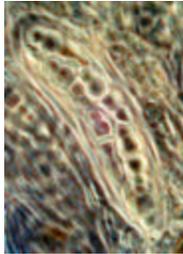


Lichen Ecology



Important stages in lichen colony establishment

Dispersal of sexual and Asexual propagules wind action, rain splash and micro invertebrates - dehiscence of ascospores from ascus and release of asexual propagules from Isidia and soredia.



Ascospores inside the ascus
(Sexual reproduction)



Isidia
(Asexual reproduction)

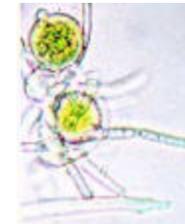


Soredia
(Asexual reproduction)

Dispersal,
Lichenization,
Establishment,
Colonization
Growth rate &
Longevity
of Lichens

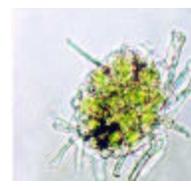
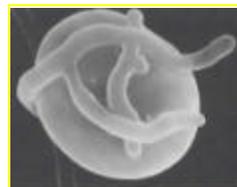
Establishment & Colonization

Ascospores germinate and recognizes its photosynthetic partner by Lectin (compound present in cell walls of algal partner)



Lichenization *in vivo*

Lichen spores associating with the right type of Photosynthetic partner and initiating lichenization



Lichenization
Photobiont *Trebouxia* cell
surrounded by fungal
hyphae

Important stages in lichen colony establishment

Dispersal,
Lichenization,
Establishment,
Colonization
Growth rate &
Longevity
of Lichens

Growth rate:

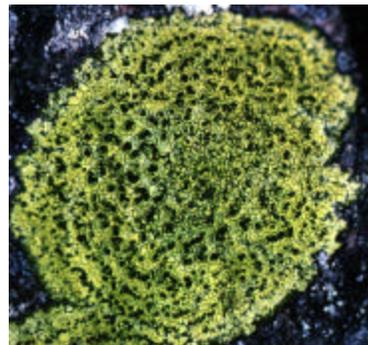
Crustose lichens grow very slow - 0.1 - 10 mm
Foliose & fruticose lichens grow - 2-4 cm



Lichen colonize compete for space. Crustose lichens compete foliose lichens for colonization

Longevity:

Crustose lichens have been estimated to be over 4,000 years old



Rhizocarpon geographicum



Lichen Distribution:

 **Worldwide**

 **Most extreme environments, from the Arctic to Antarctic, deserts to tropics, littoral zones to Mountain peaks**

 **Occur on soil, plants, animals, on or in rock, and on man-made structures**

 **Mainly in rural areas rather than cities**

 **Lichens are intolerant of atmospheric pollution, particularly Sulphur dioxide & Habitat modification**

LICHEN HABITATS

In the Earth “within a climatically uniform region each particular substrate tends to assume eventually a characteristic and often remarkably uniform lichen community”



Longevity of lichens

Botanical Record-Breakers (Part 1 of 2) - Microsoft Internet Explorer

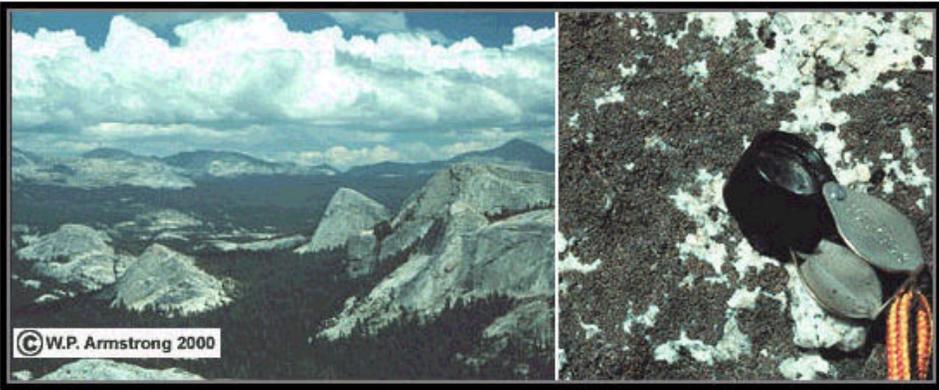
File Edit View Favorites Tools Help

Address <http://waynesword.palomar.edu/ww0601.htm#oldest> Go

Back Forward Stop Refresh Home Favorites Mail Print

day plants.

Many crustose rock lichens spend most of their lives in a desiccated state and have extremely slow annual growth rates. On massive domes and rugged peaks of the Sierra Nevada, large colonies of the lime-green map lichen (**Rhizocarpon geographicum**), ashy gray **Aspicilia cinerea**, and orange **Caloplaca saxicola** may be thousands of years old. In fact, the colorful chartreuse rock lichen **Acarospora chlorophana** may only grow a few millimeters in a century. One has only to gaze at the spectacular panoramas of glacier-carved granite throughout the Sierra Nevada to appreciate the magnitude of growth and the great age of some of these lichen colonies.



Left: Spectacular granite domes of Yosemite National Park in California's rugged Sierra Nevada are blackened by colonies of the crustose rock lichen **Lecidea atrobrunnea**. Close-up view of a hand lens and **Lecidea atrobrunnea**, a common crustose lichen throughout granite peaks and domes of the Sierra Nevada. The photo was taken at the summit Polly Dome, the highest dome in Yosemite National Park.

Done Internet

Lichen communities can be classified based on the substratum



Use hand lens



- Tree bark
- Rock
- Soil
- Leaves
- Logs
- Fence post
- Roof top
- Glass
- Insect
- Tortoise Shell



Types of Lichen Communities

 Corticolous and Lignicolous Communities

 Saxicolous Communities

 Terricolous Communities

 Follicolous Communities

 Animal Communities



Corticolous means on the “bark”

Lignicolous means on the “wood”

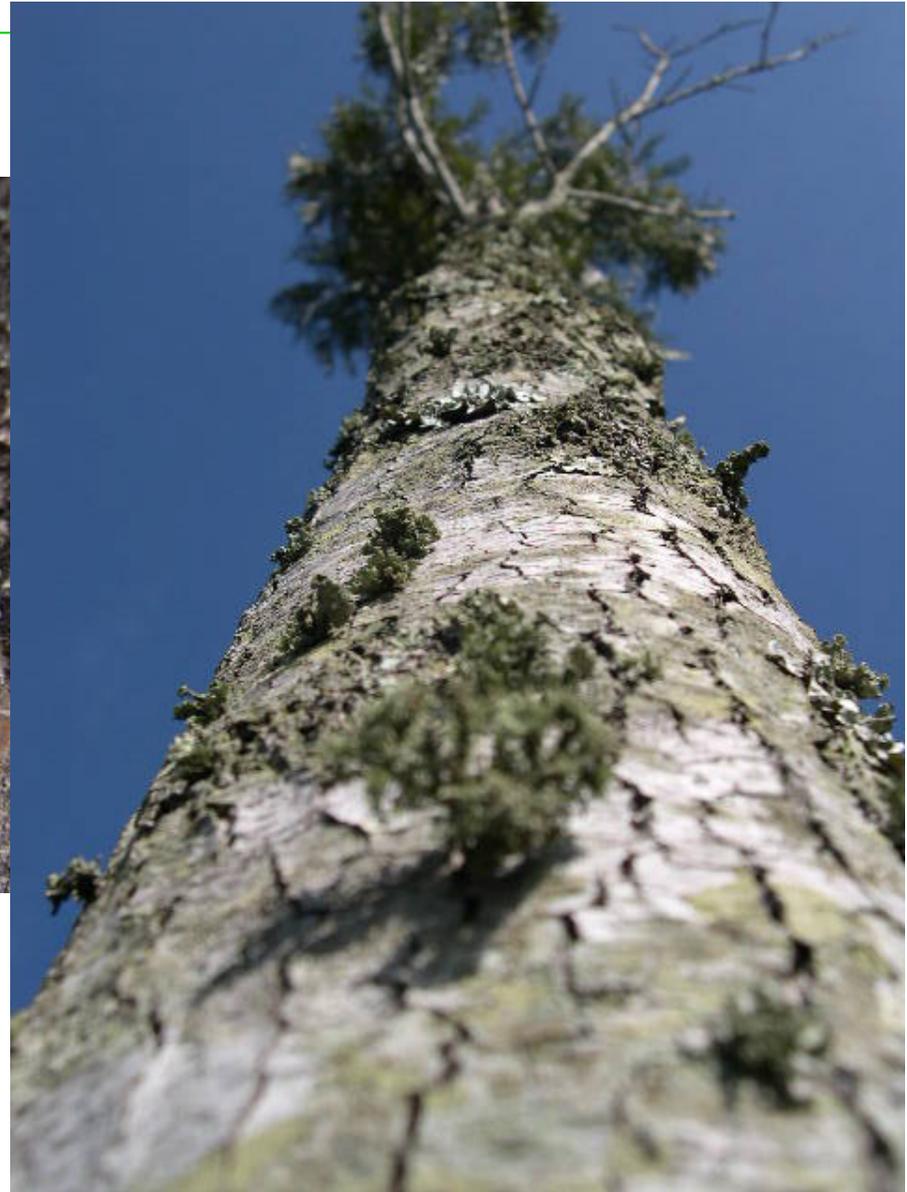
Environmental factors which regulate these communities include: Bark texture, pH, water- holding capacity, light/shade, RH etc.

LICHEN COLONIZING SUBSTRATES

Corticolous



Different types of Lichen communities occupy the tree base, trunk, upper and lower branches of the trees – vertical distribution of lichen communities on a tree.





Saxicolous Communities

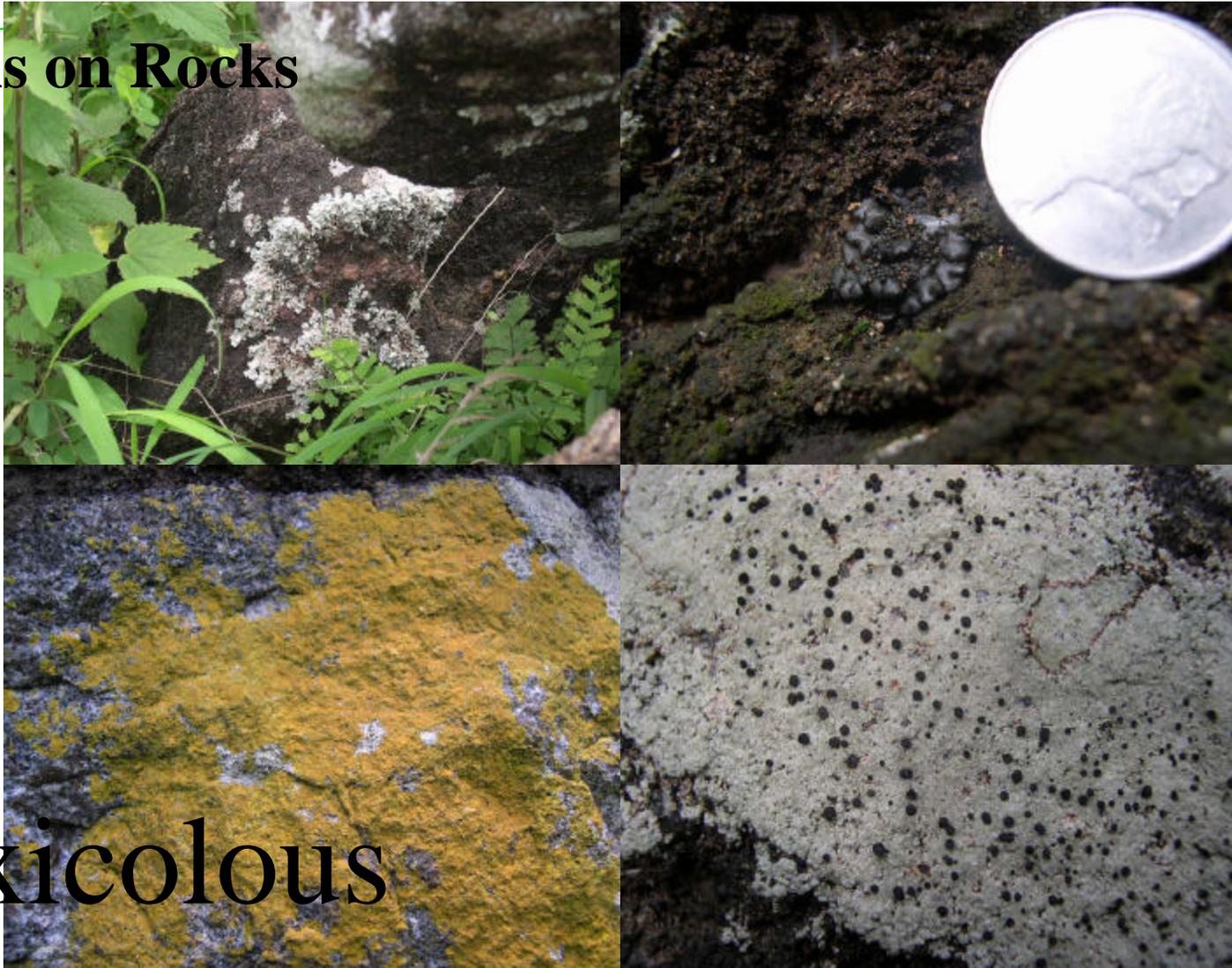
Major differences in rock lichen communities usually based on rock chemistry

Basic (high pH) rocks such as limestones

Acidic (low pH) rocks such as many sandstones, basalts, and gneiss rock types

LICHEN COLONIZING SUBSTRATES

Lichens on Rocks



Saxicolous

Saxicolous Communities (cont.)

Cryptoendolithic lichens occur inside the rocks

Mostly reported from Beacon Sandstones in the dry valleys of the Antarctic





Terricolous Communities

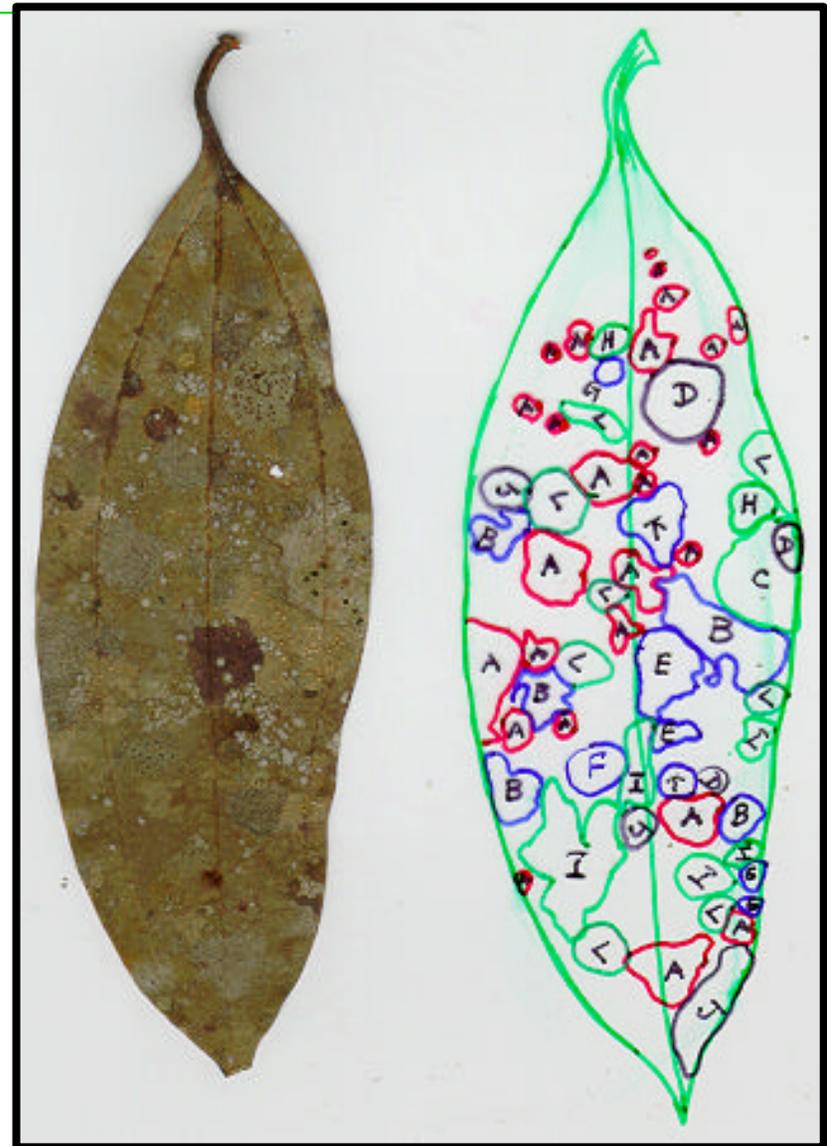
Form grass land like lichen mats in boreal/ arctic- alpine areas

Good studies on *Cladonia* and *Cladina* succession in abandoned fields (in North Carolina) has been carried out

LICHEN COLONIZING SUBSTRATES

Lichens on leaves

Follicolous



Animal Communities

Dirinaria and other taxa on the backs of *Galapagos* land tortoises

Lepraria (soredia) found on insect lacewings

Parmotrema and other lichens and algae are known from weevils in New Guinea



Lichens on a Weevil

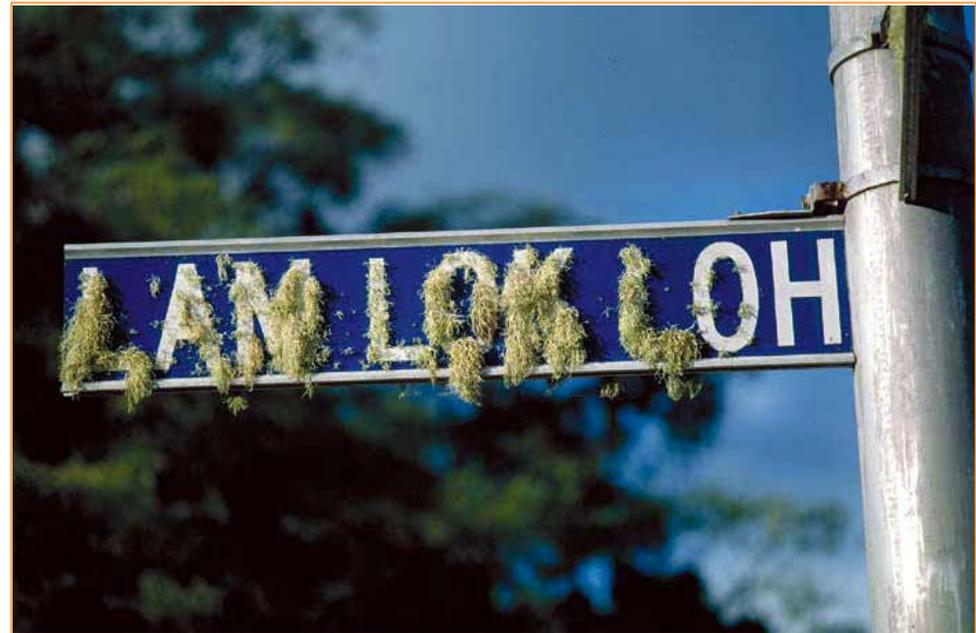


Galapagos land tortoises

Lichens on Man Made Substrates.....



Lichens on Asbestos



A street sign from Christmas Island in the Indian Ocean decorated with *Usnea*, a fruticose lichen

LICHEN COLONIZING ON MAN MADE SUBSTRATES



A lichen-covered Morris Minor from the south island of New Zealand.

On other substrates



On metal Wheel

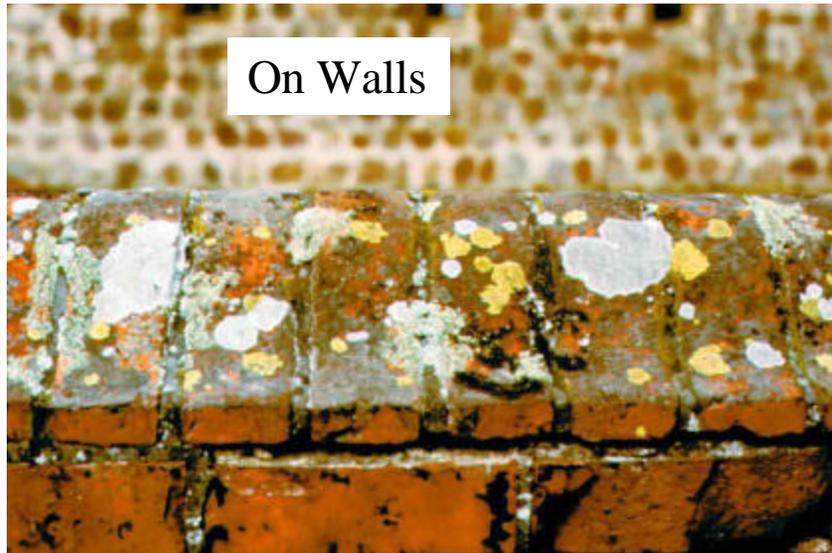


On Glass

LICHEN COLONIZING ON MAN MADE SUBSTRATES



On Roof Top



On Walls



On Fence posts

LICHEN COLONIZING ON MAN MADE SUBSTRATES



On gravestones

On gravestones lichens grow without any disturbance and are considered as a unique community.

Well studied lichen community in United Kingdom.

Ecological roles of Lichens

- ✍️ Pioneers in habitat colonization
- ✍️ Mineral cycling
- ✍️ Lichens in Food Chain & Web
- ✍️ Lichens & Invertebrates
- ✍️ Lichens & Vertebrates

We have indicated few examples with photographs of lichen association with vertebrates and invertebrates from other countries. In India our group (**M.S.Swaminathan Research Foundation**) has made observations on association of lichens with insects, birds and reptiles. Exploring our forests will bring out lot more information on lichen animal association, which is very vital to revise conservation strategies.



Succession

Primary Succession

If succession takes place on “new” habitat, then the process is termed **primary succession**

Examples: Glacial retreat, volcanic devastation, new land formation (such as 1963-1967 formation of the island of Surtsey off the coast of Iceland)

Secondary Succession

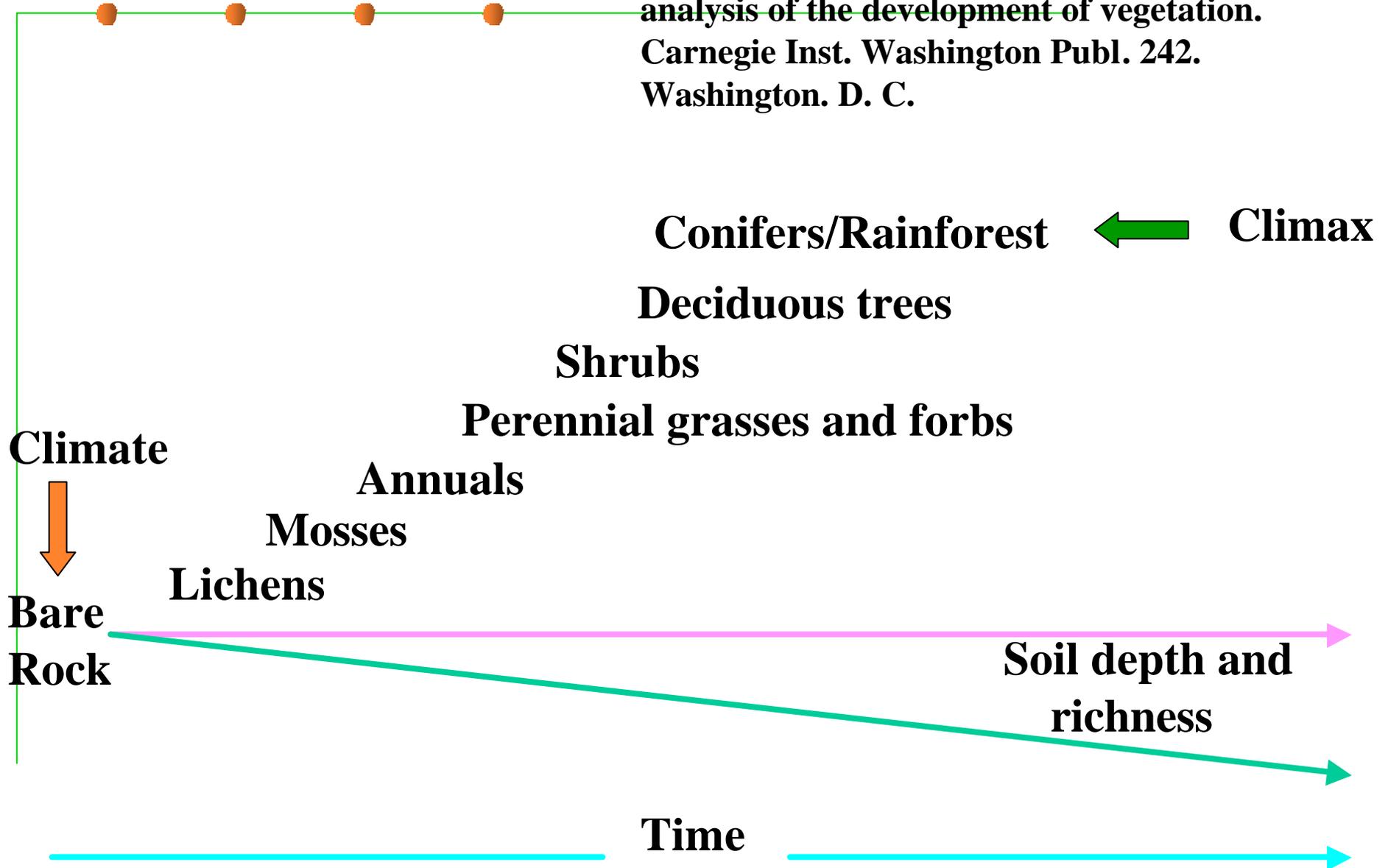
If there is “**disturbance**” which results in changes in the environment (fire, human intervention, floods etc.), the community makeup will respond through **succession** leading eventually back to a self-perpetuating or **climax** configuration

This process is called **secondary succession**

Lichens participate in both types of succession

Concept of the Sere

Model developed by
Clements, F. E. 1916. Plant succession. An analysis of the development of vegetation. Carnegie Inst. Washington Publ. 242. Washington. D. C.



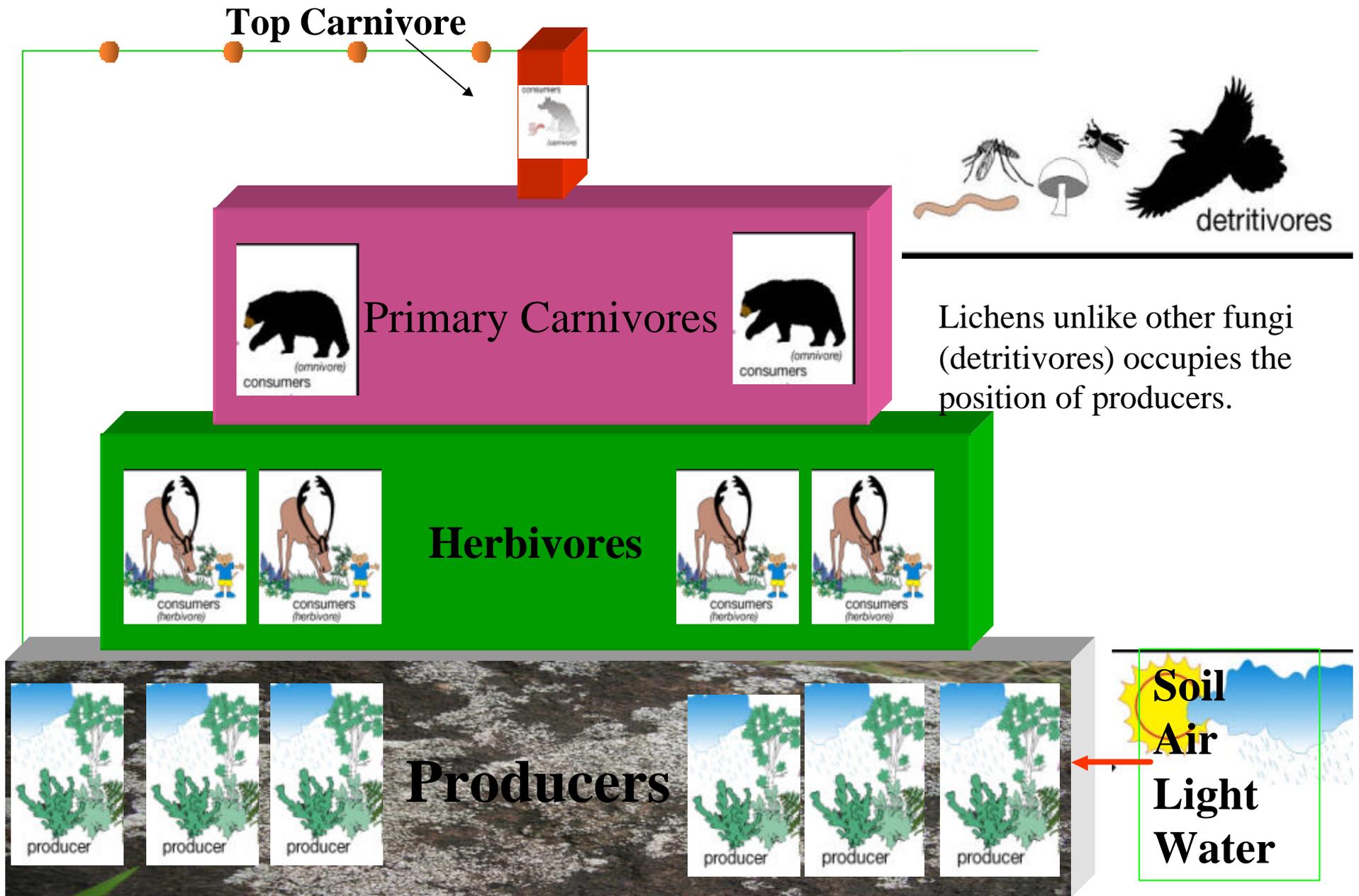
Lichens

Importance

- ✍ rock weathering, soil formation in primary succession
 - ✍ - acid secretion
 - ✍ - trapping particulates
 - ✍ - nitrogen fixation (cyanobacteria)



ROLE OF LICHENS IN FOOD CHAIN





Food Chain, Radioactive contamination and lichens

- **In the Arctic, lichens are important in the winter diets of reindeer and caribou.**
- **The lichens involved have low nutritional values but the lichens help the animals survive winter.**
- **After the nuclear reactor accident at Chernobyl in Russia many Scandinavian lichens, including those eaten by reindeer, absorbed large amounts of radioactive elements.**
- **As a result many reindeer became highly contaminated and their meat and milk was unfit for consumption by humans.**

LICHENS AND INVERTEBRATES

Protozoa - Soil Protozoa *Thecameoba* use lichen colonies as habitats

Nematoda – *Plectus cirratus* is a terrestrial form and known as Lichenophagous.

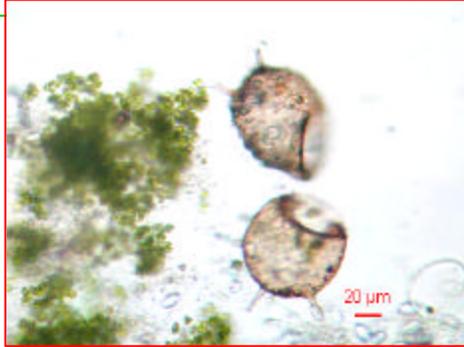
Rotifera – *Macrotrachela ehrenbergii* is Lichenophagous and live as a parasitic on lichens

Oligochaeta – *Lumbricillus* is Lichenophagous and live as a parasitic on lichen *Lichina pygmaea*

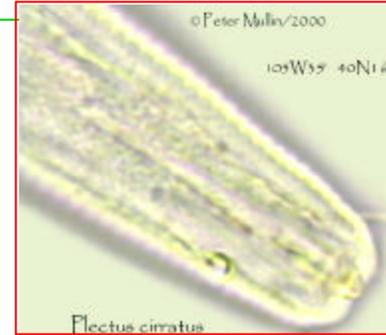
Tardigrada – *Hypsibius oberhaeuseri* is Lichenophagous and found on *Lobaria pulmonaria*

LICHENS AND INVERTEBRATES

Protozoa - *Thecameoba*



Nematoda – *Plectus cirratus*



Rotifera – *Macrotrachela ehrenbergii*



Oligochaeta – *Lumbricillus*



Tardigrada – *Hypsibius oberhaeuseri*



Tardigrade is a microscopic aquatic animal that lives in mosses and lichens

Home of Microarthropods

Mites, Tardigrads, Collembolans (springtails)

- That are barely detectable by human eyes (ranging between 0.1 - 5 mm in size).
- Their small size and large number of species – an estimated 10,000 species in more than 700 genera and 250 families in Canada alone – makes the study of microarthropods challenging
- They prefer lichens as a Boarding and Lodging facility
- Although expected to be a sub-sample of soil fauna, canopy fauna is unique to the branches, needles and lichen of the canopy.

There is a complex life system existing within a space of 5 cm on a rock.



Kocheril, Krishnamurthy & Mohanasundaram (1999) documented the diversity, distribution & nutritional status of Mites associated with lichens from Tamil Nadu & Kerala

LICHENS AND INVERTEBRATES

Mollusca– Gastropoda



Stock Island Tree Snail

**A tree snail grazing
on lichens**

<http://www.naturalwanders.com/molluskpictures.htm>



**The bivalve *Lasaea* living in intertidal inhabits
graze lichens**

LICHENS AND INVERTEBRATES

Insecta



Caterpillars mimicking as well as grazing a crustose lichen on a tree trunk.



Various species of Moths develop wing Colour similar to lichens – camouflage an adaptation to lichen rich habitats

Cryphia domestica

Association between

Chrysothrix chlorina (Deuteromycotina) & *Metisa* sp. (Lepidoptera: Psychidae)



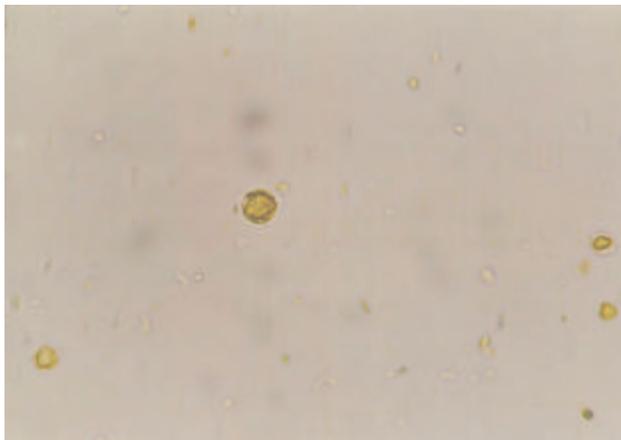
Benefits to Lichen species

Effective dispersal mechanism

Benefits to Insect species

Camouflage

Food



Trebouxia sp. isolated from the digestive tract of *Metisa* sp.

LICHENS AND INVERTEBRATES



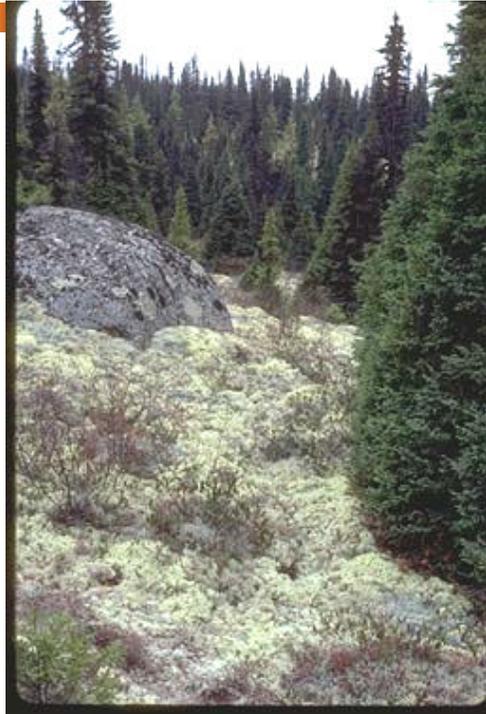
A **Grasshopper** mimicking foliicolous lichen growth as camouflage.



Spiny Leaf Insects *Extatasoma titarum* usually look like dead leaves.

This one lives on lichen-covered braches, and so has evolved camouflage to look like lichen.

LICHENS AND VERTEBRATES



Alectoria sarmentosa
Bryoria spp.
Cetraria ericetorum
C. islandica
Cladina arbuscula
C. mitis
C. rangiferina
C. stellaris
Cladonia amaurocraea
C. bellidiflora
C. coccifera
C. cornuta
C. gracilis
C. sulphurina
C. uncialis

**Soil colonizing lichen species
composition-grazed by various
vertebrates**

Flavocetraria cucullata
F. nivalis
Hypogymnia physodes
Lobaria pulmonaria
Masonhalea richardsonii
Parmelia sulcata
Peltigera aphthosa
Stereocaulon paschale
Tuckermannopsis ciliaris
Umbilicaria hyperborea
Umbilicaria. spp.



**These caribou are digging craters in the
snow to find the lichens**

Vertebrates known to eat lichens

**Caribou, Deer, Elk, Ibex, Gazelles, Musk oxen,
Mountain goats, Polar bears, Lemmings, Voles, Tree
mice, Marmots & Squirrels**



Adaptations of animal groups in Lichen rich habitats

Camouflage and Mimicry:

Mimicry (also known as **mimetism**) describes a situation where one organism, the **mimic**, has evolved to share common outward characteristics with another organism, the **model**, through the selective action of a **signal-receiver** or "**dupe**". Collectively this known as a **mimicry complex**.

Camouflage, in which a species appears similar to its surroundings, is essentially a form of visual mimicry, but usually is restricted to cases where the model is non-living or abiotic.

Lichens and Vertebrates

Amphibians



Triturus marmoratus (Marbled newt)



Aneides aeneus (Green Salamanders)



Hyla versicolour

Evolved an effective camouflage which resembles lichen covered trees or rocks

Reptiles



Uroplatus fimbriatus
(Leaf-tailed Gecko)

Lichens and Vertebrates - **Birds & lichens**



Archilochus colubris
(Hummingbird)



- **Birds use lichens for nest building**
- **Use cob-web to stick lichen thallus fragments on the outer surface of the nest to Camouflage nests in its background**
- **To protect it from its predators**
- **Feeding behavior**

IMPORTANT REFERENCES

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