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Lichens on Monuments in the Southern Part of Ukraine

Alexander Ye. Khodosovtsev

Kherson Pegagogical institute, Kherson 325030, Ukraine

Abstract

The lichens involved in processes biological weathering on the marbles and limestones of ancient cities in the southern part of Ukraine - Olvia, Khersones and Pantikapey - have been studied. 11 species of lichens with comparatively small degree of overgrown were found out on Twenty-eight species of lichen, belonging to 11 genera and 8 families, were encountered. On marble columns and plinths only 11 species were found, all with a comparatively small degree of cover. In contrast, limestone walls were colonized by 26 species of lichens, which had a large coverage on horizontal surfaces. The main factors affecting the distribution of lichens on marble and limestone substrata are: age of the stonework, inclination of the surfaces, degree of exposure and surface morphology. Inclination of surface is the main factor of limestone, whereas surface morphology is the main factor on marble. It was shown that two types of mesopits are formed under lichens on the surface of limestone damaged by lichens.

1. INTRODUCTION

Many lichens are "pioneer plants" and colonize not only naked mountain rock, but also the stone surfaces of monuments. The ability of lichens to weather the minerals on monuments was noticed during the last century, but only in recent years has this process been actively studied by scientists from different countries/ Seaward & Giacobini, 1988; Gehrmann *et al.* ,1988; Nimis & Monte, 1988; Nimis *et al.*, 1992 Gehrmann & Krumbein, 1994 etc./. The main topics of their investigations have included the study of corrosion agents, biominerali zation and biopitting, and the preparation of inventories of the lichens occurring on monuments.

Hitherto, no specific attention has been paid to the problem of lichens on monuments of Ukraine, although there has been a study of microflora species., algae and mosses, growing on the monuments of Kiev and Chernigov / Lenova *et al.*,1980/. Also, the colonization of industrial materials by lichens in the subtropical climate of Georgia has been studied by Ukrainian lichenologists/ Wasser *et al.*, 1988; 1989; Brun & Navrotskaya, 1992/.

Lichens occurring on the ruins at the ancient cities of Khersones, Olvia, Panticapey, Arches Issar and fortress Arabat have been mentioned in some floristic papers / Oxner,1956,1993; Kopachevskaya, 1986/. The aim of the present investigation was to prepare an inventory of the lichens on ancient monuments in the southern part of Ukraine and to study the corrosion caused by these lichens.

2. MATERIALS AND METHODS

During 1994, lichens were collected on marble and limestone from the ruins of ancient cities in the southern part of Ukraine: Olvia, Khersones and Panticapey. Examination of the lichens employed standard technique/Oxner, 1974/ using an EWL light microscope, as well as MBS-1 for examining the biological corrosion of marble and limestone surfaces.

3. RESULTS AND DISCUSSION

The 28 species of lichens, belonging to 11 genera and 8 families, collected on limestone and marble monuments are listed in Table 1. The examination of samples covered with lichens has shown extensive corrosion under the thalli of crustose species. Corrosion was found to be more prevalent on the limestone of the walls than on the marble of the columns.

The species composition was also different, with 11 species occurring on marble, and 25 species on limestone. The marble columns were colonized by lichens only in some locations, and then with a low coverage, while the limestone surfaces of walls had a coverage of about 60-80 %. In our opinion, the following are the main factors affecting the distribution of lichens on marble and limestone: age of the stonework, inclination of surfaces, degree of exposure, and surface morphology.

The greatest lichen diversity occurs on horizontal limestone surfaces, where *Caloplaca decipiens, C. saxicola, C.lactea, Lecanora muralis, L. albescens, Candelariella aurella* were among the dominant species. Some of them e.g. *Caloplaca aurantia, C. variabilis, Verrucaria glaucina*, preferred the more equal horizontal surfaces. Sometimes on the light vertical surfaces the large areas were taken by *Caloplaca saxicola, Lecanora albescens* and *Physcia* *adscendens, Verrucaria nigrescens* preferred to occupy concavities in shaded, vertical surface. However, vertical surfaces of limestone ruins were not completely colonized. On the upper part of vertical walls lichens occurred more often and with relatively large coverage whereas at the bottom lichens were completely absent or of seldom occurrence.

Surface morphology is more important for the distribution of the lichens on marble columns and plinths, than is surface inclination. Such lichens as *Candelariella vittelina, Caloplaca flavorubescens, Lecania rabenhorstii* occurred on smooth marble plinths only in a few small-sized cracks. However, the base of marble columns was abundantly covered by lichens. Here there were many ecological niches, due to the numerous angles and projections/places with different exposition, humidity, dust etc./, where *Lecanora muralis, L. albescens, L. dispersa, L. elenkinii, Caloplaca aurantia, Aspicilia calcarea* were usually growing.

The corrosion caused by lichens is characterized by various forms and sizes pits, denoted as micropitting and mesopitting/Gehrmann & Krumbein, 1994/. Our research has shown that it is possible to distinguish two types of mesopitting: internal and external mesopitting.

Internal mesopitting begins from the moment of perithecium formation inside the rock and only later is apparent on the limestone surface, after the ascomata have decayed or become detached. It is characteristically formed by such endolithic lichens as *Verrucaria calciseda* and *V. macrostoma*. External mesopitting, on the other hand, is formed by lichen thalli and never begins inside the rock. It is formed by the penetration of separate hyphae, arising from areoles or ascomata into the rock from the surface. From the beginning the form of such pits have the shape of shallow, plate-like holes, which in time merge into more extended trenches, grooves and cavities. External biopitting is mainly formed by such crustose epilithic lichens as *Verrucaria nigrescens, Aspicilia calcarea, Caloplaca flavovirescens* and *C. variabilis*. During the examination of marble samples with fragments of lichen thalli, internal mesopitting was not observed, while on limestone both types of biopitting were formed.

Adamo *et al.* /1993/,in their study of mafic rock, found the same kind of disaggregation and corrosion under both foliose and crustose lichens. However, on our investigated samples of limestone and marble, no strong dissaggregation was found under foliose lichens. Under the thalli of *Xanthoria calcicola* and *Physcia adscendens*, some samples with limestone biopitting, were observed, but in our opinion this was formed earlier by the activity of previously occurring crustose lichens that have been subsequently died. On the marble samples only one foliose lichen, *Ph.adscendens,* was present. It was not attached to the marble surface, whereas on limestone *Ph.adscendens* was directly attached to the rock. This phenomenon can be explained by a weak ability of this species to form the corrosion agents of necessary to dissolve marble crystals.

The research of lichens on the monuments of Ukraine is in progress and therefore the obtained results are to be further verified in field and laboratory, and published elsewhere.

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Table 1 The lichens damaging monuments of the Southern part of Ukraine.

	The lichens	Marble	Limestones
1.	Aspicilia calcarea (L.) Mudd.	+	+
2.	A.contorta (Hoffm.) Krempelh.		+
3.	Buellia epipolia (Ach.) Mong.		+
4.	Caloplaca aurantia (Pers.) Helb.	+	+
5.	C.citrina (Hoffm.)Th. Fr.		+
6.	C.decipiens (Arnold) Blomb ex Forss.		+
7.	C.flavorubescens (Huds.) Laundon	+	+
8.	C.flavovirescens (Wulf.) DT. et Sarnt.		+
9.	C.lactea (Massal.)Zahlbr.		+
10.	C.saxicola (Hoffm.) Nordin	+	+
11.	C.variabilis (Pers.)Mull.Arg.		+
12.	Candelariella aurella (Hoffm.)Zahlbr.		+
13.	C.vitellina (Hoffm.) Mull. Arg.	+	
14.	Kiliasia athallina (Hepp.) Hafellner		+
15.	Lecania rabenhorstii (Hepp.) Arnold.	+	+
16.	Lecanora albescens (Hoffm.) Branch et Rostrup.	+	+
17.	L.crenulata (Dick.)Vain.		+
18.	L.dispesa (Pers.) Sommerf.	+	+
19.	L.elekinii Mereschk.	+	
20.	L.muraluis (Schreb.) Rabench.	+	+
21.	Physcia adscendens (Fr.) Oliv.	+	+
22.	Rinodina bischofii (Hepp.) Massal.		+
23.	Verrucaria calciseda DC.		+
24.	V.glaucina Ach.		+
25.	V.nigrescens (Ach.) Pers.		+
26.	V.pontica Oxn.		+
27.	V.macrostoma Duf.		+
28.	Xanthoria calcicola Oxn.		+