Conservation of Lichens

Why Lichens require special conservation measures?

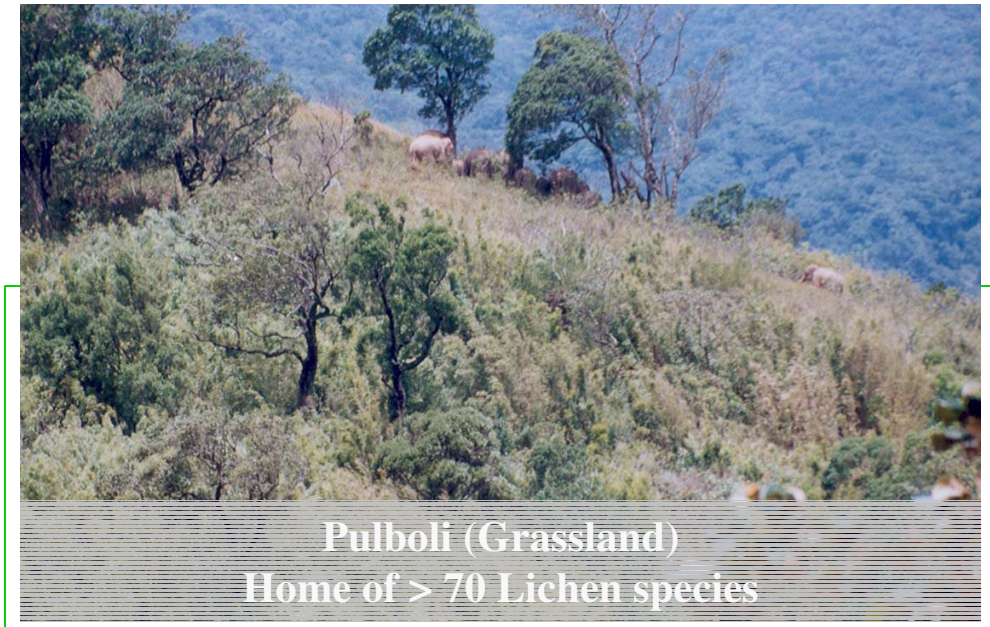
- Lichens are Eukaryotic microbes - that have genetic stability and also behave like microbes.
- Most of them are very tiny (Microlichens), and hence it is not possible to immediately notice the loss of species, changes in distribution pattern.
- They quickly respond to air pollution and habitat changes.
- Habitats where macro organisms do not colonize normally (rocky terrains, extreme environments, man-made structures) are very important for Lichens.
- Many of their community dynamics and succession patterns have not been fully studied.

Why Lichens require special conservation measures?

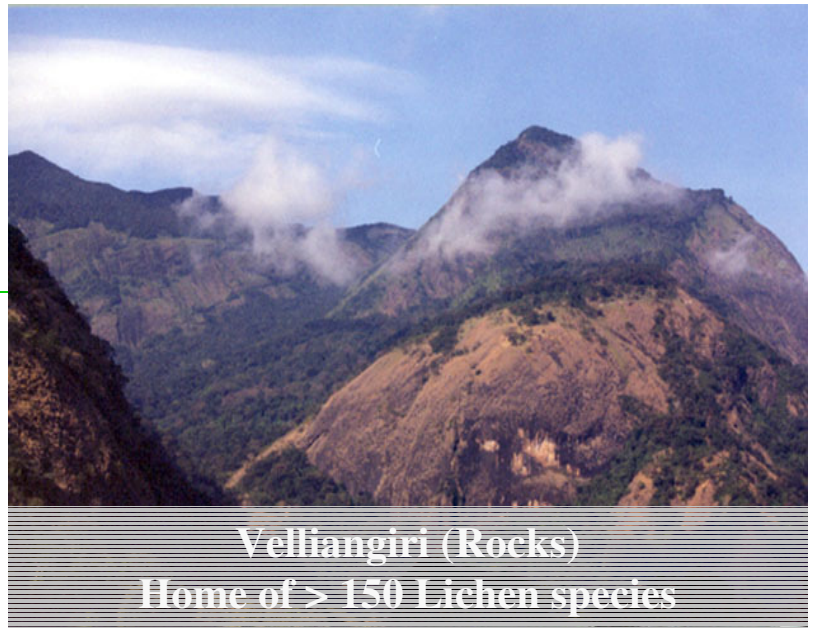
•Their ecological roles and requirements are totally different from those of the macro-organisms. And often without lichens the survival of macro-organisms is in danger.

•Lichens are well known for their adaptations to extreme environments and their ability to colonize newly exposed substrata such as lava flow and glacial retreat but they cannot withstand natural and man-made hazards.

•Lichens are vital components of ecosystem function regulating the water cycle, mineral cycling (nutrient cycling).



Pulboli (Grassland)
Home of > 70 Lichen species



Velliangiri (Rocks)
Home of > 150 Lichen species

Many areas with a high conservation value for flowering plants may also have a high value for lichens and bryophytes, the reverse is not always true.

Grasslands/Rocky areas with no conservation value when it comes to flowering plants may still be rich in lichens.

Ignorance of the environmental importance of lichens means that such areas may be overlooked during conservation assessments.

IGNORANCE!

Still there is much more to learn about Indian lichens—their diversity, Biology, Ecology.

In Tamil Nadu only four study sites have been intensively surveyed for its lichen diversity.

Ecological sampling for lichen diversity and its distribution pattern from unexplored locations will reveal many new species, their association and silent ecological functions.

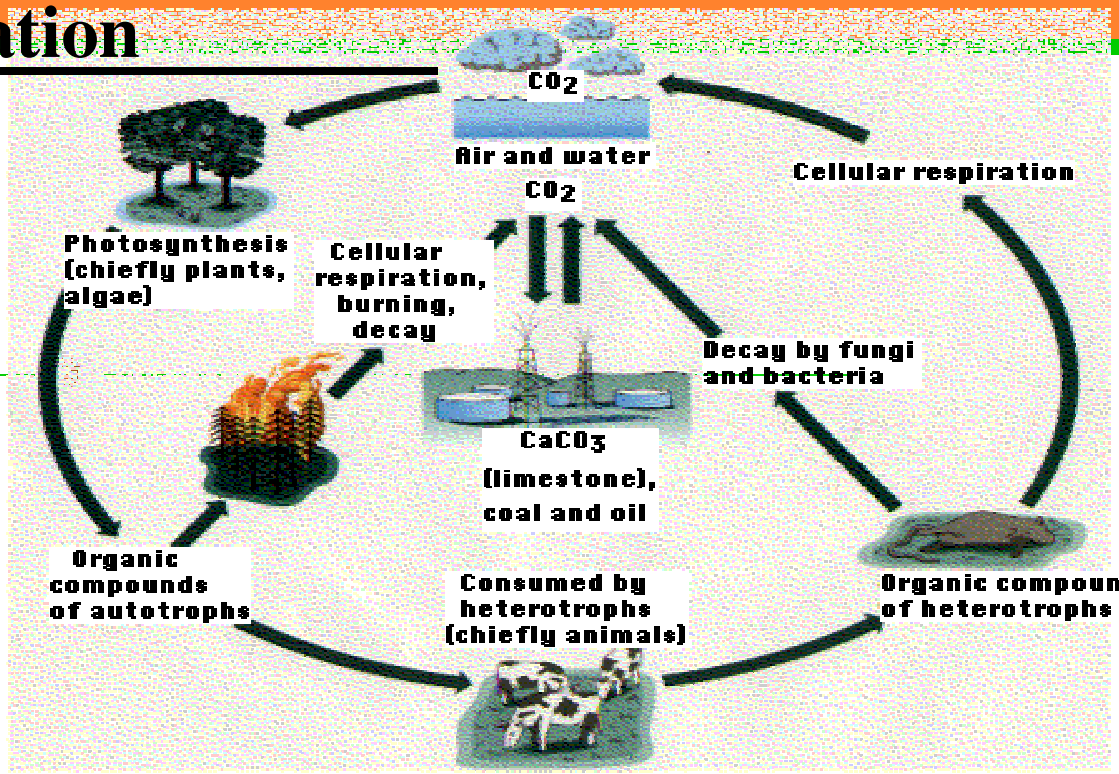
This means that Conservers often lack the information on lichens in prioritizing Conservation decisions.

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.

Carbon sequestration



http://users.rcn.com/jkimball.ma.ultranet/BiologyPages/C/CarbonCycle.gif


Parmotrema sp.,


Ramalina sp

Lichens are autotrophs

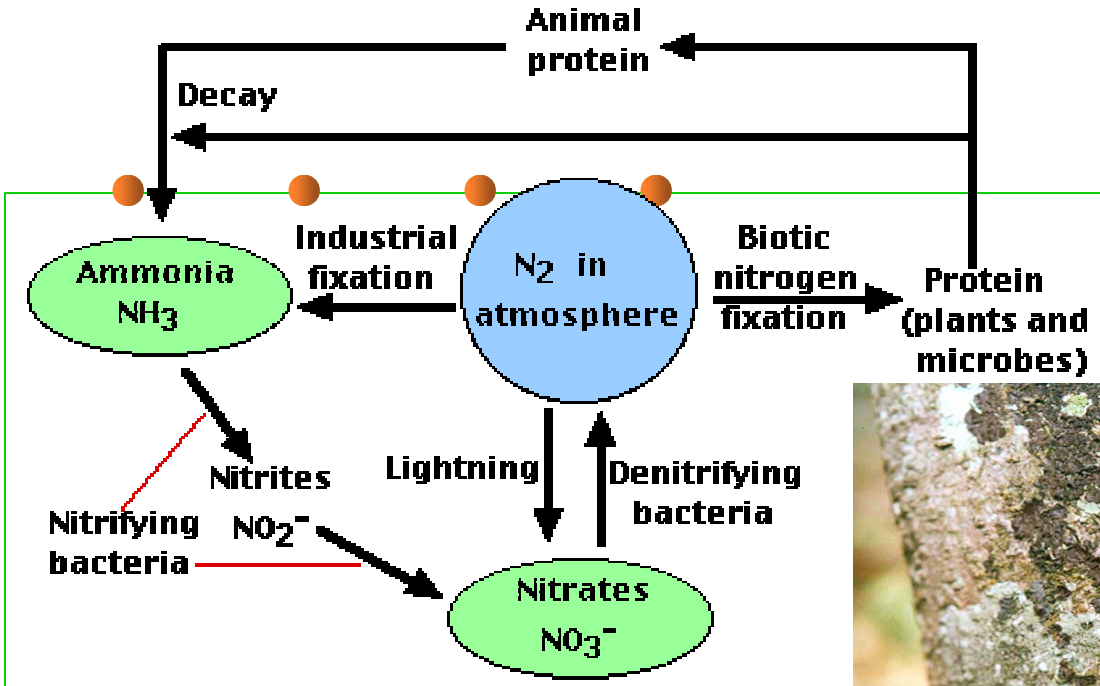
Lichens play an important role in Carbon sequestration.

They have metabolic pathways that can sequester excess Carbon as secondary compounds.

The production and storage of secondary compounds enables carbon retention upto a threshold of 30% of its body weight.

They have specialized genes such as Polyketide synthase to convert carbon into secondary compounds

Who is fertilizing the forests???



Leptogium sp. has cyanobacteria (*Nostoc* sp.) as its photosynthetic partner which is capable of fixing atmospheric N_2.

Leptogium sp.

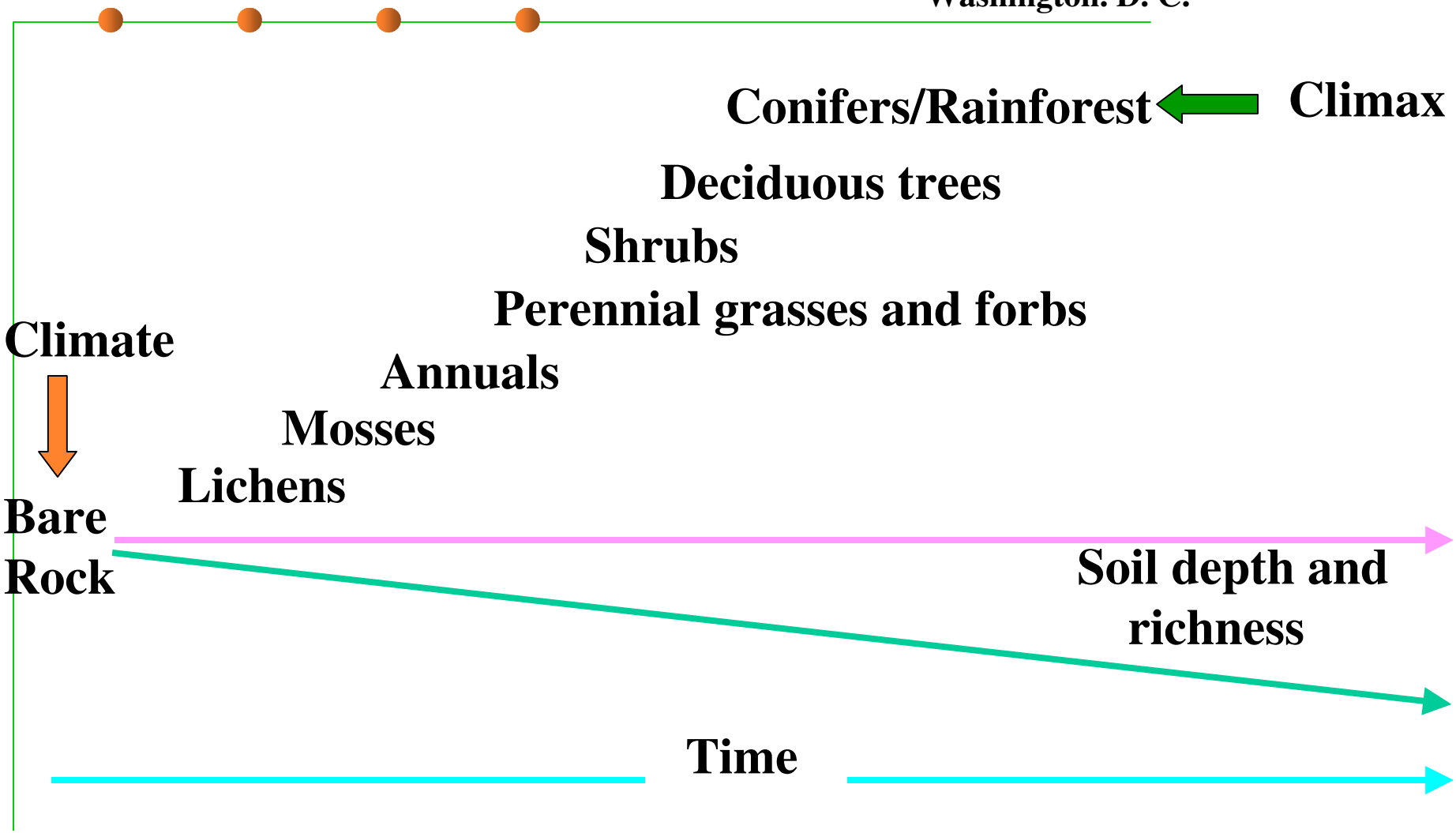
- Fixing Nitrogen and fertilizing the forest soil.
- Mineral cycling in lichen thalli growing on rocks are involved in the Pedogenesis process where top soil formation and reclamation occurs.

Soil formation

- Lichens are involved in Rock weathering
- Soil formation in primary succession mediated by secondary compounds that are Acidic in nature and are capable of degrading rock particles.
- Trapping atmospheric particulates and radionuclide deposits within rocks.

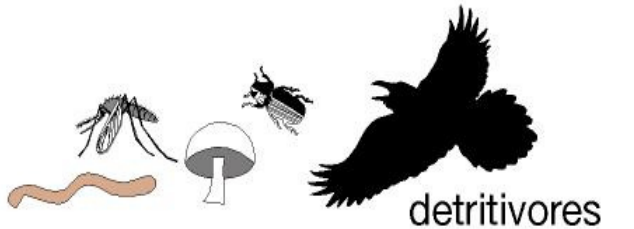
Lichens are the first colonizers of rock and newly formed habitats initiating soil formation

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



ROLE OF LICHENS IN FOOD CHAIN

Top Carnivore

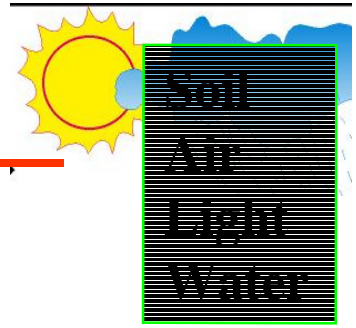


Primary Carnivores

Lichens unlike other fungi (Detritivores) occupies the position of producers.

Herbivores

Producers



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**" that 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

LICHENS AS HOME FOR INVERTEBRATES

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

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

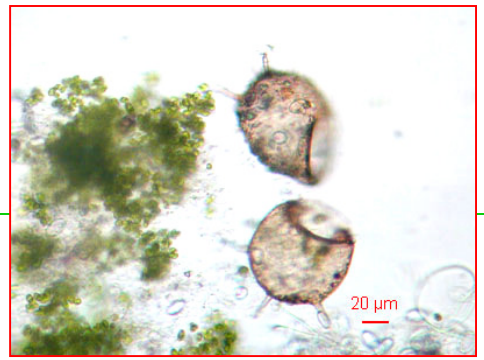
Rotifera – *Macrotrachela ehrenbergii* is Lichenophagous and live as a parasite on lichens

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

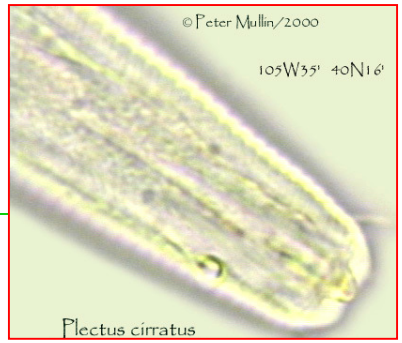
Tardigrada – *Hypsibius oberhaeuseri* is Lichenophagous and found on *Lobaria pulmonaria*

LICHENS SERVE AS HOME FOR INVERTEBRATES

Protozoa - Thecameoba

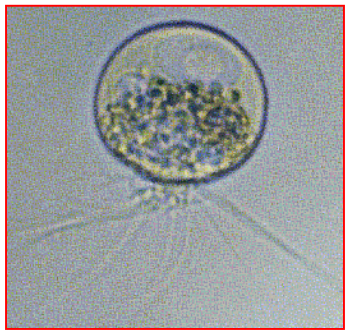


Nematoda – *Plectus cirratus*



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)

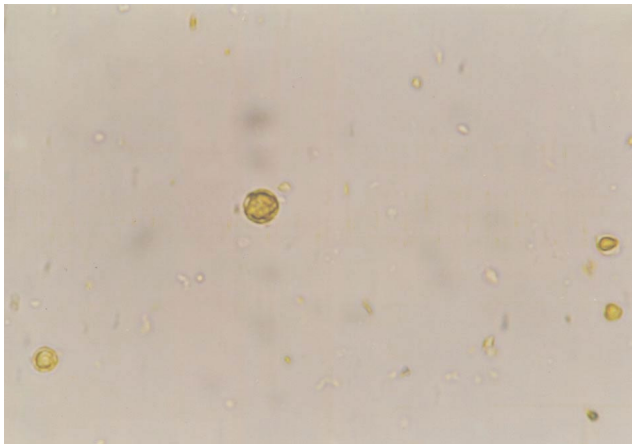
There is a complex life system existing within a space of 5 cm on a rock.

- **Mites, Tardigrads, Collembolans (springtails) 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.**

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

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

Insecta

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

Cryphia domestica

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

LICHENS AND INVERTEBRATES

Mollusca– Gastropoda

A tree snail grazing on lichens

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

The bivalve *Lasaea* living in intertidal inhabits graze lichens

COEVOLUTION OF 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.

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**".

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

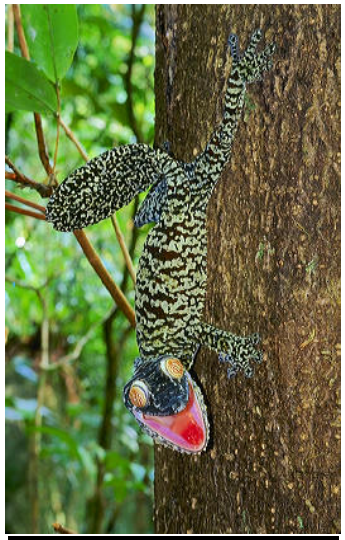
Evolved an effective camouflage that resembles lichen covered trees or rocks

***Triturus marmoratus* (Marbled newt)**

***Aneides aeneus* (Green Salamanders)**

Hyla versicolor

Calotes versicolor



Uroplatus fimbriatus
(Leaf-tailed Gecko)

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

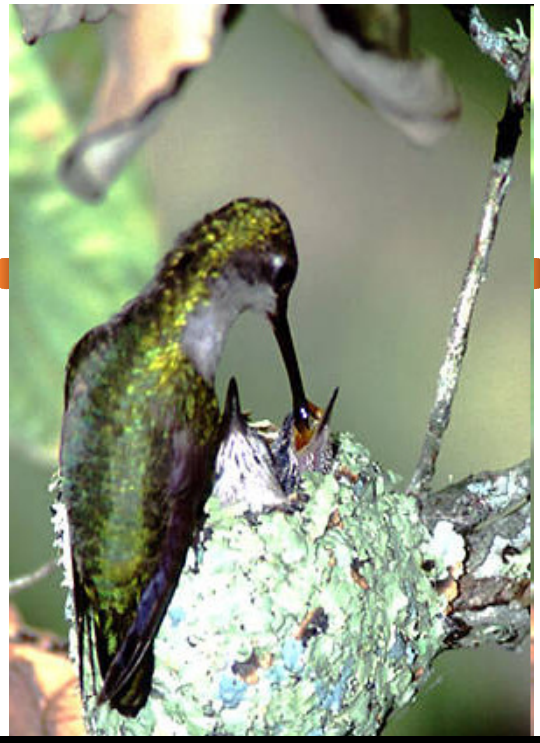
Flavocetraria cucullata
F. nivalis
Hypogymnia physodes
Lobaria pulmonaria
Masonhalea richardsonii
Parmelia sulcata
Peltigera aphthosa
Stereocaulon paschale
Tuckermannopsis ciliaris
Umbilicaria hyperborea
Umbilicaria. spp.

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

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**

INTERNATIONAL INITIATIVES ON THE CONSERVATION OF LICHENS

- Forest Health monitoring program – Lichens as indicators of air pollution / United States Department of Agriculture / USA. www.fs.fed.us/r6/aq/lichen
- "MYCONET" a database on the development of fungal classifications developed and maintained at the Field Museum, Chicago, USA. http://www.fieldmuseum.org/myconet/
- European guidelines for mapping lichen diversity as an indicator of Environmental stress. http://www.thebls.org.uk/content/documents/eumap.pdf
- IUCN – Red Database / Books on Endangered species of Lichens http://www.iucnredlist.org
- A global information system for the Biodiversity of lichens and lichenicolous fungi.

http://www.biologie.uni-hamburg.de/checklists/lichens/portalpages/portalpage.htm

Weblinks relevant to Lichen Associations around the world

- British Lichen Society / http://www.thebls.org.uk/
- International Association of Lichenologists, http://lichenology.org
- Swedish Lichen Society, http://www.sbf.c.se/slf/slf.htm
- Dutch Bryological and Lichenological Society, http://www.nordiclichensociety.org/Links/www.blwg.nl%20on%20
- Bryological and lichenological society of Middle Europe, http://www.blam.privat.t-online.de/
- Research group at South Bohemia, http://botanika.bf.jcu.cz/lichenology/

Weblinks relevant to Lichen Associations around the world

- **Bryological and Lichenological section of the Czech Botanical Society, http://botanika.bf.jcu.cz/BLS/english/online_en.html**
- **Lichenology in the Netherlands, http://www.biodiv.nl/lichens/index.htm**
- **Swiss Association of Bryology and Lichenology, http://www.bryolich.ch/english/index_engl.html**
- **Societa' Lichenologica Italiana, http://dbiodbs.univ.trieste.it/sli/home.html#sli**
- **Association Française de Lichénologie, http://www.lichenologie.org/**
- **American Bryological and Lichenological Society, http://www.abls.org/**
- **Hattori Botanical Laboratory of Japan, http://www7.ocn.ne.jp/%7Ehattorib/**

Lichen Conservation Initiatives in India:

- There is no special initiative to conserve lichen diversity.

- Conservers are of the opinion that conserving macroflora and fauna also implies conservation of lichen diversity – (But lichens demand some special conservation strategies)

- 5% of the total Indian land area has been surveyed for lichens by qualitative method.

Lichen conservation… The Way Ahead

- There is a dearth of data on Lichen from the Districts of Tamil Nadu
- Inventorying, documenting the lichen rich environments in areas of Western Ghats, Eastern Ghats, Mangroves and other forest areas to devise 'Doable Lichen Centric' conservation strategies.
- Implementation of clean air acts.
- Biologically rich fragmented sites in lichen rich locations require special conservation efforts.
- Identifying specific threats to different lichen communities such as soil lichens and implementing suitable remedies.
- Developing simplified illustrated Lichen identification manuals
- Create awareness about lichens and the need to conserve them at appropriate levels.