Kurze Mitteilung

Selectivity in Lichen-Substrate Relationships

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With one figure

(Received April 24, 1974)

Summary

The moisture retention capacity of eight different types of saxicolous lichen substrates from the Negev Desert, was measured. It was shown that there is a correlation between the establishment of the lichens Ramalina maciformis, Buellia canescens, B. sorediosa and Caloplaca ehrenbergii, and the moisture retention capacity values of the substrates. The importance of the physical properties of the substrate as factor in the lichen-substrate association are discussed.

Introduction

Lichens are most often restricted to a specific substrate, but some may become established on several types of substrate. Separating the species into the groups „saxicolous“, „corticolous“ and „terricolous“ (as keys for their identification) we may distinguish species restricted to a specific type of rock (or stone); bark or soil; or colonizing a variety of rocks, trees or soils, respectively. The extent to which the restrictions in substrate choice are correlated with chemical and/or physical properties of the substrate has been the subject of several investigations (Hale 1955, 1967; Culberson 1955, Brodo 1968), but is still not adequately understood. Mineral uptake from various substrates and their accumulation in large quantities in the thallus has been demonstrated in several studies (Smith 1962; Lonanmaa 1956; Lange 1963). Since the uptake of chemical elements may vary between species growing on the same substrate and between members of the same species growing on different substrates (Smith 1962), the availability of chemical elements cannot be considered directly responsible for any selective substrate-lichen relationship. Brodo (1968) cites a series of physical substrate properties, such as texture, stability, and moisture-holding capacity as playing important roles in the association. The correlation between the soil shrinkage-rate and Squamarina substrate choice (Garty, Gal and Galun 1974) and between the moisture retention capacity of certain rocks and the lichens colonizing their surface, as demonstrated in the present study, support the view that the requirements are for specified physical characters, indirectly determined by the chemical nature of the substrate.

1) Part of an M. Sc. thesis submitted by J. Garty to the Department of Botany, Tel-Aviv University.
Fig. 1. *Ramalina maciformis* on a Cenomanian flintstone inclusion in limestone: (reduced × 1.5)

**Materials and Methods**

This study was carried out on four lichen species: *Ramalina maciformis* (DEL.) BORY; *Buellia canescens* (DICKS.) DeNot.; *Buellia sorediosa* REICH. et GALUN and *Caloplaea ehrenbergii* (MÜLL. ARG.) ZAHLM.

Eight different types of stones were collected from the Negev desert and their moisture retention capacity (m.r.c.) determined by immersion in water, drying the surface and weighing, followed by drying for 48 h. at 110 °C and weighing again. Flintstones were kept in water for 15 minutes and others until their weight started to decrease due to dissolution.

**Observations**

*R. maciformis, B. canescens, B. sorediosa* and *C. ehrenbergii* form an association which is found in great abundance on flintstones located on all slopes (N, W, S, E) of hills and mountains of the northern and central Sinai and the Negev desert, at heights of approximately 250 m and above (GALUN 1970; GALUN and GARTY 1972). The same four species grow also on hard limestone, but on this substrate they are restricted to slopes facing north and west, on the same hills and mountains. The surface of soft limestones and chalky stones, although occupied by a variety of other lichens (such as *Caloplaea aurantia, C. aegyptiaca var. circinans, Lecanora farinosa, Buellia venusta, Diploschistes calcareus*), never serve as substrate for any of the four species reviewed in this study.

The eight types of stones examined comprise three categories according to their colonization by *R. maciformis, B. canescens, B. sorediosa* and *C. ehrenbergii*: Stones which serve as substrate in all slopes (table 1, A); stones which serve as substrate only on north-
<table>
<thead>
<tr>
<th>Categories</th>
<th>Type of Stone</th>
<th>Location</th>
<th>Moisture retention capacity %</th>
<th>Lichens present on slopes facing</th>
</tr>
</thead>
<tbody>
<tr>
<td>A 1.</td>
<td>Campanian flintstones</td>
<td>Nahal Haroa</td>
<td>0.0-0.53</td>
<td>+ + + + +</td>
</tr>
<tr>
<td>2.</td>
<td>Eocenic flintstones</td>
<td>Massh'abe Sade</td>
<td>0.008-1.64</td>
<td>+ + + + +</td>
</tr>
<tr>
<td>3.</td>
<td>Cenomanian flintstones as inclusions in limestones (fig. 1)</td>
<td>Sede Boqer College</td>
<td>0.02-0.06</td>
<td>+ + + + +</td>
</tr>
<tr>
<td>B 4.</td>
<td>Hard Cenomanian limestones</td>
<td>Sede Boqer College</td>
<td>0.3-1.3</td>
<td>+ + - - -</td>
</tr>
<tr>
<td>5.</td>
<td>Cenomanian limestones silicified internally</td>
<td>Nahal Haroa</td>
<td>0.51-5.83</td>
<td>- - - - -</td>
</tr>
<tr>
<td>C 6.</td>
<td>Eocenic chalky limestones</td>
<td>Massh'abe Sade</td>
<td>0.62-6.61</td>
<td>- - - - -</td>
</tr>
<tr>
<td>7.</td>
<td>Cenomanian limestones</td>
<td>Nahal Haroa</td>
<td>6.13-16.49</td>
<td>- - - - -</td>
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<tr>
<td>8.</td>
<td>Eocenic chalky stones</td>
<td>Massh'abe Sade</td>
<td>10.42-28.74</td>
<td>- - - - -</td>
</tr>
</tbody>
</table>
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and west-facing slopes (Table 1, B); stones which are not colonized by the four species (Table 1, C).

The data of Table 1 reveal a significant difference in m. r. c. values between the three categories of stones, and a correlation between these values and lichen distribution. Stones having low m. r. c. values (data 1—3) are preferentially selected as the substrate of *R. maciformis*, *B. canescens*, *B. sorediosa* and *C. ehrenbergii*. Stones with high m. r. c. values (data 5—8), are not suitable for the settlement of these species. Non-siliceous, hard limestones with low m. r. c. values (data 4) alternate flinstones in support of lichen growth only on the northern and western slopes, where evaporation is slower than on the southern and eastern slopes.

**Discussion**

The data obtained in this study demonstrate the importance of the physical properties of the substrate in affecting the floristic make-up of a lichen association.

Soft and hard limestones, which are of similar chemical constitution each, under the same environmental conditions, supports its own specific combination of species. Flint and hard limestones, on the other hand, of very different chemical composition, but having as a common characteristic a low m. r. c. value, act as host for the same four species, *Ramalina maciformis*, *Buellia canescens*, *B. sorediosa*, and *Caloplaca ehrenbergii*.

The accessible amount of water in the substrate surface is directly correlated with the m. r. c. of the substrate as well as with the kinetics of the evaporation process. The harder stones, which are less water permeable (Table 1), have a thicker and more durable water film on their surface. This may account for the difference in lichen establishment. The species become sorted out in response to their needs for water. Stones with intermediate m. r. c. values retain the required water film only on the relatively less exposed northern and western slopes. It must be kept in mind, that we are considering a desert climate where the amount of water is very restricted and evaporation rates are high (Ashbel 1950; Manne and Rosenan 1956; Rosenan 1956).

The thickness and persistence of the water film may play an important role in the early stage of thallus initiation, or with regard to the existence and development of mature colonies of *B. canescens*, *R. maciformis*, *B. sorediosa* and *C. ehrenbergii*.

*R. maciformis*, *B. sorediosa* and *B. canescens* rarely produce fruiting bodies in the area under study. These three are sorediose species, whereas *C. ehrenbergii* lacks soredia and produces apothecia in great abundance. The mode of thallus initiation is therefore, presumably by soredia in *R. maciformis*, *B. sorediosa* and *B. canescens*, and by germinating spores or thallus fragments in *C. ehrenbergii*. This difference in the early stages of establishment leads to the assumption that the water film on the substrate surface is a requirement on the already established thallus.

**Reference**


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