The Ecological Role of Biological Soil Crusts in the Rome Sand Plains

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What are Biological Soil Crusts?

This biological soil crust is found in the Central Range of the Dominican Republic.

Their ecological roles include:

- Soil stabilization
- Organic matter fixture
- Soil Infiltration improvement
- Moisture contribution
- Temperature buffer
Implications for Controlling Desertification

Once vegetated, this landscape was victim to desertification.

- Nigeria loses more than 351,000 hectares per year due to desertification.
- In China, more than 24,000 villages have been swept by sand storms resulting from desertification.
- In Brazil, economic losses from desertification are estimated at $300 million per year.

Source: UN’s FAO

Source: Earth Policy Institute
Rome Sand Plains, Oneida County
Objectives of the Study

1. Measure the soil moisture content beneath different cover types.

2. Determine the water absorption capacity of the biological soil crust under controlled environmental conditions.

3. Measure soil stability due to biological soil crust cover as a comparison to no cover.

4. Observe and measure the crust’s effect on surface microclimate.
Macroscopic Components of the Biological Soil Crust

<table>
<thead>
<tr>
<th>Common Species</th>
<th>Scientific Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Burned Ground Moss</td>
<td><strong>Ceratodon purpureus</strong></td>
</tr>
<tr>
<td>Reindeer Moss (lichen)</td>
<td><strong>Cladonia rangiferina</strong></td>
</tr>
<tr>
<td>Ladder Lichen</td>
<td><strong>Cladonia verticillata</strong></td>
</tr>
<tr>
<td>British Soldiers</td>
<td><strong>Cladonia cristatella</strong></td>
</tr>
</tbody>
</table>

**Uncommon Species**

<table>
<thead>
<tr>
<th>Common Name</th>
<th>Scientific Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reindeer Lichen</td>
<td><strong>Cladonia arbuscula</strong></td>
</tr>
<tr>
<td>Powdered Trumpet</td>
<td><strong>Cladonia fimbriata</strong></td>
</tr>
<tr>
<td>Yellow Moss</td>
<td>Homalotheicum fulgescens</td>
</tr>
<tr>
<td>Haircup Moss</td>
<td><strong>Polytrichum strictum</strong></td>
</tr>
</tbody>
</table>
Objective 1: To measure the soil moisture content beneath different cover types.

Method:

• Exactly 6 large sand samples were collected from the sand dune and biological soil crusts.

• Samples were weighed, dried, and re-weighed to determine moisture content.

• For moisture contribution, samples were dried and allowed to absorb water. Components were then separated and dried.

• Samples were weighed at each step.
Objective 2: To determine the water absorption capacity of the biological soil crust under different environmental conditions.

Methods:

• Exactly 75 microcosm samples were collected using clear tubes 5cm in diameter and 6cm in height.

• Samples were placed in a chamber with controlled humidity and temperature and were weighed at certain time intervals.

<table>
<thead>
<tr>
<th>Trial</th>
<th>Temperature (F)</th>
<th>Humidity (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trial 1</td>
<td>70.6±1.53</td>
<td>89.8±3.98</td>
</tr>
<tr>
<td>Trial 2</td>
<td>82.6±4.11</td>
<td>87.5±3.20</td>
</tr>
<tr>
<td>Trial 3</td>
<td>95.5±9.24</td>
<td>28.6±4.25</td>
</tr>
<tr>
<td>Natural Trial</td>
<td>80.7±6.11</td>
<td>70.7±12.12</td>
</tr>
</tbody>
</table>
Water Absorption: High Humidity, High Temperature

![Graph showing the change in mass over time for different materials under high humidity and high temperature conditions. The graph includes lines for Temperature, Humidity, Lichen, Moss, and Sand, each with distinct color codes.

- Temperature: Red dotted line
- Humidity: Blue dotted line
- Lichen: Green line
- Moss: Black line
- Sand: Orange line

The x-axis represents time in hours, ranging from 0 to 200, while the y-axis represents mass change in grams, ranging from 0 to 1.5. The graph demonstrates the differential absorption rates of the materials under the specified conditions.]
Objective 3: To observe and measure the crust’s effect on surface microclimate.

- TidBit devices were placed underground inside air-filled tubes in four locations: below bare sand and below crust-covered sand.
- Two others were attached to trees to measure surrounding air temperature.
**Objective 4:** To measure soil stability due to biological soil crust cover.

**Method:**

- A soil penetrometer was used to collect replicated (n=10) measurements of soil stability at different locations.
- Measurements were taken on the trail, on bare sand, and on the crust.
Conclusion/Summary

• This study shows that biological soil crusts have a major influence on soils even in moist, temperate regions.

• The biological soil crust is:

  Increasing water uptake by barren soils;

  Stabilizing the soil to prevent wind and water erosion;

  Buffering soil temperature through enhanced water uptake;

  And improving soil physical properties for better water infiltration and moisture retention.
Remember…

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