

THE DISTRIBUTION OF LICHENS ON SOME STONEWORKS IN THE SURROUNDINGS OF ROME

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Abstract: 34 floristic relevés concerning epilithic lichens have been carried out in 6 archaeological sites in the surroundings of Rome, on different types of substrate. 52 lichen species have been recorded. The matrix of the relevés and of the species has been submitted to programs of multivariate analysis (classification and ordination); the results allow to distinguish 5 main community-types and to order the species according to their degrees of acidophytism and nitrophytism.

Introduction

The role of lichens in the deterioration of stoneworks is still open to discussion. Deterioration by lichens can occur in the following ways: a) Increase of the thallus in time, b) variation of the thallus volume following drying and wetting, c) the capacity of the thallus to absorb water, which becomes particularly important under freezing conditions, d) the secretion of acids and other substances that can alter the rock surface. The CO₂ produced by the respiration of the lichens, in the presence of water, may attack the rock surfaces, producing pittings or small channels which make easier the penetration of the hyphae into the rock.

As for conservation, lichens are sometimes removed from the stoneworks to avoid mechanical, chemical, or purely aesthetic damages. However, these measures are not always based on informations on the ecology of the various species. Ecological information appears to be a very important point, since the removal of lichens should be accompanied by other measures for the prevention of lichen growth. This paper aims at giving a preliminar contribution on the ecology of lichens growing on different substrate-types in some archaeological areas of Latium.

Data and Methods

34 floristic relevés have been carried out in 6 localities, on four substrate types. The localities are:

1) Scavi di Ostia

- 2) Isola Sacra
- 3) Tombe Latine
- 4) Museo Nazionale Romano
- 5) Villa Madama
- 6) Caprarola, Palazzo Farnese.

The main substrate types are:

- a) carbonatic rocks, including marble and travertino
- b) pyroclastic rocks, deriving from the quaternary volcanic areas of Latium; sometimes they contain calcareous inclusions. Among the most frequent rock types are the grey granular tuff (peperino), and the yellow tuff of Via Tiberina, which were widely used in Roman buildings.
- c) artificial rocks (cement, brick, etc.);
- d) basaltic rocks, mainly used for pavements and walls.

The matrix of the 34 floristic releves and of the 52 lichen species is reported in Tab. 1. The location of the single releves is reported in the Appendix.

The data in Tab. 1 have been submitted to numerical classification in order to obtain groups of releves with similar floristic composition. The clustering algorithm is complete Linkage Clustering (Anderberg, 1973); the resemblance measure is Euclidean Distance. The same matrix has been further submitted to Reciprocal Ordering, with data transformed by Deviation from Expectation and with Cross Product as resemblance measure (see Orloci, 1978), in order to detect possible variation trends, and to analyze the correlations between species and releves. Classification and ordination have been carried out with the program package of Wildi & Orloci (1983). Nomenclature follows Nimis & Poelt (1987).

Results

The dendrogram of the releves is shown in Fig. 1: five main releve groups are formed. As shown in Tab. 2, most of the groups are well characterized by one or more differential species, as follows:

Group 1: *Lecanora muralis*, *Candelariella vitellina*, *Lecidea fuscoatra*, *Porpidia* sp., *Candelariella coralliza*, *Acarospora fuscata*, *Aspicilia cinerea*.

Group 2: *Dirina massiliensis*.

Group 3: this is an heterogeneous group; the first three releves have no differential species, the last four releves are characterized by the high frequency of *Lepraria incana* and *Tephromela atra*.

Group 4: *Lecanora dispersa*, *Caloplaca citrina*. Frequent species, shared with group 5, are: *Lecanora albescens*, *Caloplaca aurantia*, *Verrucaria nigrescens*.

Group 5: *Aspicilia calcarea*, *Bagliettoa baldensis*.

In the ordination of releves (Fig. 2a), the sequence of the releve groups along the first Principal Component is the following: 5, 4, 2, 3, 1. The first Principal Component clearly reflects a gradient in the pH of the substrate, since all releves on limestone have negative scores, all releves on siliceous rock have positive scores. Fig. 2b shows the arrangement of the indicator species along the First Compo-

nents: they are arranged, from left to right, according to increasing acidophytism.

The second component separates *Lecanora dispersa* and *Caloplaca citrina*, two nitrophytic species correlated with releve group 4, from all other calciphytic species, and represents a gradient of increasing nitrophytism (from the negative to the positive scores). Although less clearly, this gradient also applies to the silicolous species with positive scores on the first Principal Component. *Xanthoria calcicola*, *Xanthoria parietina*, *Candelariella vitellina*, *Lecanora muralis* and *Acarospora fuscata*, which are rather nitrophytic species, have positive scores on the Second Principal component, whereas *Tephromela atra*, a species which is less tolerant to eutrophication, has negative scores.

Summarizing, the space defined by the two first Principal Component, can be subdivided into 4 quadrants, as follows:

Quadrant 1 (first PC negative, second PC positive): basic pH, eutrophiated substrates.

Quadrant 2 (both PCs positive): acid pH, eutrophiated substrates.

Quadrant 3: (first PC positive, second PC negative): acid pH, non- eutrophiated.

Quadrant 4: (both PCs negative): basic pH, non-eutrophiated.

The results of these elaborations show that the two main factors responsible for the floristic variation within our data set are, in order, pH and eutrophication of the substrates. The relevés of group 3 have low absolute scores on either PC, and are not related to these factors.

Discussion and Conclusion

The most frequent species are: *Aspicilia calcarea*, *Caloplaca aurantia*, *Caloplaca citrina*, *Caloplaca holocarpa*, *Candelariella vitellina*, *Lecanora albescens*, *Lecanora dispersa*, *Lecanora muralis*, *Bagliettoa baldensis*, *Verrucaria nigrescens*, *Xanthoria parietina*, *Lecidea fuscoatra*. Most species appear to be linked to a particular type of substrate (siliceous or calcareous), with the exception of a few lichens with broader ecological amplitude such as *Physcia adscendens*, *Xanthoria calcicola*, *Xanthoria parietina* and *Diploicia canescens*.

Considering that our relevés are limited to floristic lists, often taken on small surfaces, it is not easy to attribute each releve group to a given lichen association. However, by comparing our results to those of Nimis et al. (1987), the following considerations can be made:

Releve group 1: it partially corresponds to releve group M3 of Nimis et al. (1987).

Releve group 2: it corresponds with the *Dirinetum repandae* (group M1 of Nimis et al., 1987), an association linked to low light intensity on subvertical or overhanging surfaces.

Releve group 3: it partially corresponds with releve group M2 of Nimis et al. (1987), occurring on subvertical surfaces in rather shady, humid sites.

Releve group 4: it corresponds to releve group C4 of Nimis et al., 1987 (*Caloplacion decipientis*), including nitrophytic communities on limestone.

Releve group 5: it appears as a very fragmentary facies of the *Aspicilietum cal-*

Tab. 1 - Floristic releves.

SUBSTRATE	NR. OF OCCURRENCES																																			
	C	C	M	P	C	H	C	H	H	H	C	C	B*	P	C	P	H	H	H/P	C	H	C	C	C	C	C	C	C	H	H	H	P				
RELEVE NR.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34		
<i>Acarospora fuscata</i>																																			3	
<i>Acarospora umbilicata</i>																																				1
<i>Aspicilia calcarea</i>																																				6
<i>Aspicilia cinerea</i>																																				3
<i>Buellia punctata</i>																																				1
<i>Caloplaca aurantia</i>																																				13
<i>Caloplaca citrina</i>																																				10
<i>Caloplaca festiva</i>																																				2
<i>Caloplaca holocarpa</i>																																				6
<i>Caloplaca saxicola</i>																																				2
<i>Candelariella coralliza</i>																																				2
<i>Candelariella mediana</i>																																				2
<i>Candelariella vitellina</i>																																				5
<i>Collema crispum</i>																																				1
<i>Collema tenax</i>																																				1
<i>Diploicia canescens</i>																																				3
<i>Diplotoma epipolium</i>																																				1
<i>Dirina massiliensis</i>																																				1
<i>Dirina repanda repanda</i>																																				3
<i>Haematoma ochroleucum</i>																																				1
<i>Huillia sp.</i>																																				2
<i>Lecania erysibe</i>																																				1
<i>Lecanora albescens</i>																																				11
<i>Lecanora atra</i>																																				3
<i>Lecanora caespitris</i>																																				3
<i>Lecanora crenulata</i>																																				1
<i>Lecanora dispersa</i>																																				11
<i>Lecanora muralis</i>																																				6
<i>Lecanora pruinosa</i>																																				1
<i>Lecanora rupicola</i>																																				1
<i>Lecanora soralifera</i>																																				1
<i>Lecidea fuscoatra</i>																																				5
<i>Lecidella stigmatia</i>																																				2
<i>Leproloma lincana</i>																																				3
<i>Leproloma chrysoidea</i>																																				1
<i>Leproloma xantolyta</i>																																				1
<i>Ochrolechia parella</i>																																				2
<i>Opegrapha nougeotii</i>																																				1
<i>Parmelia verruculifera</i>																																				2
<i>Phaeophaea orbicularis</i>																																				3
<i>Phycia adscendens</i>																																				4
<i>Phyconla grisea</i>																																				1
<i>Protoblaetia rupestris</i>																																				1
<i>Rhizocarpon geographycum</i>																																				1
<i>Rhizocarpon obscuratum</i>																																				1
<i>Rhodina genarii</i>																																				1
<i>Rocella phycopsis</i>																																				1
<i>Sarcogyne regularis</i>																																				1
<i>Scolicloporus umbrinum</i>																																				3
<i>Toninia aromatica</i>																																				2
<i>Verrucaria baldensis</i>																																				5
<i>Verrucaria fuscella</i>																																				4
<i>Verrucaria glaucina</i>																																				2
<i>Verrucaria muralis</i>																																				1
<i>Verrucaria nigrescens</i>																																				12
<i>Verrucaria viridula</i>																																				3
<i>Xanthoria calcicola</i>																																				3
<i>Xanthoria parietina</i>																																				5

NR. OF OCCURRENCES

Abbreviations: C: carbonatic rocks, B: pyroclastic rocks, M: artificial materials, B: basalt.

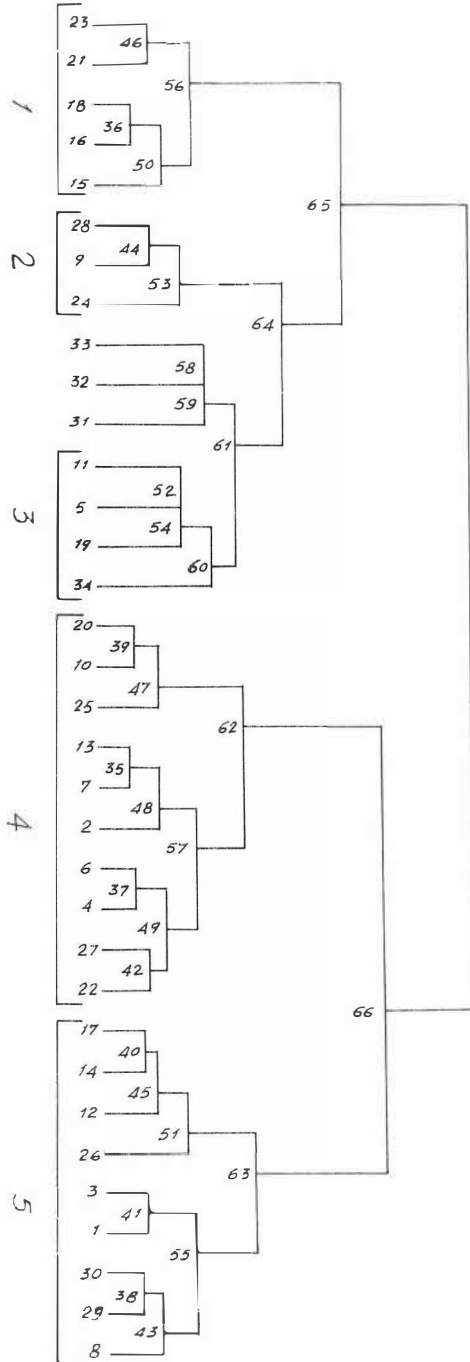


Fig. 1 - Dendrogram of the reeves.

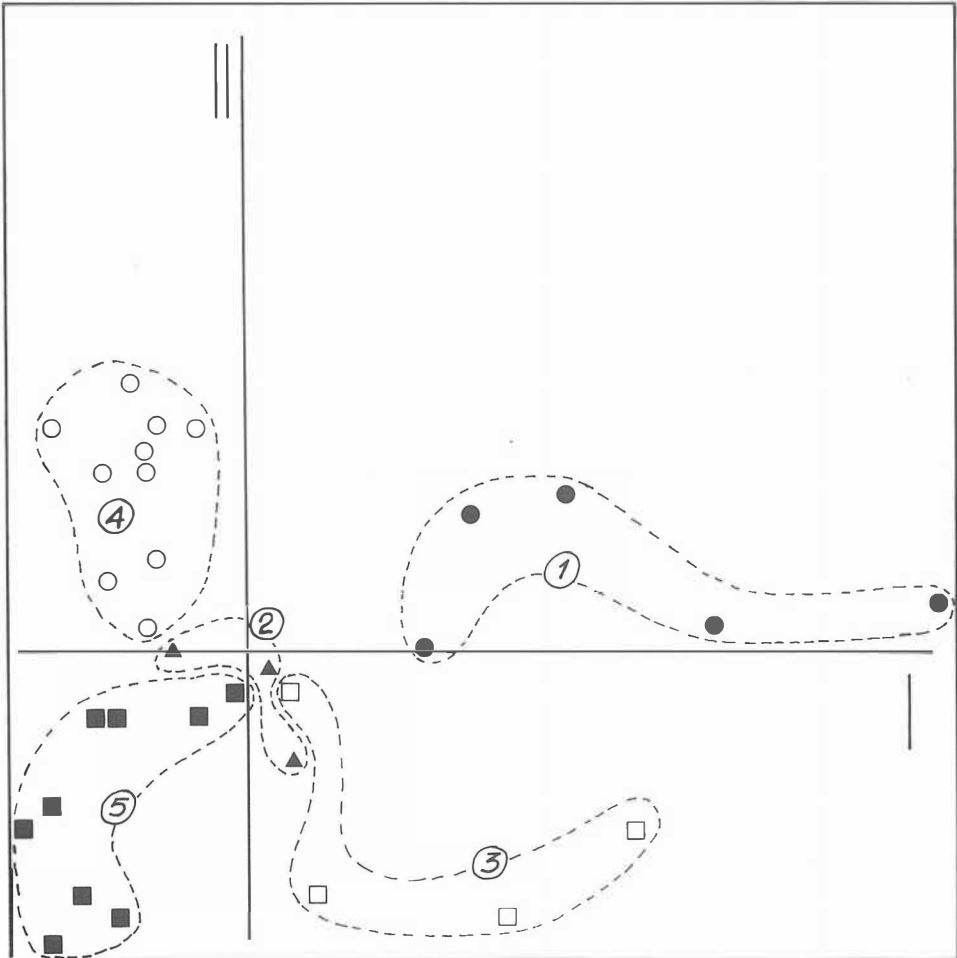


Fig. 2a - Ordination of the releves.

careae (releve group C3 of Nimis et al., 1987), a less nitrophytic association than those of the *Caloplacion decipiensis*.

As far as lichen action on the substrates is concerned, the following observations have been made:

Large terra-cotta vases (Phitos) at the Museo Nazionale Romano are colonized by the thalli of *Lecanora muralis*, which can attain a diameter of 4-7 cm, with an estimate age of about 8-15 years. The section of one of the thalli revealed a damage to the substrate, with the detachment of a few mm thick substrate fragments; the lichen appeared to be particularly aggressive, in the absence of other species probably due to air pollution. A comparison can be made with other terra-cotta vases (Ollae) in a more natural environment (Ostia Antica). In this case the

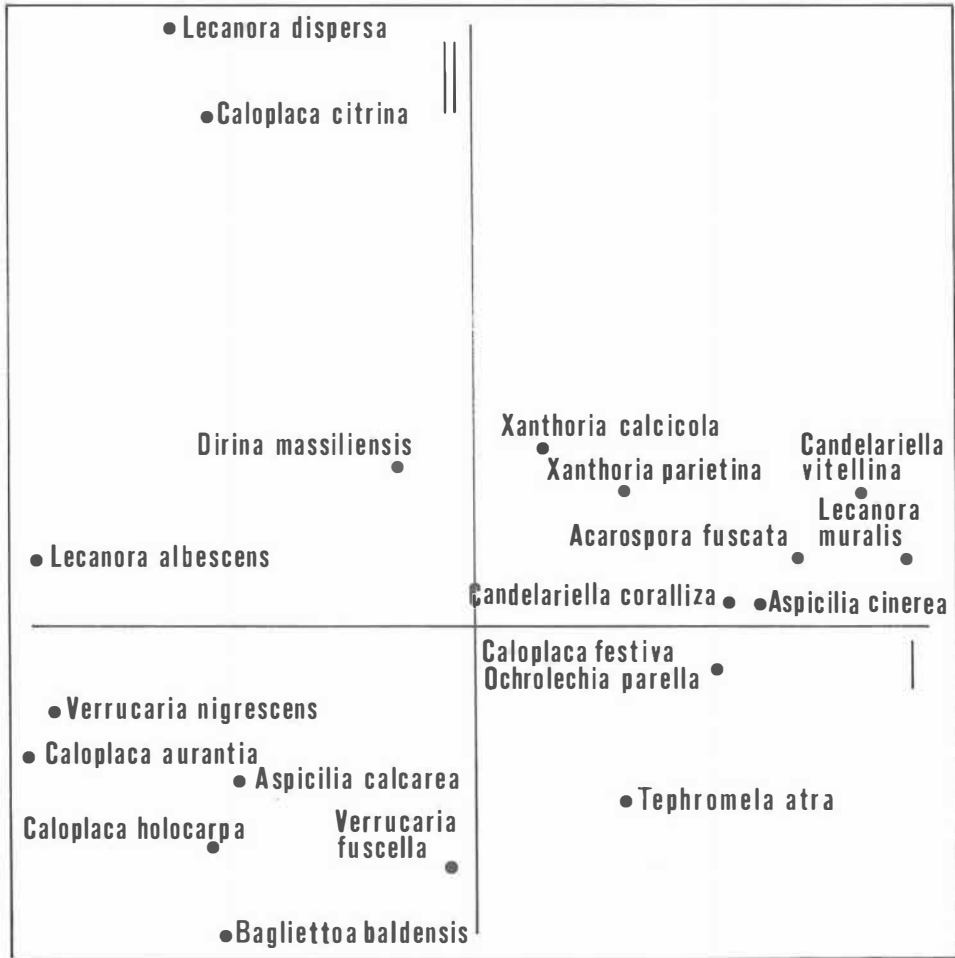


Fig. 2b - Ordination of the species.

colonizing lichen is *Tephromela atra*, that also caused the detachment of small substrate fragments mixed with parts of the thallus. Another example of heavy damage is given by the mural paintings of Palazzo Farnese at Caprarola, close to Viterbo; the paintings were colonized by *Dirina massiliensis*, causing small shallow cavities at the surface of the paintings (Seaward et al, 1989).

There is still much work to be done on the problem of lichens and stoneworks. Two points are of particular interest:

- 1) The detailed study of different species' action on different substrates.
- 2) The testing of different techniques which are currently used to remove lichens from the substrata.

Furthermore, there is a general agreement on the fact that lichens should be

removed only in presence of serious mechanical or aesthetic damage. If removal is necessary, it is important to take measures for preventing further growth, and these must be based on the knowledge of the ecology of the single species. This study gives a first floristic-ecological information on which to base further research.

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Appendix
Localities of sampling and releve numbers

OSTIA SCAVI

1) Travertino basement, 2) Temple of Attis, marble statue, 3) Campo della Magna Mater, column basement (travertino) 4) Porta Laurentina, brick, 5) Porta laurentina, Opus Reticulatum, tuff, 6) Porta Laurentina, door, travertino, 7) Columns of the Forum, cement, 8) Marble blocks in the Forum, 9) Capitolium, brick, 10) Wall painting of Via Diana, 11) Campo delle Olle, terracotta.

ISOLA SACRA

12) Tombe a Cappuccina, terracotta, 13) Marble grave.

TOMBE LATINE

14) Basement, travertino, 15) Basalt boulder, 16) Peperino boulder, 17) Travertino boulder, 18) Tuff blocks, 19) Tomba dei Valeri, brick, 20) Tomba dei Pancrazi, brick.

MUSEO NAZIONALE ROMANO

21) Funerary Monument of Fonteii, tuff, peperino, cement, 22) as before, marble fragment, 23) Terracotta Phitos.

VILLA MADAMA

24) Venus statue, marble, 25) Sarcophagus, marble, 26) Columns, granite, 27) Column, limestone, 28) Part of the door, travertine, 29) Giants' statue, basement, travertine, 30) Balaustra della Balconata, travertine, 31) Vase, calcareous conglomerate (cement), 32) Garden pavement, calcareous conglomerate (cement)-

CAPRAROLA

33) Palazzo Farnese, wall paintings, 34) Palazzo Farnese, statues and other stoneworks of the garden, tuff, peperino.