



## MORPHOLOGICAL CHANGES AND DAMAGES OF INDICATOR LICHENS FROM SAKHALIN ISLAND

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**Abstract.** Lichen morphological changes, abnormalities and damages are very important parameters that define the general vitality of lichen communities. Correct detecting of lichen abnormalities helps to make an accurate assessment of the disturbance level of ecosystems. Main morphological changes and damages of indicator lichens of the Sakhalin Island are discussed.

**Key words:** lichens, morphological changes, damages, necrosis, biomonitoring, bioindication, Sakhalin

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### Introduction

Lichens are long living organisms with a high sensibility to environmental impacts. The high sensitivity of lichens is related to lichens biology. The using of lichens as air quality detectors is a well-documented procedure (SKYE 1979; RICHARDSON & NIEBOER 1981). The most common approach involves a floristic survey and elemental analysis of tissues from selected indicator species (ST. CLAIR 1989; WETMORE 1989). Lichen physiological processes indicate pollution related to the damage significantly earlier than other with more visible changes in color, morphology or community structure which can be detected and monitored (FIELDS & ST. CLAIR 1984). Lichen tissue damages occur after long-term or repeated influence of high concentrations of various pollutants in the air which are associated with stationary and mobile sources of the pollution. Damages and changes in lichen morphology are detected and measured by transplants and other methods of bioindication (BRODO 1961). Abnormalities which occur due to air pollution are not the same for all lichen species. Therefore it is very important to know and recognize them when using lichens as bio-monitors.

### Material and methods

Lichens were collected from all available

substrates (rock, concrete, soil, tree bark and branches, dead wood, moss) and varied habitats (urban areas, conifer and deciduous forests, sea shores and mountains) on different distances from potential pollution sources – highways, heat power plants, boiler houses and LNG plant. The investigations were performed in Korsakov, Aniva, Dolinsk and Nogliki districts of the Sakhalin Island. Lichen species were identified using standard lichen keys and taxonomic treatises. Damages and morphological changes were studied visually using hand magnifier and microscope.

### Results and discussion

#### *Color changes*

The most frequently occurred damage on lichens due to air pollution is bleaching or reddening of the upper cortex of foliose, crustose and fruticose lichens. Color change is a form of necrosis and it happens when algae layer is destroyed. Sensitive and intermediate sensitive lichens are exposed to this damage more often than tolerant species. Bleaching and reddening often happen with many lichens from next genera: *Flavoparmelia*, *Flavopunctelia*, *Parmelia*, *Hypogymnia*, *Heterodermia*, *Lobaria*, *Lecanora*, *Pyrenula*, *Graphis*, *Buellia*, *Peltigera*, *Nephroma*, *Melanelia*, *Menegazzia*, *Cetraria*, *Cladonia*, *Myelochroa*, *Parmeliopsis*, *Phaeophyscia*, *Physcia*, *Physconia*, *Platismatia* etc. Dark brown or black

colored “burns” often occur on tips of the lobes and the branches of some sensitive lichen genera – *Lobaria*, *Bryoria*, *Usnea*. The color of thallus surface is always more pale in polluted areas probably due to reduction in photosynthetic capacity (FIELDS & ST. CLAIR 1984). It happens with many lichens including tolerant species – *Phaeophyscia hirtuosa*, *Ph. rubropulchra*, *Physciella chloantha*, *Physcia stellaris*.

### **Destruction of upper cortex**

This damage usually follows after color change and it often occurs with sensitive and intermediate sensitive lichens. *Lobaria* lose their upper cortex in disturbed habitats more frequently and faster than other lichens. This damage usually causes death of lichen in very soon. It also happens with tolerant lichens when pollution level changes very fast.

### **Reproductive system abnormalities**

Reproductive organs are very sensitive to air pollution. Absence of the apothecia often occurs with sensitive lichens – *Lobaria pulmonaria*, *L. quercizans*, *Peltigera collina* as well as tolerant lichens – *Myelochroa subaurulenta*, *Parmelia fertilis*, *Lecanora pachyheila*, *Melanelia olivacea*. Destruction of apothecia and perithecia is usual for crustose lichens – *Lecanora allophana*, *L. chlarotera*, *Brigantiaea nipponica*, *Graphis scripta*, *Pyrenula japonica* in polluted areas. Lichen apothecia and perithecia of crustose lichens become empty or look deformed in polluted areas. Hyperproduction of sorediae and isidia can be often found in sensitive and intermediate sensitive species – *Lobaria pulmonaria*, *L. spathulata*, *Parmelia squarrosa* as well as in tolerant species – *Phaeophyscia hispidula*, *Physconia grumosa*, *Parmelia sulcata*, *Physciella melanchnra*, *Flavopunctelia soredica* which occur in polluted areas. Sometimes solid mass of soredia or isidia may cover all the surface of the upper cortex, but it can be normal for lichens found in clear areas because of the old age of the lichen.

### **Colonization by other lichens**

This abnormality usually happens with sensitive lichens – *Lobaria pulmonary*, *Leptogium*

*burnetiae* and some other lichens from these two genera in polluted areas. In disturbed areas the thallus of the sensitive lichen is often colonized by aggressive lichens from tolerant groups like *Phaeophyscia hirtuosa*, *Physciella chloantha*, *Candelaria concolor* etc.

### **Dwarf growth and deformations**

These abnormalities are very common for almost lichens in polluted areas. Its occur both in sensitive and tolerant species. Lichen thallus become compact, deformed, torose and thick. The lichen thallus often looks like a small shrub.

### **Additional lobes formation**

In polluted areas lichens often form small rudimentary lobes along the main lobe edge. It frequently happens with sensitive and intermediate sensitive lichens like *Lobaria pulmonaria* and *L. spathulata* etc.

### **Sparse and short rhizines**

This abnormality is very common for lichens in urban areas and it often follows with sparse and short hairs around the apothecia of some *Phaeophyscia* species like *Ph. hirtuosa* and other.

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