1991); Wirth (1995); Dobson (2011); Malcolm & Galloway (1997); Ryan et al. (2002) were used. The species names were checked against Index Fungorum (<http://www.speciesfungorum.org/names/names.asp>) and Mycobank (Crous et al. 2004) to ensure their orthography. The examined specimens were stored in the herbarium of the Iranian research organization for Science and Technology with its acronym ICH, some in IRAN. Some reference material from the herbaria H, GB, C, TUR, and S was consulted for comparative purposes. The generic and family names are based on Wijayawardene et al. (2018).

Information on ecology and distribution, as well as nomenclature, has been mainly derived from Clauzade & Roux (1985); Clauzade et al. (1989); Smith et al. (2009); Brodo et al. (2001); John & Türk (2017); Santesson et al. (2004); Esslinger (2016); Nimis (2016); Gasparyan & Nimis (2016). Total genomic DNA was extracted from specimens 4375 (*Lecidea auriculata*) following Sohrabi et al. (2013).

Collecting Localities

- I. 18.7.2005. Varzeghan county, c. 26 km W of Varzeghan and c. 6 km E of Joshin village (Kharvana), Joshin Castle, 1700-2000 m, 38.6517 N, 46.3500 E. A fairly arid site dominated by vascular plants, including *Astragalus*, *Rosa*, and numerous Poaceae spp., and many annual plants.
- II. 15.7.2001. Jolfa county, Jolfa to Khoda-afarin, 5 km S of Missan village, 1000-1500 m, 38.8690 N, 46.4523 E. Slope covered by *Lonicera* and *Juniperus*, and also by *Quercus* and *Carpinus* at higher elevations.
- III. 20.8.2005. Kaleybar, 21 km S of Khoda-afarin to Jolfa road, Aynaloo, 1700-1900 m, 38.8342 N, 46.7914 E. Slopes covered by *Quercus* and *Carpinus*. [with Masoomeh Ghobad-Nejhad]
- IV. 19.8.2005. Kaleybar, c. 10 km S of Aras River and Khoda-afarin to Jolfa road, Dar-Aghzi village, 450 m, 39.0834 N, 46.8832 E. Slopes covered by *Rosa*, *Amygdalus* and mostly by *Paliurus spinachristi*.
- V. 19.8.2005. Kaleybar county, c. 4 km SW of Kaleybar, Galadarasi, towards Babak Castle (Bez Galasi), 1750-2500 m, 38.8686 N, 46.9683 E. Slopes covered by *Quercus*, *Carpinus*, and *Crataegus*.
- VI. 20.8.2005. Kaleybar, c. 10 km W of Kaleybar, Hejrandoost village, 1750-1850 m, 38.8686 N, 46.9683 E. Dominated by *Juniperus communis* and many annual species.
- VII. 20.7. 2004. Jolfa county, Khoda-afarin to Jolfa road, crossing at Uoshtipin village, Hrass, 500 m, 38.8956 N, 46.4462 E. Roadside siliceous boulders.
- VIII. 5.11. 2007. Kaleybar county, 11 km S of Asheqlu, along the road to Aynalu. 1250 m. 38.9387 N, 46.7628 E. Low, regenerating deciduous forest dominated by *Carpinus orientalis*. [with H. J. M. Sipman, U. Søchting & M. R. Asef]

RESULTS

As a result of this fieldwork in the Arasbaran UNESCO-MAB Biosphere Reserve, 227 lichenized and 36 lichenicolous fungi are reported, including 110 genera from 50 families in the Ascomycota and a single taxon in the family Corticiaceae, Basidiomycota. The majority of species listed are macrolichens with 122 species (44 epiphytic, 38 terricolous & 40 saxicolous) belonging to the following genera: *Anaptychia*, *Bryoria*, *Candelaria*, *Catapyrenium*, *Cetraria*, *Cetrelia*, *Chaenotheca*, *Cladonia*, *Collema* s.l., *Dermatocarpon*, *Evernia*, *Flavoparmelia*, *Fuscopannaria*, *Hypogymnia*, *Leptogium*, *Lepra*, *Lepraria*, *Leprocaulon*, *Lobaria*.

Melanelixia, *Melanohalea*, *Nephroma*, *Parmelia*, *Peltigera*, *Phaeophyscia*, *Physcia*, *Physconia*, *Protoparmeliopsis*, *Ramalina*, *Rhizoplaca*, *Squamarina*, *Toninia*, *Tornabea*, *Umbilicaria*, *Usnea*, *Xanthomendoza*, *Xanthoparmelia* and *Xanthoria*, and 110 species of microlichens (31 epiphytic, 15 terricolous & 63 saxicolous) belonging to the following genera: *Acarospora*, *Arthonia*, *Aspicilia*, *Buellia*, *Caloplaca*, *Candelariella*, *Catillaria*, *Dimelaena*, *Diploschistes*, *Immersaria*, *Ingvariella*, *Lambiella*, *Lecania*, *Lecanora*, *Lecidea*, *Lecidella*, *Lepra*, *Lobothallia*, *Melaspila*, *Mycobilimbia*, *Ochrolechia*, *Pachyphiale*, *Pertusaria*, *Phlyctis*, *Placocarpus*, *Pleopsidium*, *Psilolechia*, *Rhizocarpon*, *Rinodina*, *Scoliciosporum*, *Staurothele*, *Thelenella*, and *Verrucaria*. The most diverse lichenized families are Parmeliaceae (33), Physciaceae (28), Lecanoraceae (23), Teloschistaceae (15), Verrucariaceae (14), Cladoniaceae (13), Megasporaceae (12) and Ramalinaceae (11), and the most diverse genera are *Cladonia* (13 taxa), *Lecanora* (11), *Peltigera* (9), *Xanthoparmelia* (9), *Umbilicaria* (6), *Ramalina* (6), *Physcia* (6), *Circinaria* (6), *Bryoria* (5), *Phaeophyscia* (5), *Physconia* (5) and *Lecidella* (5). The most diverse lichenicolous fungi families are Mycosphaerellaceae (7 taxa), "incertae sedis" (8), Verrucariaceae (3), Polycoccaceae (2) Phaeococcomycetaceae (2) and Lichenocniaceae (2), and the most diverse genera are *Stigmidium* (5 taxa), *Rosellinula* (2), *Phaeosporobolus* (2), *Lichenocnium* (2), *Sphaerellothecium* (2), *Muellerella* (2) and *Lichenostigma* (2).

List of taxa

The following data are provided: **Ref.** = literature reviews and reports; **Syn.** = important synonyms; functional group (**L** = lichenized fungi, **LF** = lichenicolous fungi, and **LL** = lichenicolous lichens); substrate; **I** to **VIII** = collection localities listed above, followed by the collection numbers of the samples taken at that locality; **TLC** = results of thin-layer chromatography; and **New DNA** = Genbank accession number in bold. Unless otherwise indicated, the collection numbers are those of M. Sohrabi and the specimens are deposited in the ICH herbarium at the Iranian Research Organization for Science and Technology (IROST) with duplicates in the personal herbarium of M. Sohrabi.

Abrothallus caeruleus Kotte

Ref.: Sohrabi & Alstrup (2007); Seaward et al. (2008).

Acarospora fuscata (Nyl.) Arnold

L; on siliceous rock; **II:** 1459. **TLC:** gyrophoric acid.

Acarospora laqueata Stizenb.

L; on siliceous rock; **I:** 3597. **TLC:** gyrophoric acid.

Alyxoria culmigena (Lib.) Ertz

Ref.: Sohrabi & Alstrup (2007); Seaward et al. (2008) as *Opegrapha culmigena* Lib.

Alyxoria varia (Pers.) Ertz & Tehler

Ref.: Sohrabi & Alstrup (2007); Seaward et al. (2008) as *Opegrapha varia* Pers. **L;** on *Carpinus* base; **VIII:** Sipman 55427 [IRAN, B 60 0175537].

Anaptychia crinalis (Schrad.) Vězda

L; on the bark of deciduous trees; **V:** 4670, 4509.

Anaptychia desertorum (Rupr.) Poelt

L; on siliceous rock; **I:** 3517.

Anaptychia elbursiana (Szatala) Poelt

L; on siliceous or calcareous rocks; **I:** 3528; **IV:** 3682.

Anaptychia setifera Mereschk. ex Räsänen

Ref.: Jamshidi et al. (2014). **L;** on bark or branches of deciduous tree; **II:** 123, 118, 1402, 137, 1493, 1544; **III:** 3688; **V:** 4599, 4655, 4528, 4636, 4561; **VIII:** Sipman 55457 [IRAN, B 60 0175569].

Arthonia apotheciorum (A. Massal.) Almq.

Ref.: Sohrabi & Alstrup (2007); Seaward et al. (2008) as *Arthonia galactinaria* Leight.

Arthonia intexta Almq.

Ref.: Sohrabi & Alstrup (2007); Seaward et al. (2008).

Arthonia radiata (Pers.) Ach.

L; on *Carpinus* base; **VIII:** Sipman 55447 [IRAN, B 60 0175559].

Arthonia varians (Davies) Nyl.

Ref.: Sohrabi & Alstrup (2007); Seaward et al. (2008).

Arthrorhaphis aeruginosa R. Sant. & Tønnsberg

Ref.: Sohrabi & Alstrup (2007); Seaward et al. (2008).

Aspicilia candida (Anzi) Hue

L; on calcareous rock; **VI:** 4302b.

Aspicilia cinerea (L.) Körb.

L; on siliceous rock; **III:** 4065, 3807, 3729. **TLC:** norstictic acid.

Aspicilia pavimentans (Nyl.) Hue

New to Iran; **L;** on calcareous rock; **V:** 4577. **TLC:** norstictic acid.

Biatora carneoalbida (Müll. Arg.) Coppins

Ref.: Sohrabi & Alstrup (2007); Seaward et al. (2008) as *Mycobilimbia carneoalbida* (Müll.Arg.) Vitik. et al.).

Bryobilimbia hypnorum (Lib.) Fryday, Printzen & S. Ekman

New to Iran; **L;** on mosses; **V:** 4493.

Bryoria capillaris (Ach.) Brodo & D. Hawksw.

L; on mosses growing on rock; **V:** 4743, 4691, 4432. **TLC:** atranorin, barbatolic, fumarprotocetraric, and psoromic acids.

Bryoria implexa (Hoffm.) Brodo & D. Hawksw.

Ref.: Myllys et al. (2011); Boluda et al. (2015); Velmala et al. (2014). **L;** on mosses on rock; **V:** 4656a. **TLC:** connorstictic and norstictic acid.

Bryoria kuemmerleana (Gyeln.) Brodo & D. Hawksw.

Ref.: Velmala et al. (2014). **L;** on saxicolous mosses; **V:** 4656b. **TLC:** atranorin, norstictic, connorstictic, and psoromic acids.

Bryoria nadvornikiana (Gyeln.) Brodo & D. Hawksw.

Ref.: Sohrabi & Alstrup (2007); Seaward et al. (2008); Boluda et al. (2015). **TLC:** barbatolic, alectorialic, and fumarprotocetraric acids.

Buellia zoharyi Galun

L; on calcareous soil; **VII:** 4263. **TLC:** atranorin, norstictic, and stictic acids.

Calogaya biatorina (A. Massal.) Arup, Frödén & Söchting

Syn.: *Caloplaca biatorina* (A. Massal.) J. Steiner; **L;** on siliceous rock; **V:** 4596.

Calogaya decipiens (Arnold) Arup, Frödén & Söchting

Syn.: *Caloplaca decipiens* (Arnold) Blomb. & Forssell; **L;** on calcareous rock; **VI:** 4395.

Calogaya saxicola (Hoffm.) Vondrák

Syn.: *Caloplaca saxicola* (Hoffm.) Nordin; **L;** on siliceous rock; **III:** 4006.

Caloplaca cerina (Ehrh. ex Hedw.) Th. Fr. s.lat.

L; on bark or banches of deciduous tree; **II:** 105; **III:** 3813, 3685, 3690, 3772, 4020, 4013; **V:** 4645, 4467; **VIII:** Sipman 55442 [IRAN, B 60 0175554].

Caloplaca phaeothamnos Kalb & Poelt

New to Iran; **L;** on soil surfaced rock bases on fine rich soils; **III:** 4232.

Caloplaca stillicidiorum (Vahl) Lyngé

L; on mosses; **I:** 3538b.

Candelaria concolor (Dicks.) Stein

L; on bark or branches of deciduous trees; **V:** 4475.

Candelariella kansuensis H.Magn.

Ref.: Westberg & Sohrabi (2012). **L;** on siliceous rocks; **I:** 3535.

Candelariella lutella (Vain.) Räsänen

Ref.: Westberg & Sohrabi (2012). **L;** on bark of deciduous trees; **III:** 3694.

Candelariella rosulans (Müll.Arg.) Zahlbr.

Ref.: Westberg & Sohrabi (2012). **L;** on siliceous rock; **III:** 3644.

Candelariella vitellina (Hoffm.) Müll.Arg.

Ref.: Westberg & Sohrabi (2012). **L;** on mossy siliceous rock; **III:** 3726b.

Catapyrenium cinereum (Pers.) Körb.

Ref.: Sohrabi & Alstrup (2007); Seaward et al. (2008).

Catillaria chalybeia (Borrer) A. Massal.

Ref.: Sohrabi & Alstrup (2007); Seaward et al. (2008).

Cetraria aculeata (Schreb.) Fr.

Ref.: Sohrabi & Alstrup (2007); Seaward et al. (2008) as *Cetraria steppae* (Savicz) Kärnefelt. Based on molecular studies, *C. steppae* was synonymized under *C. aculeata* in Nadyeina et al. (2013). **TLC:** norstictic acid. DNA from Iranian specimen in Nadyeina et al. (2013): KU200416, KU200417, KU200418.

Cetraria islandica (L.) Ach.

Ref.: Sohrabi & Alstrup (2007); Seaward et al. (2008). **TLC:** lichesterinic, protocetraric, and fumarprotocetraric acids.

Cetrelia monachorum (Zahlbr.) W.L. Culb. & C.F. Culb.

New to Iran; **L;** on mossy siliceous rock; **V:** 4468. **TLC:** atranorin and imbricatic acid.

Cetrelia olivetorum (Nyl.) W.L. Culb. & C.F. Culb.

Ref.: Sohrabi & Alstrup (2007); Seaward et al. (2008). **TLC:** atranorin, chloroatranorin, and olivetoric acid.

Chaenotheca furfuracea (L.) Tribell

Ref.: Sohrabi & Alstrup (2007); Seaward et al. (2008).

Circinaria calcarea (L.) Körb.

L; on calcareous rock; **I:** 3580. **TLC:** aspicilin.

Circinaria elmorei (E.D. Rudolph) Owe-Larss., A. Nordin & Sohrabi

New to Iran; **L;** on calcareous rock; **IV:** 3679.

Circinaria fruticulosa (Eversm.) Sohrabi (Fig. 2)

Ref.: Sohrabi et al. (2013). **L:** on soil, vagrant. **TLC:** none detected.

Circinaria maculata (H. Magn.) Q. Ren

L; on calcareous rocks; **I:** 3537, 3570, 3602; **IV:** 3635, 3666. **TLC:** none detected.

Cladonia borealis S. Stenroos

New to Iran; **L;** on soil; **V:** 4539. **TLC:** barbatic and usnic acids.

Cladonia cariosa (Ach.) Spreng.

Ref.: Ahti & Sohrabi (2006); Seaward et al. (2008). **L;** on soil; **II:** 152. **TLC:** atranorin and fumarprotocetraric acid

Cladonia chlorophaea (Flörke ex Sommerf.) Spreng.

Ref.: Ahti & Sohrabi (2006); Seaward et al. (2008). **L;** on soil; **II:** 1474, 1388. **TLC:** fumarprotocetraric acid complex.

Cladonia coniocraea (Flörke) Spreng.

L; on dead wood or dead part of fallen trees; **III:** 3780. **TLC:** fumarprotocetraric acid complex.

Cladonia fimbriata (L.) Fr.

Ref.: Ahti & Sohrabi (2006); Seaward et al. (2008). **L;** on soil and mosses; **I:** 3527; **II:** 137 **III:** 4225; **V:** 4650. **TLC:** fumarprotocetraric acid complex.

Cladonia foliacea (Huds.) Willd.

Ref.: Ahti & Sohrabi (2006); Seaward et al. (2008). **L;** on soil and mosses; **II:** 179, 1370, 1505; **IV:** 3645; **V:** 4537; **VIII:** Sipman 55455 [IRAN, B 60 0175567]. **TLC:** usnic, fumarprotocetraric acids.

Cladonia macilenta Hoffm.

L; on soil and mosses; **III:** 4093. **TLC:** thamnolic, and barbatic acids.

Cladonia magyarica Vain.

Ref.: Seaward et al. (2008). **L;** on soil and mosses; **V:** 4553; **VI:** 4271. **TLC:** atranorin and fumarprotocetraric acid.

Cladonia pocillum (Ach.) Grognot

Ref.: Ahti & Sohrabi (2006); Seaward et al. (2008). **L;** on soil **I:** 3531; **II:** 130 **V:** 4614. **TLC:** fumarprotocetraric acid complex.

Cladonia pyxidata (L.) Hoffm.

Ref.: Ahti & Sohrabi (2006); Seaward et al. (2008). **L;** on soil; **II:** 1448, 141, 116; **V:** 4608, 4514; **VI:** 4328. **TLC:** fumarprotocetraric acid complex.

Cladonia rangiformis Hoffm.

Ref.: Ahti & Sohrabi (2006); Seaward et al. (2008). **L;** on soil, mostly associated with mosses; **II:** 120, 134; **III:** 4004; **IV:** 3656; **VIII:** Sipman 55463 [IRAN, B 60 0175575]. **TLC:** strain 1, atranorin, rangiformic acid, and fumarprotocetraric acid complex; strain 2, atranorin, rangiformic, and tr. norrangiformic acids (55463).

Cladonia rei Schaer.

L; on soil; **III:** 4186, 4023. **TLC:** homosekikaic, sekikaic acids, and fumarprotocetraric acid complex.

Cladonia subrangiformis Sandst. (Fig. 2)

Ref.: Ahti & Sohrabi (2006); Seaward et al. (2008). **L;** on soil, mostly associated with mosses; **II:** 154, 1502 **III:** 3795, 4056, 4084; **V:** 4755, 4747, 4466; **VI:** 4322. **TLC:** atranorin and fumarprotocetraric acid.

Cladonia symphycharpa (Ach.) Fr.

L; on soil; **V:** 4753. **TLC:** atranorin and norstictic acid.

Clypeococcum cladonema (Wedd.) D. Hawksw.

Ref.: Sohrabi & Alstrup (2007); Seaward et al. (2008).

Collema flaccidum (Ach.) Ach.

L: on siliceous rock or bark, often over mosses; **III:** 4010, 4136, 3705; **V:** 4522, 4695, 4502.

Dermatocarpon intestiniforme (Körb.) Hasse

L: on siliceous rock; **V:** 4609, 4521.

Dermatocarpon miniatum (L.) W. Mann

L: on limestone, rarely on slightly calcareous or siliceous rocks; **I:** 3501; **II:** 126 **III:** 4101; **V:** 4731, 4560, 4513.

Dermatocarpon moulinsii (Mont.) Zahlbr.

Ref.: Sohrabi & Alstrup (2007); Seaward et al. (2008).

Dermatocarpon velleurem Zschacke

L: on siliceous rocks; **II:** 1410; **III:** 3740; **V:** 4478, 4688.

Dimelaena oreina (Ach.) Norman

L: on slightly calcareous, hard, siliceous (often feldspar rich) siliceous rock; **I:** 3586; **II:** 1464, 1467; **III:** 4001, 3764, 3722. **TLC:** usnic, fumarprotocetraric, and gyrophoric acids.

Diploschistes muscorum (Scop.) R. Sant.

L: on calcareous soil and mosses, occasionally with *Cladonia* spp.; **I:** 3547; **II:** [1367, (F)]; **V:** 4628, 4511. **TLC:** diploschistesic and lecanoric acids.

Diploschistes scruposus (Schreb.) Norman

L: on weakly calcareous or siliceous rock; **I:** 3503, 3640, 3650; **II:** [1375, 1409, 1468, (F)], 1499, 1443; **III:** 4039, 4083; **V:** 4570; **VII:** 4241. **TLC:** diploschistesic and lecanoric acids.

Enchylium tenax (Sw.) Gray

Syn.: *Collema tenax* (Sw.) Ach.; **L:** on bare, or sparsely overgrown with mosses and higher plants, soil; **II:** 1500.

Endocarpon pallidum Ach.

Ref.: Sohrabi & Alstrup (2007); Seaward et al. (2008).

Endococcus perpusillus Nyl.

Ref.: Sohrabi & Alstrup (2007); Seaward et al. (2008).

Evernia prunastri (L.) Ach.

L: on acid bark of deciduous trees; **III:** 3773, 4080, 4175; **V:** 4588, 4452, 4554.

Flavoparmelia caperata (L.) Hale

Ref.: Sohrabi et al. (2007); Seaward et al. (2008). **L:** on mossy rock; **VIII:** Sipman 55466 [IRAN, B 60 0175577].

Gyalecta fagicola (Arnold) Kremp.

Ref.: Sohrabi & Alstrup (2007); Seaward et al. (2008) as *Pachyphiale fagicola* (Arnold) Zwackh.

Gyalolechia flavorubescens (Huds.) Söchting, Frödén & Arup

Syn.: *Caloplaca flavorubescens* (Huds.) J. R. Laundon; **L:** on bark or branches of deciduous trees; **III:** 4127; **VIII:** Sipman 55433 [IRAN, B 60 0175543].

Gyalolechia flavovirescens (Wulfen) Söchting, Frödén & Arup

Syn.: *Caloplaca flavovirescens* (Wulfen) Dalla Torre & Sarnth.; **L:** on calcareous rock; **VI:** 4382.

Hypogymnia austerodes (Nyl.) Räsänen

Ref.: Seaward et al. (2008); Sohrabi et al. (2007).

Hypogymnia physodes (L.) Nyl.

Ref.: Sohrabi et al. (2007); Seaward et al. (2008).

Hypogymnia vittata (Ach.) Parrique

Ref.: Sohrabi et al. (2007); Seaward et al. (2008).

Immersaria cupreoatra (Nyl.) Calatayud & Rambold

Ref.: Valadbeigi, Sipman, et al. (2011). **L:** on the siliceous rocks; **TLC:** gyrophoric acid.

Immersaria iranica Valadbeigi, Sipman & Rambold

Ref.: Valadbeigi, Sipman, et al. (2011). **L:** on siliceous rock. **TLC:** 2'-O-methylsuperphyllinic acid.

Immersaria usbekica (Hertel) M. Barbero, Nav.-Ros. & Cl. Roux

L: on siliceous rock; **V:** 4430, 4701, 4546, 4707. **TLC:** confluent and/or gyrophoric acid.

Ingvariella bispora (Bagl.) Guderley & Lumbsch

L: on siliceous rock; **VI:** 4379.

Lathagrium cristatum (L.) Otálora, P.M. Jørg. & Wedin

L: over mossy calcareous rock; **II:** 4194, 4027; **IV:** 3605a, 3670.

Lambiella insularis (Nyl.) T. Sprib.

Ref.: Sohrabi & Alstrup (2007); Seaward et al. (2008) as *Rimularia insularis* (Nyl.) Rambold & Hertel.

Lecania cyrtella (Ach.) Th. Fr.

L: on *Carpinus* base; **VIII:** Sipman 55448 [IRAN, B 60 0175560]. Confirmed by P. van den Boom, 2017.

Lecania dubitans (Nyl.) A. L. Sm

Ref.: Sohrabi & Alstrup (2007); Seaward et al. (2008).

Lecania koerberiana J. Lahm

L: on bark and branches of deciduous trees; **VI:** 4343b.

Lecanora albellula (Nyl.) Th. Fr.

Ref.: Sohrabi & Alstrup (2007); Seaward et al. (2008). **TLC:** isousnic and usnic acids.

Lecanora allophana Nyl.

L: on bark free or open standing deciduous trees; **II:** 93, 140; **III:** 3692, 3700, 3703, 3706, 3742, 4082, 4106, 4164; **V:** 4433, 4725, 4440, 4516, 4500, 4651;

VIII: Sipman 55437 [IRAN, B 60 0175548]. **TLC:** atranorin and chloroatranorin.

Lecanora argentata (Ach.) Malme

L; on deciduous trees, usually with smooth and cracked bark; **III:** 3774; **VI:** 4343.

Lecanora argopholis (Ach.) Ach.

L; on siliceous rock; **II:** 1471, 1420, 1404; **III:** 4033, 4055; **IV:** 3665, 3647; **V:** 4637, 4504. **TLC:** usnic acid, atranorin, epanorin, zeorin, and fatty acids.

Lecanora campestris (Schaer.) Hue.

L; on siliceous rock; **VI:** 4423.

Lecanora carpinea (L.) Vain.

Ref.: Sohrabi & Alstrup (2007); Seaward et al. (2008). **L;** epiphytic; **VIII:** Sipman 55437 [IRAN, B 60 0175548].

Lecanora populicola (DC.) Duby

New to Iran; **L;** on bark or branches of deciduous trees; **V:** 4660.

Lecanora reagens Norman

Ref.: Sohrabi & Alstrup (2007); Seaward et al. (2008).

Lecanora rupicola (L.) Zahlbr.

Ref.: Sohrabi & Alstrup (2007); Seaward et al. (2008). **TLC:** atranorin, eugenitol, chloroatranorin, and roccellic acid.

Lecanora symmicta (Ach.) Ach.

Ref.: Sohrabi & Alstrup (2007); Seaward et al. (2008).

**Lecidea auriculata* Th. Fr.

New to Iran; **L;** on siliceous rock; **VI:** 4375. **TLC:** confluent acid, 2'-O-methylanziaic acid. **DNA: MK341059.** In order to find the correct affiliation of this specimen, internal transcribed spacers ITS rDNA (ITS1 and ITS2) and the 5.8S ribosomal DNA gene were obtained in this study and its preliminary analysis was used for a confirmation of the species identity.

Lecidea swartzioidea Nyl.

Ref.: Sohrabi & Alstrup (2007); Seaward et al. (2008).

Lecidea tessellata Flörke

L; on siliceous rocks; **II:** 1407, 1506; **III:** 3755; **IV:** 3683; **V:** 4562; **VI:** 3225.

Lecidella carpatica Körb

Ref.: Sohrabi & Alstrup (2007); Seaward et al. (2008).

Lecidella elaeochroma (Ach.) M. Choisy

L; on trunks and branches of deciduous trees; **II:** 105b; **III:** 4063; **VIII:** Sipman 55437 [IRAN, B 60 0175549].

Lecidella euphorea (Flörke) Hertel

L; on trunks and branches of deciduous trees; **II:** 122, 1504, 103, 1447; **III:** 3711, 3794, 3812, 4070b, 4247,

4028, 4235; **V:** 4482, 4530, 4451, 4745, 4557, 4756, 4547.

Lecidella patavina (A. Massal.) Knoph & Leuckert

L; on calcareous rocks; **I:** 3579; **IV:** 3607; **VI:** 4290, 4316.

Lecidella stigmatea (Ach.) Hertel & Leuckert

Ref.: Sohrabi & Alstrup (2007); Seaward et al. (2008).

Lepra albescens (Huds.) Hafellner

Syn.: *Pertusaria albescens* (Hud.) M. Choisy & Werner; **L;** on the bark of deciduous trees; **III:** 4061.

Lepra amara (Ach.) Hafellner

Syn.: *Pertusaria amara* (Ach.) Nyl.; **L;** on the bark of deciduous trees; **III:** 4079.

Lepra excludens (Nyl.) Hafellner

Syn.: *Pertusaria excludens* Nyl.; **L;** on siliceous rocks; **I:** 3541, 3502, 3504, 3581; **V:** 4439. **TLC:** lichexanthone, norstictic acid.

Lepraria crassissima (Hue) Lettau

L; on dead mosse; **III:** 4076, 4171; **V:** 4726. **TLC:** divaricatic and nordivaricatic acids, zeorin.

Lepraria finkii (B. de Lesd.) R.C. Harris

L; on the bark of a deciduous tree; **III:** 3814; **V:** 4448, 4662. **TLC:** atranorin, zeorin, and stictic acid with satellites.

Lepraria leuckertiana (Zedda) L. Saag

Syn.: *Lecanora leuckertiana* Zedda; **L;** on the bark of deciduous trees; **III:** 4204, 3760, 3695. **TLC:** usnic, isousnic acids, and zeorin.

Lepraria membranacea (Dicks.) Vain.

L; commonly on lime-free siliceous rock; **V:** 4742. **TLC:** Pannaric, roccellic, angardianic acids, and occasionally atranorin.

Lepraria vouauxii (Hue) R. C. Harris

Ref.: Sohrabi & Orange (2006). **L;** commonly grows in the shady habitat on lime-free siliceous rock; **I:** 3560, 3590, 3549; **II:** 1539. **TLC:** pannaric acid-6-methyl ester, roccellic, and angardianic acids.

Leprocaulon microscopicum (Vill) Gams ex D. Hawksw.

L; on thin soil layers or mosses; **II:** 1491; **III:** 4086.

Leproplaca chrysodeta (Vain.) Ahti

Ref.: Sohrabi & Alstrup (2007); Seaward et al. (2008) as *Caloplaca chrysodeta* (Vain. ex Räsänen) Dombr.

Leptogium burnetiae C. W. Dodge

L; on mosses on rocks among trees or in sheltered habitats; **II:** 375b; **III:** 4055, 4143, 4207; **V:** 4489. The species is known from N America and C Europe.

Leptogium saturninum (Dicks.) Nyl.

L; on the bark of a deciduous tree; **II**: 92; **III**: 3732.

Lichenocodium pyxidatae (Oudem.) Petr. & Sydow

Ref.: Sohrabi & Alstrup (2007); Seaward et al. (2008).

Lichenocodium usneae (Anzi) D. Hawksw.

Ref.: Sohrabi & Alstrup (2007); Seaward et al. (2008).

Lichenostigma cosmopolites Hafellner & Calatayud

Ref.: Sohrabi & Alstrup (2007); Seaward et al. (2008).

Lichenostigma rugosum G. Thor

Ref.: Sohrabi & Alstrup (2007); Seaward et al. (2008).

Lichenostigma verrucosum Brackel & Valadbeigi

Ref.: Valadbeigi & Brackel (2011). **LF**; on *Aspicilia* sp.

Lobarina scrobiculata (Scop.) Nyl. ex Cromb.

Ref.: Sohrabi & Alstrup, (2007); Seaward et al., (2008) as *Lobaria scrobiculata* (Scop.) DC.

Lobothallia alphoplaca (Wahlenb.) Hafellner

L; on siliceous rock; **V**: 4697.

Lobothallia radiosa (Hoffm.) Hafellner

L; on siliceous rocks; **I**: 3593, 3540; **II**: 1425; **III**: 4184; **VI**: 4362.

Marchandiomyces aurantiacus (Lasch) Diederich & Etayo

Ref.: Sohrabi & Alstrup (2007); Seaward et al. (2008).

Megaspora verrucosa (Ach.) Hafellner & V. Wirth

L; on the bark of a deciduous tree; **VIII**: Sipman 55434 [IRAN, B 60 0175544].

Megaspora rimisorediata Valadbeigi & A. Nordin

Ref.: Valadbeigi, Nordin, et al. (2011). **L**; on bark of deciduous tree.

Melanelixia glabra (Schaer.) O. Blanco *et al.*

Ref.: Sohrabi et al. (2007); Seaward et al. (2008). **L**; epiphytic; **VIII**: Sipman 55440 [IRAN, B 60 0175552]. **TLC**: lecanoric acid.

Melanelixia subargentifera (Nyl.) O. Blanco *et al.*

Ref.: Seaward et al. (2008); Sohrabi et al. (2007). **L**; epiphytic; **VIII**: Sipman 55456 [IRAN, B 60 0175568].

Melanelixia subaurifera (Nyl.) O. Blanco *et al.*

Ref.: Seaward et al. (2008); Sohrabi et al. (2007).

Melanohalea exasperatula (Nyl.) O. Blanco *et al.*

Ref.: Seaward et al. (2008); Sohrabi et al. (2007). **L**; epiphytic; **VIII**: Sipman 55460 [IRAN, B 60 0175572].

Melanohalea infumata (Nyl.) O. Blanco *et al.*

Ref.: Seaward et al. (2008); Sohrabi et al. (2007).

Melaspilea arthonioides (Fée) Nyl.

New to Iran; **Syn.**: *Melaspilea enteroleuca* (Ach.) Ertz & Diederich sensu Ertz et al. (2015); **L**; on *Carpinus* base; **VIII**: Sipman 55428 [IRAN, B 60 0175538].

Milospium graphideorum (Nyl.) D. Hawksw.

LF; on *Opegrapha* sp.; **V**: 4503.

Monerolechia badia (Fr.) Kalb

Ref.: Sohrabi & Alstrup (2007); Seaward et al. (2008) as *Buellia badia* (Fr.) A. Massal.

Muellerella pygmaea (Körb.) D. Hawksw.

LF; on *Dimelaena oreina*; **I**: 3539; **VI**: 4302.

Mullerella ventosicola (Mudd) D. Hawksw.

Ref.: Sohrabi & Alstrup (2007); Seaward et al. (2008).

Mycobilimbia tetramera (De Not.) Vitik. et al.

Ref.: Sohrabi & Alstrup (2007); Seaward et al. (2008).

Myriolecis crenulata (Hook.) Śliwa, Zhao Xin & Lumbsch

Syn.: *Lecanora crenulata* Hook.L; **L**; on calcareous rock; **VI**: 4348.

Myriolecis hagenii (Ach.) Śliwa, Zhao Xin & Lumbsch

Syn.: *Lecanora hagenii* (Ach.) Ach.; **L**; on trunk and branches of deciduous trees; **II**: 1439; **V**: 4584, 4693.

Myriolecis semipallida (H. Magn.) Śliwa, Zhao Xin & Lumbsch

Syn.: *Lecanora semipallida* H. Magn.; **L**; on siliceous rock; **III**: 3759, 4137.

Nephroma parile (Ach.) Ach.

L; on deciduous, rarely conifer trees and on siliceous rock; **V**: 4686, 4487, 4621.

Niesslia peltigericola (D. Hawksw.) Etayo

Ref.: Sohrabi & Alstrup (2007); Seaward et al. (2008) as *Raciborskiomyces peltigericola* (D. Hawksw.) M.E. Barr).

Parmelia saxatilis (L.) Ach.

Ref.: Sohrabi et al. (2007); Seaward et al. (2008).

Parmelia sulcata Taylor

Ref.: Sohrabi et al. (2007); Seaward et al. (2008). **L**; on mossy rock; **VIII**: Sipman 55469 [IRAN, B 60 0175580].

Parmeliella triptophylla (Ach.) Müll. Arg.

Ref.: Sohrabi & Alstrup (2007); Seaward et al. (2008).

Parmelina tiliacea (Hoffm.) Hale

Ref.: Sohrabi et al. (2007); Seaward et al. (2008). **L**; on mossy rock; **VIII**: Sipman 55462 [IRAN, B 60 0175574].

Peltigera canina (L.) Willd.

L; usually over moss or humus layer on soil, siliceous and calcareous rocks; **III**: 4066, 4099; **V**: 4542.

Peltigera collina (Ach.) Schrader

L; on mossy siliceous rock; **V**: 4464.

Peltigera elisabethae Gyeln.

L; on mossy soil; **V**: 4557, 4709, 4435.

Peltigera horizontalis (L.) Willd.

L; on humus, often on base-rich soils, mossy rock, and mossy or decayed stumps; **II**: 98, 1434; **III**: 4075, 4036; **V**: 4434, 4719.

Peltigera neckeri Hepp ex Müll. Arg.

L; on mossy siliceous rock; **III**: 3799, 3775, 4073, 4100; **V**: 4583, 4499, 4497.

Peltigera ponojensis Gyeln.

L; on stony lime- and dolomite soils as well as base-rich siliceous soils; **II**: 142; **III**: 4107.

Peltigera praetextata (Flörke ex Sommerf.) Zopf (Fig. 2)

L; on mossy trunks of trees, on mossy boulders, rarely on soil; **II**: 1369, 1377; **III**: 3723, 3704, 3758, 4248, 4104, 4109; **V**: 4601, 4449, 4666, 4505, 4717, 4438, 4649.

Peltigera rufescens (Weiss) Humb.

L; on dolomite soils, as well as base-rich siliceous soils; **I**: 3505; **II**: 111; **III**: 4089, 4051; **V**: 4728; **VIII**: Sipman 55465 [IRAN, B 60 0168955].

Peltigera virescens (J. Steiner) Gyeln.

L; on base-rich siliceous soils; **II**: 106.

Pertusaria flavicans Lamy

New to Iran; L; on siliceous rocks; **II**: 1541, 1616; **III**: 3811, 4129.

Pertusaria pluripuncta Nyl.

New to Iran; L; on siliceous rocks; **I**: 3557; **V**: 4593, 4445, 4508.

Pertusaria pseudocorallina (Lilj.) Arnold

New to Iran; L; on siliceous rocks; **I**: 3508, 3577, 3585, 3500.

Pertusaria xanthoplaca Müll. Arg.

New to Iran; L; on calcareous rock; **IV**: 3612.

Phaeophyscia ciliata (Hoffm.) Moberg

L; on free-standing deciduous trees; **V**: 4715; **VI**: 4319; **VIII**: Sipman 55451 [IRAN, B 60 0175563].

Phaeophyscia nigricans (Flörke) Moberg

L; on calcareous rock; **V**: 4350b.

Phaeophyscia orbicularis (Neck.) Moberg

L; on calcareous rock; **V**: 4615; **VI**: 4350, 4355.

Phaeophyscia poeltii (Frey) Clauzade & Cl. Roux

New to Iran; L; on the bark of deciduous trees; **II**: [1418 (UPS)].

Phaeophyscia sciastra (Ach.) Moberg

L; on calcareous rock; **V**: 4496.

Phaeosporobolus alpinus R. Sant., Alstrup & D. Hawksw.

Ref.: Sohrabi & Alstrup (2007); Seaward et al. (2008).

Phaeosporobolus usneae D. Hawksw. & Hafellner

Ref.: Sohrabi & Alstrup (2007); Seaward et al. (2008).

Phlyctis argena (Spreng.) Flot.

L; on the stems of deciduous trees; **V**: 4661, 4685.

Physcia adscendens H. Olivier

L; on free-standing deciduous trees, rather rare on calcareous rock; **II**: 94, 1532; **III**: 4173, 4091, 3761, 4112, 4134; **V**: 4447, 4630.

Physcia aipolia (Ehrh. ex Humb.) Fűrnr.

L; on the bark of deciduous trees in open sites; **II**: [115(UPS)]; **III**: 4191, 4055, 3785, 4081, 3786; **VIII**: Sipman 55435 [IRAN, B 60 0175545].

Physcia biziana (A. Massal.) Zahlbr.

L; on the bark of deciduous trees; **II**: [1449,1551(UPS)].

Physcia caesia (Hoffm.) Fűrnr.

L; on calcareous stone; **II**: [1424 (UPS)]; **VI**: 4361, 4363.

Physcia dubia (Hoffm.) Lettau

Ref.: Sohrabi & Alstrup (2007); Seaward et al. (2008).

Physcia stellaris (L.) Nyl.

L; frequently on branches of deciduous trees; **II**: 1405, 1551, 1538; **V**: 4454, 4460, 4668, 4517, 4702; **VI**: 4402, 4350c; **VIII**: Sipman 55441 [IRAN, B 60 0175553].

Physconia detersa (Nyl.) Poelt

Ref.: Sohrabi & Alstrup (2007); Seaward et al. (2008).

Physconia distorta (With.) J. R. Laundon

L; on bark of free-standing deciduous trees; **II**: 86, 1432; **III**: 3693, 4215, 4160; **V**: 4481, 4667, 4696, 4576, 4710.

Physconia enteroxantha (Nyl.) Poelt

Ref.: Sohrabi & Alstrup (2007); Seaward et al. (2008).

Physconia muscigena (Ach.) Poelt

Ref.: Sohrabi & Alstrup (2007); Seaward et al. (2008).

Physconia perisidiosa (Erichsen) Moberg

L; over mosses; **I**: 3574b; **VIII**: Sipman 55436 [IRAN, B 60 0175546].

Placidium lachneum (Ach.) de Lesd.

L; on soil surface of raw soils, soil- or rock-mosses; **II**: 1476, 1473; **III**: 3796c; **VII**: 4262.

Placocarpus schaeereri (Fr.) Breuss

L; on limestone, rarely on dolomitic rocks; **II**: 1385; **III**: 4116c, 4224, 3752, 4078; **V**: 4473.

Pleopsidium flavum (Bellardi) Körb.

L; on smooth siliceous rock; **II**: 1431, 1349; **IV**: 3660, 3664.

Pleopsidium gobiense (H. Magn.) Hafellner

Ref.: Jamshidi & Shahidi (2015); Shahidi et al. (2013); Jamshidi et al. (2014).

Pleurosticta acetabulum (Neck.) Elix & Lumbsch (Fig. 2)

Ref.: Sohrabi et al. (2007); Seaward et al. (2008). L; epiphytic; **VIII**: Sipman 55459 [IRAN, B 60 0175571].

Polycoccum pulvinatum (Eithner) R. Sant.

Ref.: Sohrabi & Alstrup (2007); Seaward et al. (2008).

Pronectria robergei (Mont. & Desm.) Lowen

Ref.: Sohrabi & Alstrup (2007); Seaward et al. (2008).

Protopannaria pezizoides (Weber) P. M. Jørg & S. Ekman

Ref.: Sohrabi & Alstrup (2007); Seaward et al. (2008).

Protoparmeliopsis muralis (Schreb.) M. Choisy s.lat.

L; on calcareous rock; **I**: 3582, 3587; **III**: 3730, 4216, 4031, 4048; **V**: 4660; **VI**: 4421.

Protoparmeliopsis peltata (Ramond) Arup, Zhao Xin & Lumbsch

Syn.: *Rhizoplaca peltata* (Ramond) Leuckert & Poelt; L; on siliceous rocks; **II**: 1378.

Protothelenella sphinctrinoides (Nyl.) Mayrhofer & Poelt

Ref.: Sohrabi & Alstrup (2007); Seaward et al. (2008).

Psilolechia lucida (Ach.) M. Choisy

Ref.: Sohrabi & Alstrup (2007); Seaward et al. (2008).

Psorula rufonigra (Tuck.) G. Schneider

L; on siliceous rocks; **II**: 1426; **III**: 3712, 3809.

Pyrenodesmia variabilis (Pers.) A. Massal.,

Syn.: *Caloplaca variabilis* (Pers.) Müll. Arg.; L; on siliceous rock; **I**: 3542.

Ramalina capitata (Ach.) Nyl.

L; on wind-exposed siliceous rock; **II**: 85, 1487; **VI**: 4280, 4288, 4297.

Ramalina farinacea (L.) Ach.

L; on twigs of deciduous trees; **V**: 4558.

Ramalina fraxinea (L.) Ach.

L; on free-standing deciduous trees; **II**: 133, 172; **III**: 4733, 4158.

Ramalina pollinaria (Westr.) Ach.

Ref.: Sohrabi & Alstrup (2007); Seaward et al. (2008).

Ramalina polymorpha (Lilj.) Ach.

Ref.: Sohrabi & Alstrup (2007); Seaward et al. (2008).

Ramalina sinensis Jatta (Fig. 2)

L; On free-standing deciduous trees with subneutral bark; **II**: 109, 145, 1408, 1412 [1376, 1455, 157 (TSN)]; **III**: 3697, 4152, 3702, 4113, 4135, 3777; **V**: 4676, 4569. **TLC**: usnic acid.

Rhizocarpon alpicola (Anzi) Rabenh.

L; on siliceous rock; **V**: 4431.

Rhizocarpon geminatum Körb.

L; on siliceous rock; **V**: 4513.

Rhizocarpon geographicum (L.) DC.

L; on siliceous rocks; **I**: 3589, 3594, 3504; **II**: 1456, 1552, 1470; **III**: 3802, 4105; **V**: 4706, 4643, 4582, 4706, 4640; **VI**: 4366, 4346, 4346.

Rhizocarpon viridiatrum (Wulfen) Körb.

L; on siliceous rocks; **III**: 4226, 4203.

Rhizoplaca chrysoleuca (Sm.) Zopf

L; on siliceous rocks; **V**: 4495; **VIII**: Sipman 55468 [IRAN, B 60 0175579].

Rhizoplaca melanophthalma (Ramond) Leuckert & Poelt

L; on siliceous rock; **I**: 3534.

Rhizoplaca subdiscrepans (Nyl.) R. Sant.

Ref.: Sohrabi & Alstrup (2007); Seaward et al. (2008).

Rinodina dubyana (Hepp) J. Steiner

L; on calcareous rock; **VI**: 4377, 4290, 4390.

Rinodina milvina (Wahlenb.) Th. Fr.

Ref.: Sohrabi & Alstrup (2007); Seaward et al. (2008).

Rinodina pyrina (Ach.) Arnold

Ref.: Sohrabi & Alstrup (2007); Seaward et al. (2008).

Rinodina trachytica (Massal.) Bagl. & Carestia

New to Iran; L; on siliceous rock; **III**: 4000.

Romjularia lurida (Ach.) Timdal

L; on limestone along cracks covered by soil; **II**: 1495; **VI**: 4275, 4409.

Rosellinula frustulosea (Vouaux) R. Sant.

Ref.: Sohrabi & Alstrup (2007); Seaward et al. (2008).

Rosellinula haplospora (Th. Fr. & Almq. ex Th. Fr.) R. Sant.
New to Iran; **LF**; on *Aspicilia* sp.; **III**: 4236.

Rusavskia elegans (Link) S.Y. Kondr. & Kärnefelt
Syn.: *Xanthoria elegans* (Link) Th.Fr.; **L**; on siliceous rocks; **I**: 3537, 3552; **II**: 1429, 1475; **III**: 4154; **V**: 4544, 4680.

Sclerococcum saxatile (Schaer.) Ertz & Diederich
Ref.: Sohrabi & Alstrup (2007); Seaward et al. (2008) as *Dactylospora saxatilis* (Schaer.) Hafellner.

Scoliciosporum umbrinum (Ach.) Arnold
Ref.: Sohrabi & Alstrup (2007); Seaward et al. (2008).

Scytinium aragonii (Otálora) Otálora, P.M. Jørg. & Wedin
New to Iran; **L**; on soil and mosses; **V**: 4658.

Scytinium gelatinosum (With.) Otálora, P. M. Jørg. & Wedin
Ref.: Sohrabi & Alstrup (2007); Seaward et al. (2008) as *Leptogium gelatinosum* (With.) J. R. Laundon.

Scytinium lichenoides (L.) Otálora, P. M. Jørg. & Wedin
Syn.: *Leptogium lichenoides* (L.) Zahlbr. **L**; on soil and mosses; **I**: 1481; **V**: 4469, 4674, 4540; **VI**: 4330.

Sphaerellothecium cladoniae Alstrup and Zhurb.
Ref.: Sohrabi & Alstrup (2007); Seaward et al. (2008).

Sphaerellothecium reticulatum (Zopf) Etayo
Ref.: Sohrabi & Alstrup (2007); Seaward et al. (2008) as *Echinothecium reticulatum* Zopf).

Squamarina cartilaginea (With.) P. James
L; on a calcareous rock, rarely on calcareous stony soils; **IV**: 3606, 3655.

Staurothele fissa (Taylor) Zwackh
Ref.: Sohrabi & Alstrup (2007); Seaward et al. (2008).

Stigmidium congestum (Körb.) Triebel
Ref.: Sohrabi & Alstrup (2007); Seaward et al. (2008).

Stigmidium fuscatae (Arnold) R. Sant.
Ref.: Sohrabi & Alstrup (2007); Seaward et al. (2008).

Stigmidium pumilum (Lettau) Matzer & Hafellner
Ref.: Sohrabi & Alstrup (2007); Seaward et al. (2008).

Stigmidium tabacinae (Arnold) Triebel
Ref.: Sohrabi & Alstrup (2007); Seaward et al. (2008).

Stigmidium xanthoparmeliarum Hafellner
Ref.: Sohrabi & Alstrup (2007); Seaward et al. (2008).

Telogalla olivieri (Vouaux) Nik. Hoffm. & Hafellner
New to Iran; **LF**; on *Xanthoria parietina*; **II**: 1529.

Thalloidima candidum (Weber) A.Massal.
Syn.: *Toninia candida* (Weber) Th. Fr.; **L**; on lime-rich to weakly calcareous rocks, especially in fissures; **VI**: 4349.

Thalloidima sedifolium (Scop.) Kistenich, Timdal, Bendiksbj
Syn.: *Toninia sedifolia* (Scop.) Timdal; **L**; on calcareous soils; **II**: 1444, 1513; **III**: 4111, 4176; **V**: 4456; **VI**: 4420; **VII**: 4260, 4264.

Thelenella muscorum (Fr.) Vain.
Ref.: Sohrabi & Alstrup (2007); Seaward et al. (2008).

Toninia tristis (Th. Fr.) Th. Fr.
Ref.: Sohrabi & Alstrup (2007); Seaward et al. (2008).

Tornabea scutellifera (With.) J. R. Laundon
L; on bark or branches of a deciduous trees; **III**: 4133, 4221; **V**: 4723; **VIII**: Sipman 55458 [IRAN, B 60 0175570].

Tremella ramalinae Diederich
Ref.: Sohrabi & Alstrup (2007); Seaward et al. (2008).

Umbilicaria cinerascens (Arnold) Frey
Ref.: Sohrabi & Alstrup (2007); Seaward et al. (2008).
TLC: gyrophoric acid.

Umbilicaria cinereorufescens (Schaer.) Frey
Ref.: Sohrabi & Alstrup (2007); Seaward et al. (2008).
TLC: gyrophoric acid.

Umbilicaria freyi Codogno, Poelt & Puntillo
Ref.: Sohrabi & Alstrup (2007); Seaward et al. (2008).
TLC: gyrophoric acid.

Umbilicaria hirsuta (Sw.) Hoffm.
L; on siliceous rock; **III**: 3726. **TLC:** gyrophoric and lecanoric acids

Umbilicaria polyphylla (L.) Baumg.
L; on siliceous rock; **V**: 4535. **TLC:** umbilicatic and gyrophoric acids.

Umbilicaria vellea (L.) Hoffm.
Ref.: Sohrabi & Alstrup (2007); Seaward et al. (2008).
TLC: gyrophoric and lecanoric acids.

Usnea glabrata (Ach.) Vain.
New to Iran; **L**; on bark or branches of a deciduous tree; **III**: 4125, 4182, 4151, 4057. **TLC:** protocetraric, fumarprotocetraric, salazinic, and norstictic acids.

Vahliella leucophaea (Vahl) P.M. Jørg.
Ref.: Sohrabi & Alstrup (2007); Seaward et al. (2008) as *Fuscopannaria leucophaea* (Vahl) P. M. Jørg.

Varicellaria lactea (L.) I. Schmitt & Lumbsch
New to Iran; **L**; on siliceous rocks; **V**: 4491, 4552, 4484.

Verrucaria fuscella (Turner) Winch
L; on limestone; VI: 4370.

Verrucaria tristis (A. Massal.) Trevis.
Ref.: Sohrabi & Alstrup (2007); Seaward et al. (2008).

Xanthocarpia tominii (Savicz) Frödén, Arup & Søchting
New to Iran; L; on soil, VIII: Søchting US11067, US11072 [IRAN].

Xanthomendoza fallax Søchting, Kärnefelt & S.Y. Kondr

Syn.: *Oxneria fallax* (Arnold) S.Y. Kondr. & Kärnefelt
L; on steep surfaces of weakly calcareous or siliceous rock; III: 3745, 4117, 4088; V: 4690, 4721; VI: 4396.

Xanthomendoza fulva (Hoffm.) Søchting, Kärnefelt & S. Kondratyuk

Syn.: *Gallowayella fulva* (Hoffm.) S.Y. Kondr. et al.;
L; on free-standing deciduous trees; V: 4567.

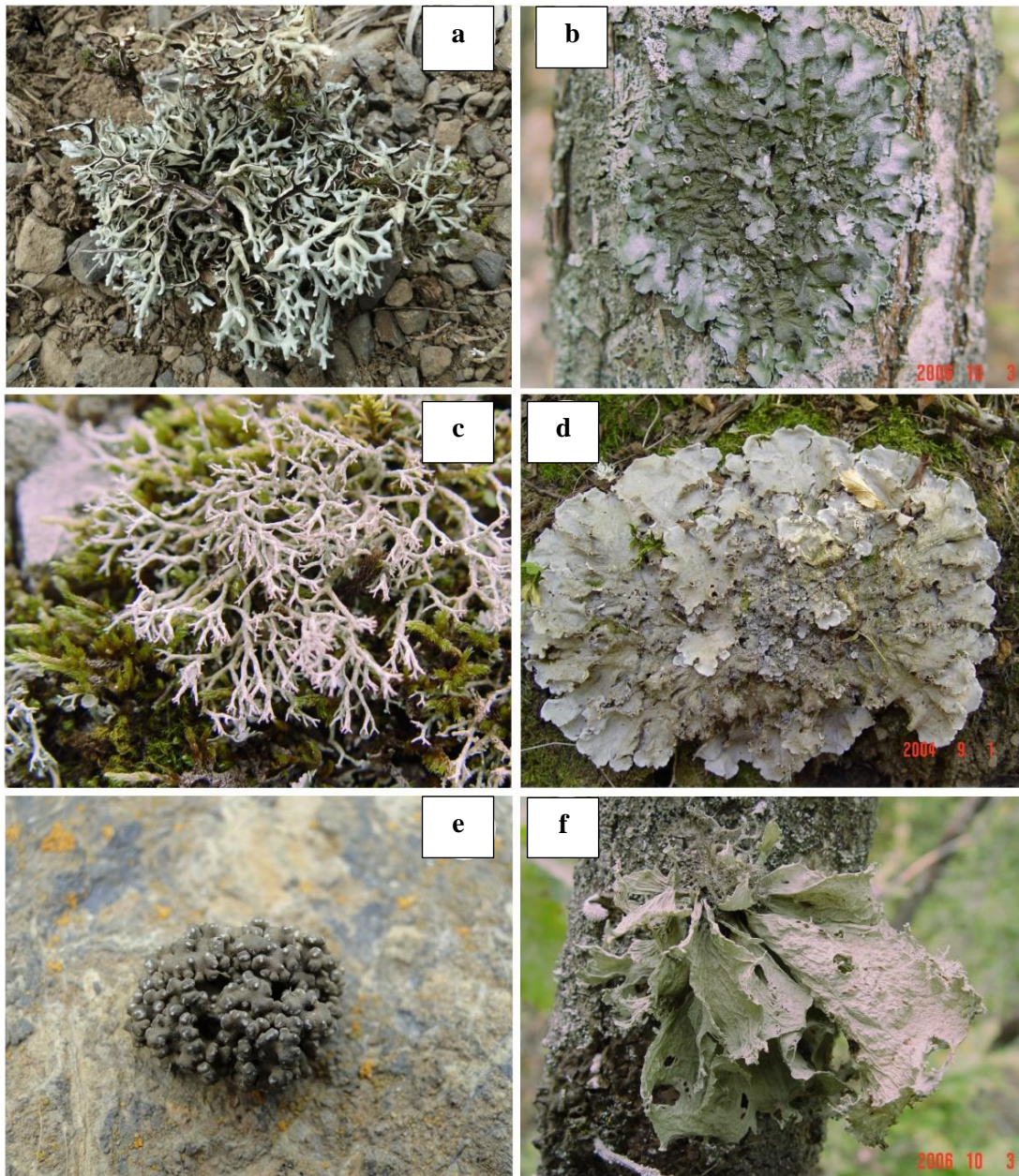


Fig. 2. Selected lichens from Arasbaran: a. *Xanthoparmelia camtschadalis* (Location VII); b. *Pleurosticta acetabulum* (Location III); c. *Cladonia subrangiformis* (Location II); d. *P33eltigera praetextata* (Location III); e. *Circinaria fruticulosa* (Location VII); f. *Ramalina sinensis* (Location III).

Xanthoparmelia camtschadalis (Ach.) Hale (Fig 2)

Ref.: Sohrabi et al. (2007); Seaward et al. (2008).

Xanthoparmelia conspersa (Ach.) Hale

Ref.: Sohrabi et al. (2007); Seaward et al. (2008).

Xanthoparmelia loxodes (Nyl.) O. Blanco et al.

Ref.: Sohrabi et al. (2007); Seaward et al. (2008).

Xanthoparmelia pokornyi (Körb.) O. Blanco et al.

Ref.: Sohrabi et al. (2007); Seaward et al. (2008).

Xanthoparmelia pulla (Ach.) O. Blanco et al.

Ref.: Sohrabi et al. (2007); Seaward et al. (2008).

Xanthoparmelia ryssolea (Ach.) O. Blanco et al.

L; vagrant on soil surfaces, on calcareous soil; VI: 4391a.

Xanthoparmelia stenophylla (Ach.) Ahti & D. Hawksw.

Ref.: Sohrabi et al. (2007); Seaward et al. (2008).

Xanthoparmelia tinctina (Maheu & Gillet) Hale

Ref.: Sohrabi et al. (2007); Seaward et al. (2008).

Xanthoparmelia verruculifera (Nyl.) O. Blanco et al.

Ref.: Sohrabi et al. (2007); Seaward et al. (2008).

Xanthoria parietina (L.) Th.Fr.

L; on the bark of deciduous trees and shrubs; II: 173, 1536, 1546; III: 3716; IV: 3616, 3661; V: 4578.

Xanthoriicola physciae (Kalchbr.) D. Hawksw.

Ref.: Sohrabi & Alstrup (2007); Seaward et al. (2008).

DISCUSSION

Of the 260 taxa recorded here, 20 taxa are additional to Seaward et al. (2008). The most updated Iranian lichen checklist contains c. 935 taxa (ca. 855 are lichenized and ca. 80 lichenicolous or allied fungi) (Sohrabi et al. unpublished data). According to Urbanavichus (2015), 1840 taxa of lichenized fungi are known for the whole Caucasus region (including c. 200 lichenicolous and 30 saprotrophic non-lichenized fungi) and the author predicts c. 3500 taxa of lichens for the Caucasus hotspot region. Moreover, currently, more than 730 and 824 lichen taxa are reported from Georgia and Azerbaijan respectively (Barkhalov 1975; Barkhalov 1983); Nakhutsrishvili 1986; Inashvili & Batsatsashvili 2010; Novruzov & Alverdieva 2013). The lichen checklist of Armenia includes 422 taxa (Harutyunyan et al. 2011; Gasparyan & Sipman 2016).

In comparison with the NW neighboring countries of Iran (Armenia and Azerbaijan), the lichen diversity of Arasbaran is still poorly explored. In 2015, as a result of the international lichenological excursion to Armenia, 176 species of lichenized and lichenicolous fungi were reported from Khosrov Forest State Reserve, Armenia (Gasparyan et al. 2015) at a distance of c. 200 km from Arasbaran.

The majority of the species located within the holarctic floristic kingdom are mainly distributed in the circumboreal and Irano-Turanian regions, while some have a widespread distribution within broad altitudinal and latitudinal ranges in different continents, traditionally considered to be cosmopolitan or subcosmopolitan (Nimis 2016). Those with a bipolar distribution are *Aspicilia cinerea*, *Candelaria concolor*, *Candelariella vitellina*, *Cetrelia olivetorum*, *Chaenotheca furfuracea*, *Protoparmeliopsis muralis*, *Lecanora rupicola*, *Diploschistes muscorum*, *Ingyariella bispora*, *Physcia adscendens*, *Umbilicaria polyphylla*, *Lepraria lobificans*, *Lepraria vouauxii*, *Lobothallia radiosa*, *Parmelia sulcata*, *Peltigera canina*, *Rusavskia elegans*, *Rhizocarpon geographicum*, and *Bryobilimbia hypnorum*. It is possible to differentiate many taxa into phytoclimatic groups, such as:

Arctic-alpine: *Lecidella carpathica*, *Pleopsidium flavum*, *Umbilicaria cinerascens*, *U. cinereorufescens*, and *U. polyphylla*.

Boreal-montane: *Acarospora fuscata*, *Bryoria nadvornikiana*, *Cetraria aculeata*, *C. islandica*, *Circinaria calcarea*, *Cladonia borealis*, *Evernia prunastri*, *Hypogymnia physodes*, *Lepraria membranacea*, *Toninia tristis* and *Vahliella leucophaea*
Submediterranean to mediterranean: *Buellia zoharyi*, *Caloplaca phaeothamnos* *Cetraria aculeata*, *Cladonia magyrica*, *C. subrangiformis*, *Dermatocarpon moulinsii*, *D. vellereum*, *Lepraria leuckertiana*, *L. crassissima*, *Pertusaria pseudocorallina* and *Umbilicaria freyi*.

An understanding of the taxonomy, ecology, and biogeography of the Caucasus and Iranian lichens (including the Arasbaran region) will be a long-term research project. Still, the mycobiota (lichenized and lichenicolous fungi) of Iran and neighboring countries are poorly explored and in general, this area hides numerous unreported and undescribed species. This paper is summarising the current knowledge of the lichenized and lichenicolous fungi in the Arasbaran Biosphere Reserve. As such it presents a small contribution to our understanding of the biota of Iran and the Caucasus region and provides additional distributional data for some poorly know lichenized and lichenicolous species.

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Conflict of interest statement

The authors declare no conflict of interests.

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فهرست به روز شده از قارچ‌های گل‌سنگی و گل‌سنگ رست ارسباران، ذخیره گاه انسان - زیست کره یونسکو، شمال غربی ایران

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چکیده: بر اساس بررسی ۵۳۳ نمونه‌ی هرباریومی و مرور منابع علمی، ۲۲۷ قارچ گل‌سنگی و ۳۶ قارچ گل‌سنگ رست ("گل‌سنگ دوست") متعلق به ۱۱۵ جنس و ۵۲ خانواده (شامل ۸ آرایه با خانواده "نا مشخص") از ذخیره گاه انسان زیست کره یونسکو در ارسباران گزارش می‌شوند. علاوه بر این، ۱۰۳ آرایه برای اولین بار از ارسباران گزارش می‌شود. از بین اینها، نوزده قارچ گل‌سنگی شده و دو قارچ گل‌سنگ رست قبلاً از ایران گزارش نشده‌اند. قارچ‌های گل‌سنگی *Aspicilia pavimentans*, *Bryobilimbia hypnorum*, *Caloplaca phaeothamnos*, *Cetrelia monachorum*, *Circinaria elmorei*, *Cladonia borealis*, *L. populicola*, *Lecidea auriculata*, *Pertusaria flavicans*, *P. pluripuncta*, *P. pseudocorallina*, *P. xanthoplaca*, *Phaeophyscia poeltii*, *Rinodina trachytica*, *Scytinium aragonii*, *Usnea glabrata*, *Varicellaria lactea*, *Xanthocarpia tominii*, *Rosellinula haplospora* and *Telogalla olivieri*. از ITS rDNA برای تأیید و شناسایی *Lecidea auriculata* استفاده شد. تاریخچه مطالعه فلورستیک و تنوع گونه‌های گل‌سنگ در منطقه به طور خلاصه مورد بحث قرار گرفت.

کلمات کلیدی: آذربایجان، تنوع زیستی، منطقه قفقاز، استپ جنگلی، منطقه ایرانو-تورانی