

Lichen biota in the low land of the Ob basin

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The article reviews the lichen diversity in the low land of the Ob basin based on the data published by the author and other specialists. So far, species diversity has reached 430 taxonomic units from 102 genera and 42 families. There are data about the distribution of certain lichen species for the main types of habitat and substrates with in cenosis. The largest variety is shown in communities of dark coniferous forests and mixed forests with declining aspens in the tree layer (215 species), of forested fens (161 species), and inundated forest cenosis (100 species). The least variety is found in ground slope communities (13 species) and phytocenoses of transition moors (12 species).

Keywords: Lichen biota; Ob basin; Phytocenosis; Habitat

The low land of the Ob basin includes nearly the whole West Siberian plain, except for its northern part which refers to the basins of the rivers Pur and Taz. Because of both orographic and climatic conditions, swamps occupy more than half of the West Siberian plain [1]. Dark coniferous forests are in well-drained areas of interfluvial regions. These areas increase from the north to the south. Pine forests are widespread and are usually located on sand or form bog moss pine forests on waterlogged soils [2,3]. The lichen in the low land of the Ob basin has not been studied completely. To a certain extent, the reasons are that there is little specificity and relative scarcity of boreal lichen biotas in Siberia's plains as well as its inaccessibility.

In the early 20th century, works of Sokolov [4] and Kuznetsov [5] gave some information on lichen collected in various areas of Tobolsk and Tomsk provinces. Sokolov states that there are 21 species of lichen in spruce forests in the taiga in Mariinsko-Chulymskyi district. Kuznetsov describes 30 lichen species, which were mostly dumetose and foliose lichen collected from soil in pine forests, top soil and pine bark in bogged up community of the upper swamp, and from rocks on the banks of the Tom in southern and southeastern parts of the former Tomsk province.

Savich published two lists of lichen in the former Tobolsk province according to the collection of Gorodkov [6,7]. Savich listed 47 and 72 species. In 1915, Savich [8] reported the results of targeted studies of lichen, pointing out 45 species in 50 forms. These were collected in the surroundings of Novonikolaevsk in Tomsk province, an area that is now Novosibirsk. Bronzov [9] mentions 10 species of ground lichen in his more thorough survey of the upper swamp of the Vasyugan.

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In his first report on lichen of Priob, Gluzdakov [10] gives information on 21 species collected in areas near Novosibirsk hydroelectric power station (Novosibirsk region). His second report, on 'epiphytic lichen of forest cenosis in Priob' deals with distribution of lichen in phytocenoses, mentions 15 lichen species. This research included a vast territory of the Middle Ob between 55° and 65° [11].

The work of Sukhinina on *Usnea* lichen in Tomsk region is of great interest [12]. This account gives information on 18 species collected near the village Plotnikovo in Bakcharskyi district (the left bank of the Ob). The work of Khramov and Valutsky is also significant. It discusses features of forest and swamp phytocenoses in the eastern Vasyugan according to definitions given by Sukhinina. This study gives information on finding 191 lichen species and presents a list of 99 species with eco-phytocenosis analysis for the largest and most widespread species [13].

The scope of information on lichen biota of the region has increased in recent years. Lapshina and Rudenko's work [14] on ground macro lichen of the upper swamps in forest area of West Siberia describes 32 species of lichen. In 2000, Rudenko pointed out nine species of genus *Peltigera* for interfluvial communities of Tomsk region [15]. In 2001, Kovaleva gives information on 47 species of epiphytic lichen for interfluvial forests in the north of the Ob-Tom interfluvial area [16]. In 2001 also, Efremov and Kovaleva detailed [17] 94 species, emphasizing lichen flora of the oligotrophic swamp area of Tomsk region. In 2002, Kovaleva mentions 277 species found in hydromorphic complexes of Tomsk region [18]. In 2004, Kovaleva published a list of 189 species of lichen for interfluvial forests of the same territory [19]. The present author [20,21], Sorokina [22–24], Sedelnikova and Svirko [25,26] and many other authors have also published information on lichen of particular communities and territories in the West Siberian plain.

A great number of works deal with research on lichen biota in nature conservation areas. There are 194 species in Yugansky sanctuary [27]; 84 species in natural parks Sibirskie uvaly [28], 204 species in Kondinskie ozera [29]; 164 species in Elizariyevskiy reserve [30] and 150 species in the Ob flood plain near Surgut [31,32].

Species diversity of lichen biota in the plain area of the Ob basin includes 430 taxonomic units from 102 genera and 42 families. The present author provided in 2014 a detailed analysis of taxonomic structure of lichen biota and the role of local lichen biotas [33], describing the distribution of peculiar species of lichen according to types of habitat. Taxonomic units are according to Santesson's Checklist [34] and Diederich et al. [35].

From the eco-cenotic standpoint, the plain area of the Ob basin is a variety of habitats. Analysis of species distribution over various plant communities reveals the following features.

The most interesting communities are those of dark coniferous forests and mixed forests especially with declining aspens in the tree layer. Their lichen biota shows the greatest variety (215 species, which is 50% of all species). Species, which are the rarest in the territory under study, are in mixed dark coniferous forests especially old ones: *Arthonia mediella* Nyl., *A. patellulata* Nyl., *A. radiata* (Pers.) Ach., *A. spadicea* Leight., *A. tenellula* Nyl., *Bacidia rubella* (Hoffm.) Massal., *Calicium adpersum* Pers., *C. salicinum* Pers., *C. sphaerocephalum* (L.) Ach., *C. trabinellum* (Ach.) Ach., *C. viride* Pers., *Chaenotheca phaeocephala* (Turn.) Th. Fr., *C. trichialis* (Ach.) Th. Fr., *Collema fuscovirens* (With.) J. R. Laundon, *Lecanactis amylacea* (Ehrh.) Arnold, *Leptogium subtile* (Schr.) Torss., *Pertusaria constricta* Erichs., *P. leptospora* Nitschke, *P. leucostoma* (Bernh.) Massal., *P. pulvereosulphurata* Harm., *P. servitiana* Erichs., *P. trachythallina* Erichs., etc.

As a rule, epiphytic lichen is most widespread in forest communities as well as other lichen species growing on tree trunks bases and deadwood. The lichen species growing on soil are less widespread; they can also move from soil to trees and start growing on fallen tree trunks and tree trunk bases.

Forested fens represent the second largest number of lichen species in the plain area of the Ob basin (i.e. 161 species, 37.4%). These areas have a pronounced surface microrelief, which creates a variety of ecological conditions. The tree layer can include cedar, spruce, birch, pine-tree and larch. The shrub layer can include rowan, willow and black currant. The ground cover of such forests has a pronounced maculiferous character. There are mostly mesophile forest species in micro uplands, and hygrophilous swamp species occupy micro lowlands. Lichen and its various communities are widespread everywhere; richly covering tree and shrub trunks and branches, rotten wood of stubs and debris, in ground cover among bogs. These communities and species include standard epiphytic species located on trunks and branches from Parmeliaceae and Cladoniaceae family growing on trunk base, debris and tree turnouts. These communities include species rarely found in the territory under study: *Arthonia apatetica* (A. Massal.) Th. Fr., *Heterodermia speciosa* (Wulfen.) Trevis., *Hypogymnia tubulosa* (Schaer.) Hav., *Peltigera degenii* Gyeln., *P. horizontalis* (Huds.) Baumg., *P. membranacea* (Ach.) Nyl.

Inundated forest cenoses have the third largest biodiversity (i.e. 100 species, 23.3%). In inundated communities there is a variety of lichen flora also because of the number of substrates; the level of floodwater is important in this respect. In inundated willow and poplar forests of young trees with smooth bark (especially in the higher half of trunks) covered with river floodwater lichens developed only on high parts of trunks. As a rule, these are crustaceous species from *Caloplaca* and *Candelariella* genera. Apart from usual and widespread species, there are also rare crustaceous lichen species – *Caloplaca cerinella* (Nyl.) Flagey, *C. flavorubescens* (Hudson) Laundon, *Arthonia patellulata* Nyl. On trees there are crustaceous *Lecanora intumescens* (Rebent.) Rabenh., *L. populicola* (DC.) Duby, *L. persimilis* (Th. Fr.) Nyl., and foliose lichen from *Phaeophyscia*, *Physcia*, *Physconia*, *Xanthoria* genera.

In inundated communities, which are the least flooded by the river, the variety of lichen increases. As a rule, these communities are on large, old willows (up to 35 m high) and poplars. The shrub layers consists of *Swida alba* (L.) Opiz, which sometimes occupies the whole community, black cherry and black currant. In such phytocenoses, lichen is on tree trunks, trunk bases and debris. In the inundated poplar forest on the left part of the Chulym floodplain on rotten debris, there were fruticose lichens *Stereocaulon paschale* (L.) Hoffm. and *S. subcoralloides* (Nyl.) Nyl., which usually grow on rock streams, moss-covered stones, fine grained soil and gravel.

Epiphyte and epigeic lichens represent two large eco-substrate groups, which are the most widespread ones in pine forests with lichen and grass layer. We have found 68 species of lichen in this type of plant communities: 15.8% of the total number of species. In pine forests on sand, there is a wide range of the following genera: *Cladonia* Hill ex P. Browne. – *Cladonia arbuscula* (Wallr.) Flot., *C. cariosa* (Ach.) Spreng., *C. chlorophaea* (Flörke ex Sommerf.) Spreng., *C. coccifera* (L.) Willd., *C. cornuta* (L.) Hoffm., *C. crispata* (Ach.) Flot., *C. gracilis* (L.) Willd., *C. rangiferina* (L.) F. H. Wigg., *C. stellaris* (Opiz) Pouzar & Vezda, *C. uncialis* (L.) Wigg. and etc. Sometimes on the ground cover along road shoulders or among green mosses, there are *Peltigera didactyla* (With.) J. R. Laundon, *P. malacea* (Ach.) Funck, *P. rufescens* (Weis) Humb.

Lichenobiota of the upper bogs is not very diverse and includes 61 species: 14.2% of the total. First, there are epiphytic representatives of the Parmeliaceae family and species from the Cladoniaceae family, which make clear homotypical mats and cushions on sphagnum peat or mixed lichenosinusia on the tree waste of ericoid subshrubs.

In plant communities of transition bogs, lichens do not have outstanding biological significance, and their diversity is small (12 species, 2.8%); they hardly provide ground cover. These are epiphytic and epixilical/ epixylic lichens from the Parmeliaceae and the Cladoniaceae families.

Ledge primary rocks in the south and southeast of Tomsk region are very interesting for the lichenologist. In this article, we have omitted the information acquired on rocky substrates in the south because these substrates are very rare and seen in subzones of southern taiga and sub-boreal forests. Epilytic lichens which are diverse mostly because of mountainous habitats grow on them [21,36]. On bedrock exposures there could be both obligate epilytic and multisubstrate lichens – found not only on rocks. There could also be species associated with these habitats, growing on fine-grained soil in rock crevices, on sand substrate of dry southern and more humid northern slopes. A complex of species, typical for such cenosis, forms here: *Arctomia delicatula* Th. Fr., *Peltula euploca* (Ach.) Poelt, *Collema limosum* (Ach.) Ach., *Diploschistes muscorum* (Scop.) R. Sant., *Leptogium tenuissimum* (Dickson) Koerb., *Peltigera lepidophora* (Vain.) Bitter, *P. venosa* (L.) Hoffm., *P. didactyla*, *P. malacea*, *Stereocaulon condensatum* Hoffm., *Trapeliopsis flexuosa* (Fr.) Coppins & P. James and etc. Overall, there are 13 typical species for this habitat; 3% of the total number.

Besides natural landscapes, lichens are found in various conditions, on various substrates [37]. This is especially true for multisubstrate and eurytopic species.

Zonal forest communities demonstrate the greatest diversity of lichen species in the plain in the Ob basin; 215 species (50% of the total number) inhabit dark coniferous and mixed forests. Azonal plant communities also have significant species diversity: 161 species inhabit lowland swamps in forests; 100 species inhabit inundated forests, 61 and 12 species inhabit upper and transition bogs. Habitats on slopes and the communities affected by man do not demonstrate rich lichen species diversity, but they introduce a number of species, which cannot be seen in other types of communities in the plain in the Ob river basin. Thus, the diversity and distribution of lichens among plant communities depend on the conditions of forming phytocenosis (luminance and humidity), the microclimate and on the number and quality of substrates in any particular habitat.

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