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Bryophytes and Lichens: Small but Indispensable Forest Dwellers

What is a Bryophyte?

Bryophytes are the small green plants commonly known as mosses, liverworts and hornworts. Compared to plants, they have primitive tissues for conducting food and water, and they lack a protective outer surface to maintain water balance. Most bryophytes, because they lack tissues such as roots, obtain their water through direct surface contact with their environment. During dry weather they have the capacity to withstand complete dehydration. Bryophytes that are dry may appear dead but will regain normal function when moisture is available. Instead of producing seeds, bryophytes can either reproduce sexually by means of spores, or asexually when small pieces break off and grow into new individuals.

liverwort

conehead liverwort
Conocephalum conicum

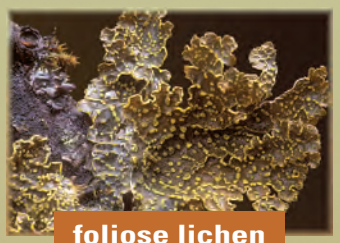
hornwort

dotted hornwort
Anthoceros punctatus

juniper haircap moss
Polytrichum juniperum

mosses

Douglas' neckera
Neckera douglasii



foliose lichen

yellow specklebelly
Pseudocyphellaria crocata

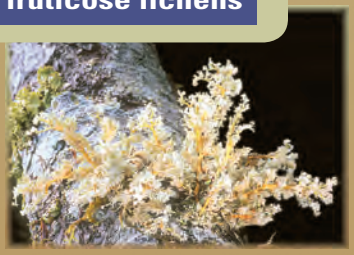
What is a Lichen?

Lichens are dual organisms consisting of a fungus and an alga or a cyanobacterium. The fungus provides the alga with structure, protection, nutrients, and water absorbed from the atmosphere and the substrate (e.g., soil, rotten logs, tree branches). In return, the alga provides carbohydrates from photosynthesis to the fungus. Algae from some lichens grow independently of the fungus, but in lichen form, the algae can inhabit more challenging environments than when growing alone. Most lichens can reproduce asexually. They either produce specialized propagules containing both partners, or parts of the lichen simply break, allowing both the fungus and the alga to disperse together. In some lichens, the fungal partner reproduces sexually by releasing spores, but the partner alga must be present in order for a lichen to reform.

Lichens are grouped into three categories of shape: foliose (leaf-like), fruticose (shrub-like), and crustose (growing closely attached to a surface).

fruticose lichens

Devil's matchstick
Pilophorus acicularis



clustered coral
Sphaerophorus globosus

crustose lichens

map lichen
Rhizocarpon geographicum

bullseye lichen
Placopsis gelida

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Cryptogams

Bryophytes and lichens, collectively referred to as non-vascular cryptogams, are important components of forests and other ecosystems around the world. They are especially conspicuous in forests of the Pacific Northwest. Despite their small size, cryptogams are abundant, and by draping tree branches and trunks and carpeting the forest floor, logs, and rocks, they provide much of the unique aesthetic appeal of Pacific Northwest forests. Their combined biomass on some rainforest trees may exceed the biomass of leaves or needles on those trees. A close look at a single branch or tree trunk provides only a hint of the enormous diversity of these organisms. Washington's Olympic Peninsula alone is home to more than 1000 species. Without cryptogams, the forest would lose much of its visual beauty and many essential ecological functions that cryptogams provide.

The various habitat niches of a big leaf maple, from the ground through the canopy, contain a diversity of cryptogams. These resident cryptogams, in turn, benefit the maple by fixing nitrogen, and moderating loss of water and nutrients. Some common species are: Left side from top to bottom — *Graphis scripta, Frullania nisquallensis, Antitrichia curtipendula, Anthoceros punctatus.* Right side from top to bottom — *Ramalina farinacea, Porella navicularis, Rhytidiadelphus loreus, Peltigera britannica.*

Hydrology

Bryophytes absorb water like sponges. Moisture from fog and rain is collected by cryptogams growing on branches in the canopy, tree trunks, and the ground. Consequently, cryptogams slow the rate at which water is lost from the forest ecosystem. In addition, they reduce erosion, a process that can that can wash away soil nutrients, damage the forest floor, and adversely affect the integrity of streams.

courtesy of Erik Ackerson

◁ Seaside kidney fixes nitrogen. When the outer layers are eaten by animals, a bright yellow interior is revealed. ▷

seaside kidney
Nephroma laevigatum

Microclimate

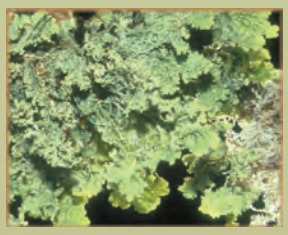
Water stored in bryophytes and lichens evaporates slowly, and helps to maintain a humid environment in forests long after rainfall has ceased. This is important not only for the growth of cryptogams, but also for plants. As evaporation of water from leaves exceeds rates of water transport from the roots, plants begin to close the small pores in their leaves that allow gas exchange. This conserves water at the expense of reduced photosynthesis. In the humid conditions created by cryptogams, plant leaves lose less water so they can keep their pores open longer and continue photosynthesizing.

courtesy of Erik Ackerson

Nutrient Cycling

Lichens play an especially important role in forest nutrient cycling. Low soil nitrogen is typically a limiting factor for plant growth in Pacific Northwest forests. Lichens with cyanobacterial partners, such as seaside kidney (*Nephroma laevigatum*) and lettuce lung (*Lobaria oregana*), are able to 'fix' nitrogen. This means they can convert nitrogen gas directly from the air to a usable form, something that vascular plants cannot do. Many lichens grow on tree branches, but may be knocked to the ground during storms. When these lichens decompose, the nitrogen leaches into the soil and becomes readily available for other plants. Lichens and bryophytes concentrate various nutrients deposited from the atmosphere, which in turn become available to other plants when they are leached by rainfall. Many organisms depend on lichens for food. This is another way in which nutrients assimilated by lichens cycle in the forest. Rodents eat ground-dwelling lichens, whereas elk and deer are especially fond of nitrogen-rich lichens such as lettuce lung. A bright yellow color on seaside kidney is an obvious sign of consumption by animals; the outer rich layer has been eaten, which exposes the less succulent and less nutritious yellow interior.

Intriguing Facts About Bryophytes and Lichens



lettuce lung
Lobaria oregana

◁ It has been estimated that lettuce lung provides an average of 3.2 kilograms of nitrogen each year for each hectare of Pacific Northwest forest.

Sphagnum sp.

◁ Some bryophytes, such as Sphagnum moss, can hold up to seven times their weight in water.

courtesy of Erik Ackerson

common witch's hair
Alectoria sarmentosa and *Bryoria* sp.

△ Lichens, such as common witch's hair, frequently obtain moisture from fog, helping it thrive near the timberline on Mt. Hood in Oregon.

▷ Native Americans made the poisonous horsehair lichen edible by steaming it in a pit oven for two days.

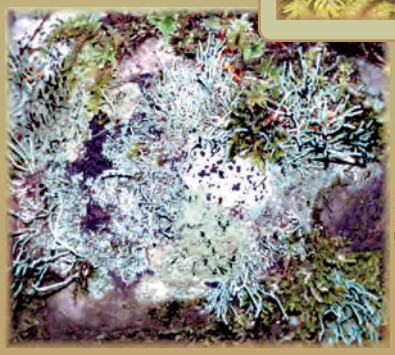
horsehair lichen
Bryoria fremontii

stair-step moss
Hylocomium splendens

◁ The age in years of stair-step moss can be determined by counting the number of "steps."

▽ Seemingly lifeless lichens and bryophytes become photosynthetically active within minutes after wetting.

roof screw moss
Tortula ruralis



courtesy of Erik Ackerson

△ A variety of bryophytes and lichens are able to grow on a surface (substrate) as inhospitable as rock.

ochre disk crust
Ochrolechia laevigata

courtesy of Erik Ackerson

▷ Alder bark is naturally red-brown but appears white because it is covered by lichens, such as the ochre disk crust.

◁ The work of a botanist! Exploring the realms of cryptogams often entails a very close examination of the subject matter.

Shelter

Many invertebrate animals, such as some insects, make their homes in mats of bryophytes and lichens. Invertebrates hiding amongst these cryptogams are a food source for various birds that may also take advantage of the natural nesting sites afforded by cryptogams or use them as a source of materials for nest building.

courtesy of Tom Hamer

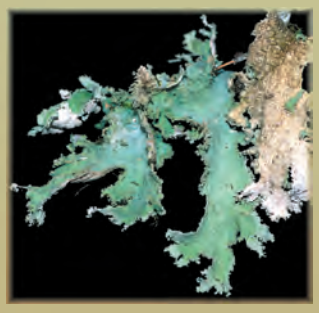
Many species such as the marbled murrelet (left), rufous hummingbird (above), and winter wren (right) use mosses for nesting material.

Special Species Discovered on the Olympic Peninsula

Some rare bryophyte and lichen species have been found recently in and near Olympic National Park, northwestern Washington.

▻ Flag moss –
This moss has been found only three locations in Washington.

flag moss
Discelium nudum



old-growth specklebelly
Pseudocyphellaria rainierensis

◅ Old-growth specklebelly –
A Pacific Northwest endemic, this lichen occurs only in very old forests. Over twenty new locations have been discovered on the Olympic Peninsula, some with large, healthy populations.

▻ Northern fan coral –
This lichen was not previously known from the lower 48 states, but is now found in the Olympic National Park.

northern fan coral
Bunodophoron melanocarpum

▻ Goblin gold –
Some of the largest and healthiest known populations of this rare moss are on the Olympic Peninsula.

goblin gold
Schistostega pinnata

▻ Bent-kneed four-tooth –
This rare moss is found in association with decayed logs and other large woody debris.

bent-kneed four-tooth
Tetraphis geniculata

common scissorleaf
Herbertus aduncus

◅ Common scissorleaf –
A rare liverwort found in forested coastal bogs.

cat-tail moss
Isothecium myosuoides

common witch's hair
Alectoria sarmentosa

Conservation

Bryophytes and lichens lack many structural barriers common to plants that limit entry of water, gases, nutrients and harmful substances. Many species are sensitive to air pollution and have been used as biological indicators of change. Sensitive species exposed to pollutants have a stunted, aberrant appearance, and slowed growth rates. Common witch's hair is a sensitive species commonly found in Pacific Northwest forests.

Many impoverished bryophyte and lichen communities in the eastern United States are recovering thanks to cleaner air in the last few decades.

The greatest risks to the vast biodiversity represented by moss and lichen communities are poor air quality and loss of critical habitats. These issues are mainly societal, and the fate of these special organisms is a factor to consider as people make individual decisions that shape our world.

Photography, except as noted, by Martin Hutten

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