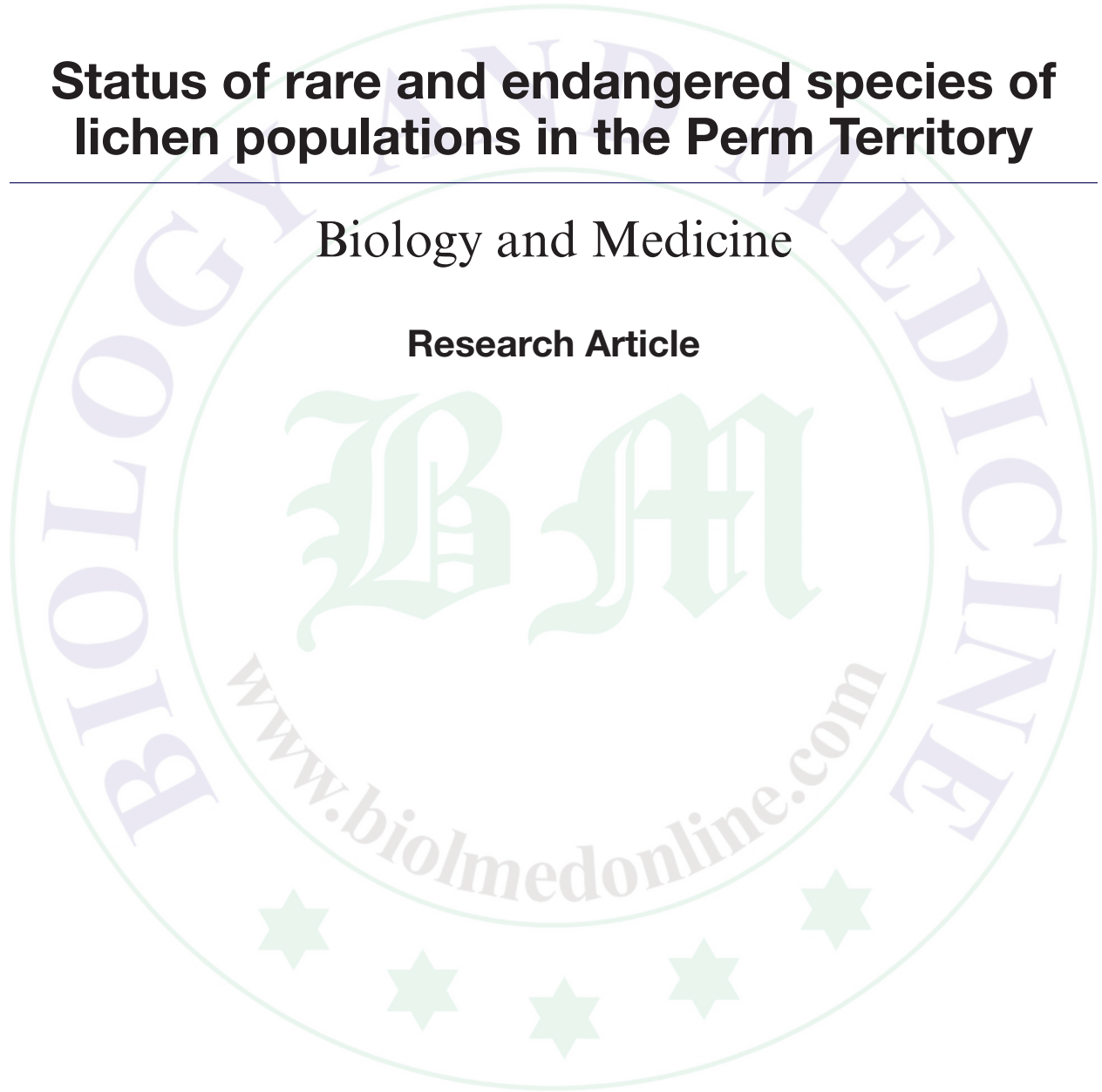


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Status of rare and endangered species of lichen populations in the Perm Territory

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Abstract

A long-term program of status monitoring of flora and fauna species listed in the IUCN Red List of the Perm Territory is implemented according to the policy of the IUCN Red List (Red Data Book) and its annexes. This publication presents the results of a 7-yr monitoring of the status of 14 species of lichens populations: 4 of them are listed in the Red Data Book of the Russian Federation; 4 species out of 14 are listed in the Red Data Book of the Perm Territory, and 6 of them are in the annex. The initial data of the number and locations of the protected species were obtained due to lichenological studies that have been conducted in the Perm Territory since 1995. According to the monitoring program, the peculiarities of regional distribution were determined; the search of the new locations and habitats, the study of eco-substrate, and phytocenological confinement were provided; and the evaluation of the number and status of protected species populations was accomplished.

Keywords: Monitoring; the IUCN Red List (Red Data Book); rare and protected species of lichens; the status of populations.

Introduction

The protection of rare species covers a wide range of environmental protection activities. The protection measures of vascular plants elaborated by Baranova [1] could be applied to the other components of the biota as well:

- Conduction of the regional Red Data Books; protection of the old forests, floodplains, marshes, and the other ecosystems within the protected areas of Russia (OOPT).
- Monitoring status of cenopopulations of rare and endangered species.
- Transfer of germs of rare plants into the culture with a subsequent cultivation in botanical gardens; creation of living collections of protected species.
- Creation of legal, administrative and economic mechanisms in order to ensure the conservation of natural biocenosis and the diversity of plant species in anthropogenic ecosystems.

- Development of public relation activities in order to inform the public about the status and problems of biodiversity conservation.

In the Perm Territory, the conservation of biological diversity covers all these areas. But they are rather implemented for vascular plants and vertebrate animals. This fact can be explained by the longer period of their study. That is why the lichens were not mentioned in the list of the Perm Territory animals, plants, and fungi species of Red Data Book approved by the Governor's Decree No. 235 dated 11.10.2001. During the following years, while working on the next edition of the Red Data Book of the Perm Territory, the studies proving the necessity of including the endangered lichens species into the regional Red Data Book were accomplished.

Based on additional field research, deep analysis of the factors and criteria which provoke downsizing, 14 lichen species were

listed in the Red Data Book of the Perm Territory, rare species category [2]. The evaluation of the status and degree of real or potential threats for each of the species was done according to advice and tips developed by Zavarzin and Muchnik [3]. As a result, 14 lichen species were listed in the Red Data Book of the Perm Territory [4], with a various protection degree. *Bryoria fremontii* (Tuck.) Brodo & D. Hawksw., *Lichenomphalia hudsoniana* (H. S. Jenn.) Redhead et al., *Lobaria pulmonaria* L. (Hoffm.), and *Nephromopsis laureri* (Kremp.) Kurok. are listed in the Red Data Book of the Russian Federation [5]. Four species are in the Red Data Book of the Perm Territory: *Flavoparmelia caperata* (L.) Hale and *Flavopunctelia flaventior* (Stirt.) Hale are marked with the first rareness category, *Sticta wrightii* Tuck. is the second, and *Heterodermia speciosa* (Wulfen) Trevis. is the third one. The rest of the species are included in the list of those which require special attention. They are: *Anaptychia ciliaris* (L.) Körb., *Cetrelia cetrarioides* (Delise & Duby) W.L. Culb. & C.F. Culb., *Flavopunctelia soledica* (Nyl.) Hale, *Lobaria scrobiculata* (Scop.) DC, *Parmelina tiliacea* (Hoffm.) Hale, *Usnea longissima* Ach. The protected lichen species, except *Lichenomphalia hudsoniana*, are epiphytes; most of them have coniferous and temperate deciduous forests ecological optimum. In taiga, they are on the border of their habitat; they are very rare; if living on the suitable substrates they prefer high humidity air conditions. A long-term program of status monitoring of flora and fauna species listed in the IUCN Red List of the Perm Territory region is implemented according to the policy of the IUCN Red List (Red Data Book) [6]. According to this program, the regular check-ups of already known and the identification of new habitat, monitoring the population dynamics of the number of natural rare and endangered species populations, the identification of the limiting factors leading to the reduction of their number are required. Being dependent on the rarity category, the periodicity known habitats survey were set. So the species of the first category must be inspected annually; the second one species – every 3 yrs; and the third category and the annexes species – every 9 yrs.

Goal of the research is the implementation of a long-term status monitoring of lichen species listed in the Red Data Book of the Perm Territory and its annex.

Materials and Methods

The initial data of the number and locations of the protected species were obtained as a result of the lichenological studies that have been conducted in the Perm Territory since 1995. The biotope of the found species being analyzed was called a single location. The complex of identified biotope thalli of a certain species was attributed to one cenopopulation. The research of the known and identification of the new locations were done according to detail-routing method. All along the route, a targeted search of monitoring objects was carried out; the number of populated forophytes was taken into account in order to provide the further recalculation of the results per hectare of the studied area. On each tree, the number of thalli was counted; the projective cover was determined and pointed out on the trunk. Vital state was assessed by the presence of necrotic spots, obvious deformation of thalli, and by the presence of reproductive structures on the thalli (soredia, isidia, and apothecia). In order to record the soil ground layer species, in the areas of protected object detection, the accounting platforms (25 × 25 cm) were set. The projective cover of thalli was determined by eye.

The total length of the routes during 7 yrs of monitoring activities was 370 km. Each botanical and geographical area was examined.

Results and Discussion

By the beginning of the monitoring program, 102 protected species location were known (Table 1).

As a result of 7 yrs targeted search, 75 new localities of 11 species were identified, with 82.7% of them belonging to four types: *Lobaria pulmonaria*, *Nephromopsis laureri*, *Heterodermia speciosa*, and *Cetrelia cetrarioides*. 7 species out of 11 had from 1 to 3 new locations; for 3 out of 11 species the new location while route surveys were not identified.

The spread of the protected species in the region is presented by the distribution of locations within the botanical–geographical regions (BGR) (Table 2).

The majority of the species (9 out of 14) are local spread ones. They rather exist either in mountain biotopes or on the flat part of the region. In areas of the Cis-Ural region the isolated species were identified: *Bryoria fremontii*, *Flavoparmelia caperata*, *Flavopunctelia flaventior*,

Table 1: The identification of protected species location during the monitoring.

| Species name | No. of known locations | | No. of new locations |
|----------------------------------|------------------------|------|----------------------|
| | 2006 | 2013 | |
| <i>Lobaria pulmonaria</i> | 39 | 72 | 33 |
| <i>Nephromopsis laureri</i> | 16 | 25 | 9 |
| <i>Bryoria fremontii</i> | 2 | 2 | 0 |
| <i>Lichenomphalia hudsoniana</i> | 3 | 3 | 0 |
| <i>Flavoparmelia caperata</i> | 1 | 3 | 2 |
| <i>Flavopunctelia flaventior</i> | 1 | 1 | 0 |
| <i>Heterodermia speciosa</i> | 7 | 21 | 14 |
| <i>Sticta wrightii</i> | 1 | 2 | 1 |
| <i>Anaptychia ciliaris</i> | 9 | 11 | 2 |
| <i>Cetrelia cetrarioides</i> | 7 | 13 | 6 |
| <i>Flavopunctelia soledica</i> | 3 | 6 | 3 |
| <i>Lobaria scrobiculata</i> | 8 | 9 | 1 |
| <i>Parmelina tiliacea</i> | 2 | 3 | 1 |
| <i>Usnea longissima</i> | 3 | 6 | 3 |
| Total | 102 | 177 | 75 |

Table 2: The spread of protected lichens species in the Perm Territory.

| Species name | No. of locations | Spread of locations by BGR* | | | | | |
|----------------------------------|------------------|-----------------------------|----|----|---|----|----|
| | | 1 | 2 | 3 | 4 | 5 | 6 |
| <i>Lobaria pulmonaria</i> | 72 | 22 | 10 | 12 | 4 | 7 | 17 |
| <i>Nephromopsis laureri</i> | 25 | 4 | 5 | 1 | – | 5 | 10 |
| <i>Bryoria fremontii</i> | 2 | 2 | – | – | – | – | – |
| <i>Lichenomphalia hudsoniana</i> | 3 | – | – | – | – | 1 | 2 |
| <i>Flavoparmelia caperata</i> | 2 | – | – | 2 | – | – | – |
| <i>Flavopunctelia flaventior</i> | 1 | – | – | 1 | – | – | – |
| <i>Heterodermia speciosa</i> | 21 | 4 | 1 | 7 | – | – | 9 |
| <i>Sticta wrightii</i> | 2 | – | – | – | – | – | 2 |
| <i>Anaptychia ciliaris</i> | 11 | 1 | – | 8 | – | – | 2 |
| <i>Cetrelia cetrarioides</i> | 13 | 4 | – | 3 | – | 3 | 3 |
| <i>Flavopunctelia soledica</i> | 6 | – | 1 | 5 | – | – | – |
| <i>Lobaria scrobiculata</i> | 9 | – | – | – | – | 1 | 8 |
| <i>Parmelina tiliacea</i> | 3 | 1 | 1 | 1 | – | – | – |
| <i>Usnea longissima</i> | 6 | – | – | – | – | – | 6 |
| Total | 176 | 38 | 18 | 40 | 4 | 17 | 59 |

*Botanic-geographical regions [7]: 1 – middle taiga fir-spruce forest; 2 – south taiga fir-spruce forest; 3 – temperate deciduous-spruce-fir forest; 4 – Kungurskaya island forest; 5 – middle and south taiga foothill fir-spruce and spruce-fir forest; 6 – north and middle taiga cedar-spruce mountain forest.

Flavopunctelia soledica, *Parmelina tiliacea*, *Lichenomphalia hudsoniana*, *Sticta wrightii*, *Lobaria scrobiculata*, *Usnea longissima* were found only in the mountains biotopes. *Lobaria pulmonaria*, *Cetrelia cetrarioides*, *Anaptychia ciliaris*, *Heterodermia speciosa*, *Nephromopsis laureri* are more widely spread. It is important to mention that *Anaptychia ciliaris* is spread in the flat parts while *Nephromopsis laureri* is rather

found in the mountain parts of the region. The majority of *Lobaria pulmonaria* localizations are in the mountain forests or in the middle taiga lowlands. While in the southern taiga forests, in the subzone of mixed spruce-broadleaf forests and near the Kungurskaya island forest only single isolated cases of this species were found.

Colonizing ability on the various substrates is one of the indicators of species

ecological plasticity. *Lobaria pulmonaria* has the highest diversity of colonized substrates. In the mountains, this species lives on the wood substrates and moss rocks. The thalli of *Lobaria pulmonaria* were found on nine species of deciduous and coniferous tree species, excluding the larch and pine. The selective attitude of this species toward the substrate is noticed on the most commonly colonizes forophyte. In the woodlands of mountain forest and subalpine zones of the Northern Urals the lichen inhabits almost exclusively the old trunks of tall mountain ashes. In the forests of middle Urals *Lobaria* prefers aspen, and in the southern Taiga and broad-spruce-fir forests the forophyte is linden and elm. *Nephromopsis laureri* and *Lobaria scrobiculata* are the other typical epiphytic species which can inhabit wet wood and moss rocks; however, the main substrate for them is the bark of living trees mainly deciduous, rarely conifers. *Lichenomphalia hudsoniana* is also one of the subtract selective species, it is found on plant debris and interlayers of humus of mountain tundra. The remaining 10 species are obligate epiphytes, with a different selectivity for forophytes. *Flavopunctelia soledica*, *Anaptychia ciliaris*, and *Heterodermia speciosa* have a various set of forophytes. The last two species colonize only hardwoods, while *Flavopunctelia soledica* can live on deciduous as well as coniferous species.

The majority of the studied populations of protected and those which need special attention species are not numerous; this fact poses a real threat of their disappearance from the region. The group of the most threatened species consists of those with the isolated locations and small numbers of thalli on a limited number of forophytes: *Flavopunctelia flaventior*, *Flavoparmelia caperata*, *Bryoria fremontii*, *Parmelina tiliacea*. The additional threat for these species of lichens is the high degree of disturbance of their habitats and the close proximity to human settlements.

The considerable fluctuations in the number of different habitat conditions were observed for *Lobaria pulmonaria*. In the vast majority of the known localities the number of thalli per tree varies from 1 to 5. However, in the mountain forests due to the presence in the stand of old tall mountain ash the number of thalli and populated forophyte could be much higher. The populations located in the reserve "Vishersky" at the top of the mountain-forest

belt are the biggest ones. In these conditions, *Lobaria pulmonaria* inhabits the trunks of mountain ash, together with other protected species of lichen: *Sticta wrightii*, *Heterodermia speciosa*, and *Cetrelia cetrarioides*. 20 accounting areas of 100 m², in Kuryksar woodland ridge possess 117 mountain ash trees. The lichen was found only on 40 of them (34.2% of the number of the recorded trees); 260 thalli were observed. Their number varied from 5 to 60 per tree. The species is very rare in the central and southern areas of the region; in the habitats a few thalli of *Lobaria* were found on individual trees like birch, linden, and elm. However, in the literature it is possible to find indications of widespread *Lobaria pulmonaria* around the city of Perm in the late 19th and early 20th centuries [8,9]. Currently, this species was not found in the forests surrounding the city.

The monitoring revealed the joint growth biotopes of three to five protected and those which need the special attention lichen species; this is a good reason to provide the preservation of these key areas and give them the status of protected ones [10].

Conclusion

A long-term monitoring provided the information about the spread and the current state of rare and protected species of lichens in the Perm region. These data are important enough to provoke the actions for elimination of negative factors affecting the species listed in the Red Data Book and their habitats.

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