

Evaluation of the current situation of the lichen flora of Azerbaijan

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Abstract

The article is devoted to the results of research of the lichen biota of Azerbaijan. Based on the conducted study it's been identified 811 species out of 202 genera, 67 families and 24 orders. 28 new species and 2 subspecies. Taxonomic and ecobiomorphological features of the studied lichen biota have also been determined. Due to nomenclatural changes, the family spectrum has increased by 12 families, and the genus spectrum by 47 genera in the taxonomic structure. 166 relict and 13 rare species which need protection have been identified and entered into the Red Book of Azerbaijan: *Heterodermia dactyliza* (Nyl.) Swinscow et Krog, *Lecanora leptyroides* (Nyl.) Nilsson, *Lecanora multispora* Makar, *Usnea longissima* Ach. *Anaptychia elbursiana* (Szat.) Poelt. *Cladonia strepsilis* (Ach.) Grognot), *Ramalina Montana* Barkhal, *Cetraria islandica* (L.) Ach. *Bilimbia pulchra* Oxn. *Lobaria pulmonaria* (L.) Hoffm. *Stereaulon alpinum* Laurer, *Tornabea scutellifera* (With.) J. R. Laundon, *Usnea florida* (L.) Weber ex F. H. Wigg.).

Keywords: species, lichens, biota, taxonomic structure, Azerbaijan

Introduction

The Republic of Azerbaijan is located in Western Asia and is the largest country of Transcaucasia. Major part of the area of Azerbaijan is located between the southeast parts of the mountain system of the Greater and Minor Caucasus and the Talish. The relief of Azerbaijan is diverse. Two forms of relief prevail here: lowlands and highlands. More than half of the territory is occupied by mountains which belong to the system of the Greater Caucasus in the north and the Minor Caucasus in the west and southwest. Along with Talish Mountains they surround the Kura-Araz Lowland from north, west and southeast. Natural conditions are diverse ranging from warm and humid subtropics of Lankaran Lowland and the Talish to highlands of the Greater Caucasus. Climate of Azerbaijan is influenced by its geographic location, relief and the Caspian Sea. Semiarid climate, climate of arid steppes, subtropical, moderate and cold climates are available here. Arid subtropical climate is characteristic of Absheron and the Kura-Araz Lowland. Humid subtropical climate is only observed in the south of Talish Mountains. Moderate climate is in forest-grown highlands of the Greater and Minor Caucasus. Cold climate is observed in high ridges, peaks of the Greater and Minor Caucasus, subalpine and alpine meadow belts. The area of Azerbaijan is rich in flora. More than 4500 species of flowering plants are spread here. Broad-leaved forests, mixed forests, riparian woodland, open woodland, alpine meadows are presented here [1].

Materials and Methods

Specimens of original collections gathered in the territory of Azerbaijan in various years (1990, 1993-2020) and literary sources [2, 3, 4, 5, 6, 7, 8], were used as the basis of this article. Collection, herborization and establishment of lichens were carried out under generally accepted lichenological methodology [9]. Traditional methods of taxonomical, bio morphological, geographical and ecological analyses were

used in the work. The taxonomical analysis of the lichen flora was carried out based on the taxonomic classification of the section *Ascomycota* [10, 11, 12, 13]. During the bio morphological analysis works of lichenologists [9, 14] were used.

Results and Discussion

All diversity of the lichen flora of Azerbaijan belongs to the section *Ascomycota* of 7 classes, 7 subclasses, 24 orders, 2 suborders, 67 families and 202 genera. The basis of the lichen flora with the largest species diversity is composed of representatives of the class *Lecanoromycetes*, combining 685 species (84% of the total number of species), 160 genera (79% of the total number of genera), 47 families (70% of the total number of families). The class *Eurotiomycetes* includes 51 species (6,29%), 12 genera (5,94%), 4 families (5,97%), *Arthoniomycetes* 38 species (4,69%), 13 genera (6,44%), 5 families (7,46%), *Dothidiomycetes* 23 species (2,84%), 10 genera (4,95%), 7 families (10,5%), *Lichenomycetes* 8 species (0,99%), 4 genera (1,98%), 2 families (2,99%), *Coniocybomycetes* 5 species (0,62%), 2 genus (0,99%), 1 family (1,49%), *Leotiomyces* 1 species (0,12%), 1 genus (0,50%), 1 family (1,49%).

It was established that the main volume of the taxonomic diversity refers to 12 orders: *Lecanorales*, *Caliciales*, *Pertusariales*, *Peltigerales*, *Teloschistales*, *Verrucariales*, *Arthoniales*, *Lecideales*, *Ostropales*, *Acarosporales*, *Umbilicariales*, *Pleosporales* mounting to 753 species (93% of the total number of species). From them the leading position is held by lichens of the order *Lecanorales*, comprised of 286 species (35, 8%) of 61 genera and 12 families. The analysis of the family spectrum showed that the largest families with regard to the number of species are: *Parmeliaceae*, *Lecanoraceae*, *Physciaceae*, *Ramalinaceae*, *Teloschistaceae*, *Verrucariaceae*, *Lecideaceae*, *Megasporaceae*, *Acarosporaceae*, *Collemataceae*,

Pertusariaceae, *Peltigeraceae*, *Arthoniaceae*, *Graphidaceae*, *Umbilicariaceae* (Table 1). These 16 families combine 620 species that make up 76.% of the total number that is the majority of the species diversity of the

lichen flora, which may be accounted for by the ecological plasticity of their representatives growing on various substrata and in various environmental conditions.

Table 1: Key families and genera

| Family spectrum | | | |
|-------------------|---------------------------------------|--------------------|---------------------------------------|
| Family | Number of genera / % of total number | Family | Number of genera / % of total number |
| Parmeliaceae | 30/14.9 | Megasporaceae | 4/1.98 |
| Lecanoraceae | 7/3.46 | Acarosporaceae | 6/2.97 |
| Physciaceae | 8/3.96 | Collemataceae | 7/3.46 |
| Ramalinaceae | 8/3.96 | Pertusariaceae | 1/0.49 |
| Teloschistaceae | 15/7.43 | Peltigeraceae | 2/0.99 |
| Cladoniaceae | 2/0.99 | Arthoniariaceae | 2/0.99 |
| Verrucariaceae | 9/4.45 | Graphidaceae | 5/2.47 |
| Lecideaceae | 8/3.96 | Umbilicariaceae | 1/0.49 |
| Generic spectrum | | | |
| Genus | Number of species / % of total number | Genus | Number of species / % of total number |
| <i>Cladonia</i> | 49/6.04 | <i>Peltigera</i> | 17/2.09 |
| <i>Lecanora</i> | 49/6.04 | <i>Physcia</i> | 16/1.97 |
| <i>Caloplaca</i> | 24/2.96 | <i>Lecania</i> | 16/1.97 |
| <i>Pertusaria</i> | 24/2.96 | <i>Arthonia</i> | 15/1.85 |
| <i>Aspicilia</i> | 21/2.59 | <i>Ramalina</i> | 15/1.85 |
| <i>Lecidea</i> | 21/2.50 | <i>Usnea</i> | 14/1.73 |
| <i>Rinodina</i> | 20/2.47 | <i>Umbilicaria</i> | 13/1.60 |
| <i>Verrucaria</i> | 20/2.47 | <i>Bacidia</i> | 11/1.36 |
| <i>Acarospora</i> | 17/2.10 | <i>Rhizocarpon</i> | 11/1.36 |

To the rest 51 families 191 species refer, that is 24% of the total number. To date, the lichen flora of Azerbaijan numbers 202 genera. To the largest genera containing more than 10 species each, 18 genera refer combining 373 species that makes up 46% of the total number. Quantitative adjectives of the systematic structure reflect a degree of heterogeneity of an area and diversity of natural conditions. Leading position of the families *Parmeliaceae*, *Lecanoraceae*, *Physciaceae* can be explained by the wide ecologic plasticity of their representatives which grow on various substrata and in various ecological conditions. The high status of the family *Teloschistaceae* is conditioned by favourable habitat conditions. The abundance of the representatives of families *Verrucariaceae*, *Lecideaceae*, *Rhizocarpaceae*, *Umbilicariaceae* is linked to the abundance of rocks. The fact that families *Cladoniaceae* and *Peltigeraceae* prevail is conditioned by richness of broad-leaved forests. As a whole, the spectrum of the leading families of lichen flora of Azerbaijan is typical for lichen floras of temperate Holarctics.

On the researched territory there are two large genera *Cladonia* (family *Cladoniaceae*) and *Lecanora* (family *Lecanoraceae*) which are leading both among genera of this family and among genera of lichens of the region on the whole. The representatives of genus *Lecanora* (49 species) are noticed on arboreal substratum, also on outcrops of silicate rocks and on lime stones. Species of genus *Cladonia* which include also 49 species on the researched territory grow mainly on sandy and lime soils to form moss and lichen groups on soils in humid and arid habitats.

Representatives of genus *Caloplaca* numbering 24 species on the territory of Azerbaijan grow from plains to subalpine ridges on most various substrata.

Genus *Pertusaria* comprises 24 species occurring on the bark of leaf-bearing trees as well as on rocky substratum.

Genus *Aspicilia* including 21 species in lichen flora is represented mainly by lithophil lichens which grow on stones and rocks and species growing on soil substratum.

Representatives of genus *Lecidea* (21 species) are noted on bark of trees and also on stony substratum. Lithophil lichens hold leading position

The discovered species of genus *Rinodina* combine 20 species. They were found on outcrops of rocks, on lime stones and also on bark of trees.

Also 20 species from genus *Verrucaria* are found. Up-growth of species of genus *Verrucaria* is primarily linked to the humid habitats. Representatives of the genus are typical for mountainous territories.

Genus *Acarospora* is represented by 17 species. Representatives of the genus belong to corticose lichens growing on lime stones and rock.

Representatives of genus *Peltigera* also include 17 species mainly spread on soils as well as on mossy stones, rocks, more rare on barks of trees at bases of trunks.

Representatives of genus *Physcia* (16 species) are noted on tree barks, on stony substrata and some species such as *Physcia caesia* (Hoffm.) Föhrn. And others are found on soil too.

Genus *Lecania* also consists of 16 species met on tree barks as well as on rocks.

Genera *Arthonia* and *Ramalina* contain even number of species (15 each). *Arthonia* is an inhabitant of arboreal races. Species of genus *Ramalina* are met on tree barks and rocks.

Representatives of genus *Usnea* include 14 species. They are spread in coniferous and broad-leaved mountain forests. Significant role in the vegetable cover of Azerbaijan belongs to lichens of genera *Bacidia*, *Rhizocarpon*, *Umbilicaria* growing on mountainous landscapes.

Analysing the composition of leading families and genera of the lichen flora of the researched region it should be noted

that their basis is made up of polymorphous families and genera typical for lichen floras of temperate Holarctics.

During the bio morphological analysis crustose, foliose, fruticose, verrucous- or scaly - fruticose lichens were marked out. It was established that in the spectrum of life forms, crustose species (65%) prevail, foliose make up 18%, fruticose 8%, verrucous- or scaly - fruticose 7%, the share of umbilicus biomorphes is 3%. Prevalence of crustose lichens is probably connected with that they are the most adapted to all kinds of environmental conditions, as for the foliose and fruticose lichens their development requires relatively moistened ecotypes. An analysis of distribution of lichens according to environmental groups showed that in the researched lichen flora the epiphytic lichens are represented by the largest number of species – 338 species which is connected with the diversity of forest ecotypes. A bit less, epilithic lichens – 312 species, epigeic lichens are represented by significantly lesser number - 161 species.

An analysis of distribution of lichens according to botanical-geographical areas showed that out of 811 species 507 species grow in the Greater Caucasus: S.M. Alverdiyeva, V.S. Novruzov ^[5], 480 species in the Minor Caucasus: S.M. Alverdiyeva, V.S. Novruzov ^[5], E.A. Novruzov ^[15], A.A. Bayramova ^[16]; 371 species in Talish: Sh.O. Barkhalov ^[17]; 341 species in Nakhchivan Autonomous Republic: D.T. Ganbarov ^[18], T.Y. Pashayev ^[19] and 52 species in areas of the Kura-Araz lowland: S.M. Alverdiyeva ^[5]. In the lichen flora of Azerbaijan 166 relict species of lichens of 38 families and 79 genera are marked. From them – 157 species grow in the Greater Caucasus, 105 in Talish and 79 species in the Minor Caucasus.

Arising from conducted researches it was discovered six endemics in the area of Azerbaijan. From them six species – *Dimirella barchalovii* Novruz., *Graphis albinata* Novruz., *Lecanora oxneri* Novruz., *Lecania saviczii* Novruz., *Physcia subnuda* Novruz., *Aspicilia grossheimii* Oxn. grow in the Greater Caucasus. Almost all endemic species are very narrowly local.

Since lichens are the most sensitive component of ecosystems, atmospheric pollution having a negative effect on them leads to reduction of their species composition. Besides the factor of atmospheric pollution, the species composition of lichens is influenced by another factor – destruction of ecosystems as a result of the anthropogenic effect on nature (unauthorized lumbering, pasturing the livestock, forest fires).

An analysis of general distribution of lichens of the region showed that some of these species in the area of the region under study are rare, narrowly localized, therefore we entered them into the Red Book of Azerbaijan ^[20].

Each species was entered into one of the categories adopted by the Red Book of the World Conservation Union. By the degree of endangerment they were classified into 4 categories: a category CR (in a critical state) – four species (*Heterodermia dactyliza* (Nyl.) Swinscow et Krog, *Lecanora leptyroides* (Nyl.) Nilsson, *Lecanora multispora* Makar., *Usnea longissima* Ach.), NT (near to threatened) – 2 species (*Anaptychia elbursiana* (Szat.) Poelt., *Cladonia strepsilis* (Ach.) Grognot), VU (vulnerable) – 1 species (*Ramalina montana* Barchal), LC (least threatened) – 6 species (*Cetraria islandica* (L.) Ach., *Bilimbia pulchra* Oxn., *Lobaria pulmonaria* (L.) Hoffm., *Stereaulon alpinum* Laurer, *Tornabea scutellifera* (With.) J. R. Laundon, *Usnea florida* (L.) Weber ex F. H. Wigg.).

The major limiting factor affecting the quantity of rare species is the anthropogenic factor leading to destruction of natural ecotopes of species. Therefore, nature-conservative activity should be aimed at preservation of natural ecotopes of rare species.

Conclusion

While the evaluation process it was identified that the flora of lichens of Azerbaijan according to literary data and home researches at the present time numbers 811 species, 5 subspecies, from which 30 species are new for Azerbaijan. Also 166 relict and 13 rare species which need protection were identified and entered into the Red Book of Azerbaijan.

In the result of conducted work, an inventory of herbarium specimens of lichens was compiled as well as the species composition updated. Inventory making was done in conjunction with the modern nomenclatural revisions and with consideration of literary data. At the present time specimens of lichens are stored in the lichen bryological herbarium of the Institute of Botany of Azerbaijan National Academy of Sciences (BAK).

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