Red Oak Lichens

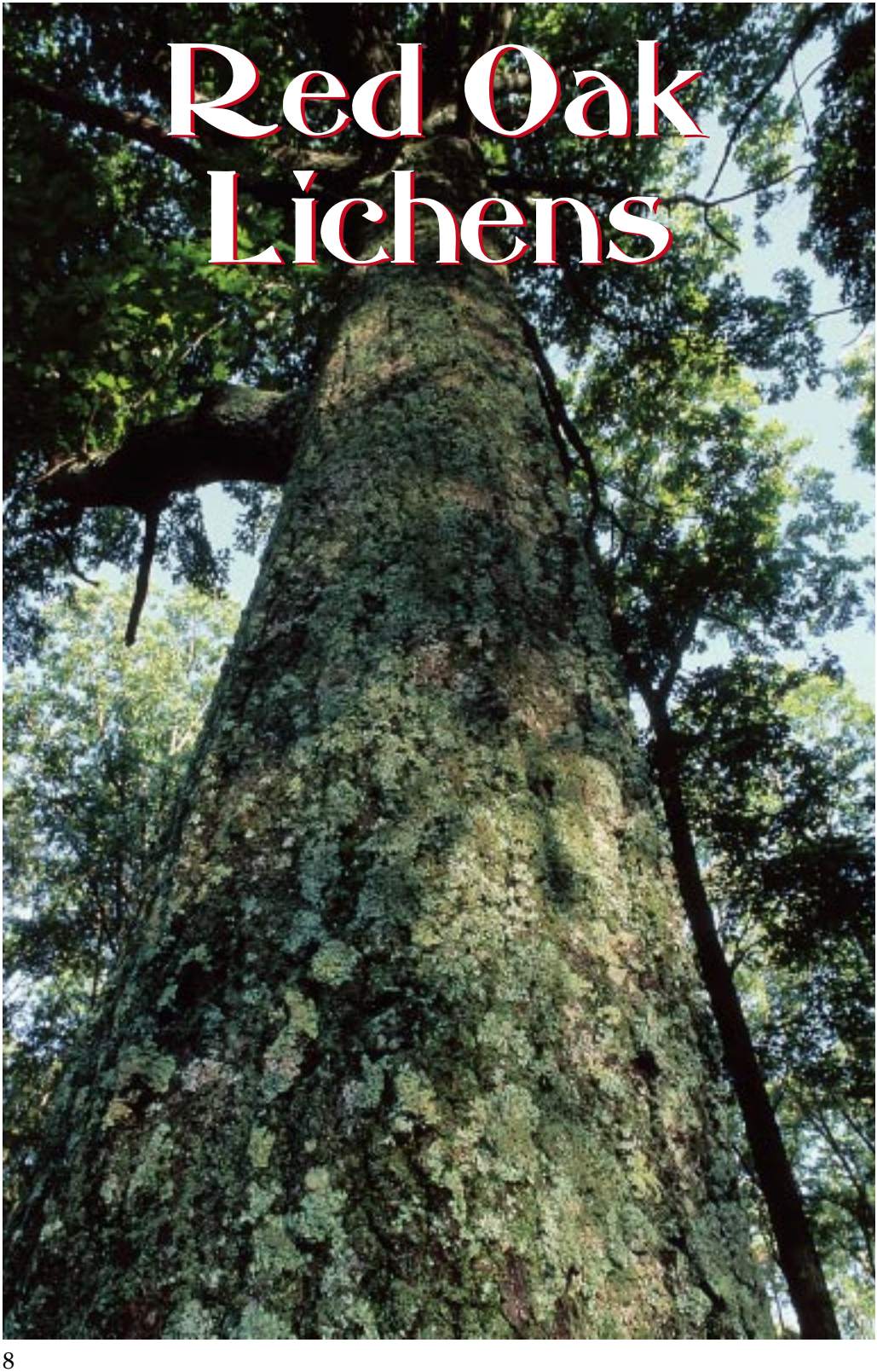

Photo by Bill Byrne

Red oaks are among the most common of the great deciduous trees of New England, renowned for their beauty, lumber and the mast they provide. While squirrels, deer and bear visit these trees for food, a host of lichens utilize their bark and branches as permanent habitat. Learning to identify a few of these obscure, symbiotic organisms can add a new dimension to your enjoyment of many forest habitats.

by Roger Monthey, Constance Stubbs and Stephen Sharnoff

Lichens are among the most unique and interesting life forms on the planet. They are symbiotic organisms consisting of a fungal partner and an algal partner or cyanobacterium. The fungal threads, or hyphae, surround and even grow into the algal cells, while providing most of the lichen's bulk and shape. Lichens absorb water, carbon dioxide and minerals from rainfall and atmospheric moisture. These substances and oxygen are absorbed by fungal hyphae and passed to algal cells. The algal cells, through photosynthesis, manufacture the carbohydrates necessary for the nutritional health of both the fungal and algal partners.

Lichens form a beautiful tapestry on our forest trees in New England, but look for them also on downed logs and branches, rocks, soil and other habitats. They grow on a wide variety of substrates in a variety of growth forms including foliose, fruticose, and crustose [see *Massachusetts Wildlife*, #3, 1997]. Foliose forms are leafy and spread horizontally over substrates. They anchor themselves with root-like threads called rhizines. Fruticose forms are shrubby or beard-like. They may be erect or pendulous and can easily be removed by hand. Crustose forms are encrusting and spread over and into the surface of the substrate on which they grow. They cannot be removed by hand without crumbling.

Many woodlot owners in New England have northern red oak, *Quercus rubra*, growing on their properties, and certainly anyone who hikes or hunts in the forests of Massachusetts should know these familiar and important mast producing trees. Most folks tend to take them for granted, noticing only their lobed leaves, large size and prolific acorns, but stop and examine one even briefly and all sorts of those strangely colored and mysteriously shaped vegetative growths known as lichens can be discerned on their bark and branches. What are these lichens doing there and what purpose do they serve?

The trunk of this mature red oak provides an ideal substrate for a large variety of lichens, all of which must compete for living space.

Irwin Brodo, Sylvia Sharnoff and Stephen Sharnoff published Lichens of North America in 2001. Among the many interesting things the authors reveal about our native lichens in this book is the fact that these seemingly insignificant life forms are an important component of forest ecosystem function and diversity. Lichens are colonizers of tree bark, as well as other wood, dead vegetation, mosses, rock, soil, leaves and manmade structures. Those growing on trees absorb nutrients from rainwater, influence humidity levels by absorbing and then releasing rainwater and dew, and some species with specialized cyanobacteria contribute fixed nitrogen to ecosystems. Lichens also serve as food for many animals, as nesting material for many birds and mammals, and as camouflage and shelter for small, mostly invertebrate animals that live in lichen-covered habitats.

There are thousands of species of lichens worldwide, and few people have the inclination or determination to learn how to identify even a few hundred of them. That many species lack common names and must therefore be remembered by their scientific Latin names further compounds the public relations problem that lichens face. In the interest of creating a little more passion for these symbiotic miracles, we thought it might prove useful to profile a baker's dozen of readily identifiable lichen species that can commonly be found growing on a specific habitat: the bark and limbs of red oak trees.

Lichen Values

Like all living things, lichens play a host of roles within the ecosystems in which they live. Aside from their high ecological and underappreciated aesthetic values, they also have a number of present and potential scientific and commercial values. The authors offer the following list of values and "ecological services" provided by lichens:

- Produce carbohydrates and accumulate biomass.
- Contribute to forest nutrient cycling through leaching by rainfall, and by decomposition when they fall to the forest floor.
- Provide organic material and increase the moisture-holding capacity of forest soils by litterfall.
- Capture rainfall/dew and retain this moisture for a time which helps to ameliorate soil erosion and to increase humidity which aids growth of forest vegetation.
- Provide food for wildlife such as flying squirrels and red-backed voles, and nest-building materials and camouflage for birds and small mammals.
- Provide food and/or habitat for a large assortment of invertebrates.
- Convert or "fix" atmospheric nitrogen into forms more readily usable by plants.
- Excellent indicators of the quality of our air, as they are sensitive to sulfur dioxide and other gases and are efficient accumulators of heavy metals.
- Potential for medicinal qualities and antibiotics.
- Dyeing of wool on a small scale in cottage industries (some lichens were formerly used commercially for dyeing of wool).
- Used in perfume industry in Europe.
- Dating substrates of unknown age such as archaeological remains and others.

Our co-author, Dr. Constance Stubbs, surveyed the lichens growing on red oak in the University of Maine Experimental Forest during a study of the associations between small invertebrates such as water bears (microscopic animals that have claws and a lumbering gait reminiscent of our mammalian bears; see box), nematodes and mites. She listed 15 species of foliose (leafy growth form) and fruticose (shrubby or hair like growth form) lichens that typically grow on red oak in the Northeast. She also listed 17 species of crustose (crustlike growth form) lichens.

The lichens appearing on the following pages are not intended to represent the complete list of the lichens that grow on red oak, but rather portray a representative suite of the foliose and fruticose species that anyone can expect to encounter while examining red oaks in the Northeast. Please keep in mind that the species listed are not restricted to growing only on red oak; most can also be found on other substrates. We have provded the Latin names as taken either from the 1994 publication, ***The Lichens of British Colombia*** by Goward, McCune and Del Meidinger, or the recent book by Brodo et al. mentioned above. We also borrowed liberally from Mason Hale's book, ***How to Know the Lichens***, (1979) to come up with the descriptions. We

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Since the loss of the American Chestnut from our forests, the red oaks have become our most important mast producers, providing wildlife with millions of nutritious acrorns. Unfortunately, acron production is not reliable from year to year.

hope that by providing this partial list of the lichens that grow on red oaks, interested people can more readily identify — and thus more fully appreciate — these fascinating organisms.

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Dr. Constance Stubbs is a Research Associate with the University of Maine in Orono, Maine.

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Common Lichen Terms

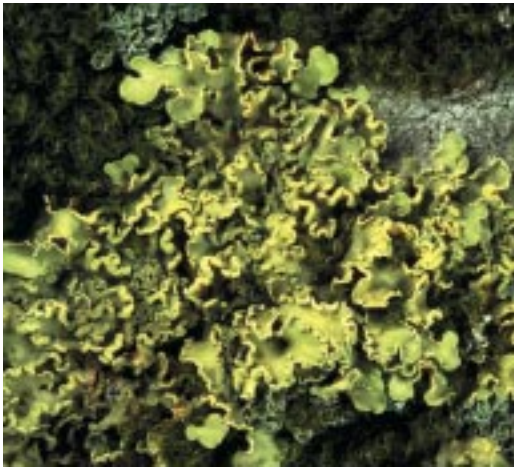
Thallus — the vegetative body of a lichen

Apothecia — cup-like structures on the thallus that produce fungal (but not algal) spores for reproduction

Rhizines — rootlike hairs that attach lichens to surfaces

Soredia — granular bundles of fungal threads and algae (like tiny bales of hay) which break off and provide a vehicle for the asexual dispersal of certain lichens.

Isidia — tiny, fingerlike protuberances emerging from the upper surface of the thallus that contain fungal threads and algae and provide a vehicle for the asexual dispersal of certain lichens.



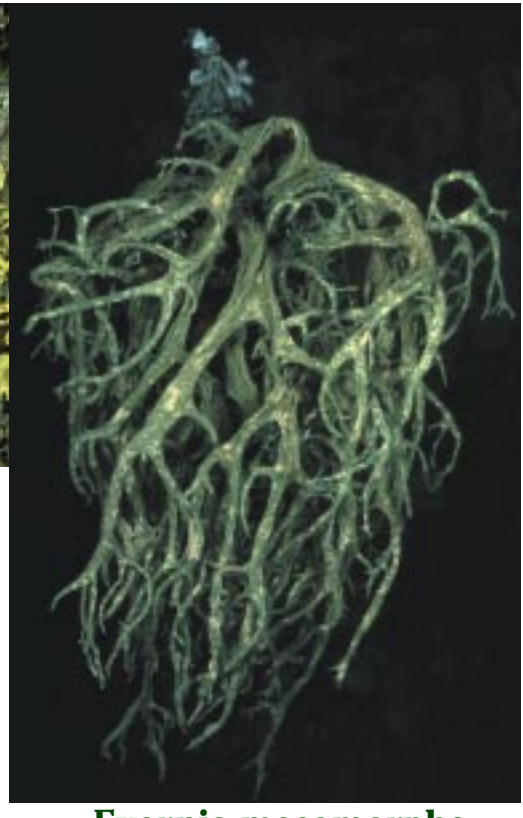
Allocetraria oakesiana

(listed as *Tuckermannopsis oakesiana* by Stubbs and *Cetraria oakesiana* by Mason Hale)

This is a yellowish-green lichen similar to *Flavoparmelia caperata* (see below); however, the lobes of this lichen are narrower (0.1-3 mm wide) than in *F. caperata* and are usually strap-shaped and linear. Also unlike *F. caperata*, most of the soredia are on the margins of the lobes. This species is apparently common on the bark of hardwoods and conifers, and on rocks in northern woods.

Bryoria furcellata

This lichen is hairlike in appearance and its thallus is a beautiful chestnut brown. Fully mature specimens have soredia erupting from white surface soralia (regions in which soredia are produced). It is rather stiff, tufted to prostrate, and measures 4-10 cm long. According to Mason Hale, it is by far the most common *Bryoria* lichen in the eastern states.



Evernia mesomorpha

This lichen is shrubby in appearance. It is pale yellowish-green, limp, erect to pendulous, and about 4-6 cm long. The surface of the thallus is irregularly wrinkled and has granular soredia. It is considered common in northern forests.

Flavoparmelia caperata

This is a yellow-green lichen that can cover large areas on the tree trunk. The lobes of its thallus are quite broad and apically rotund (3-10 mm wide).

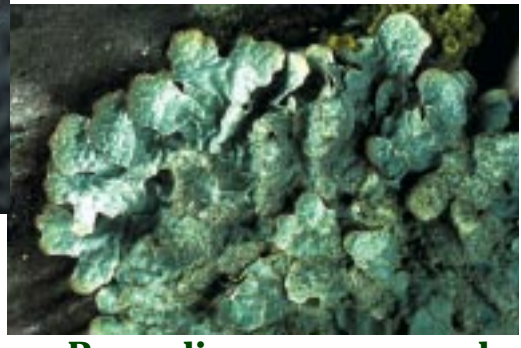
Hypogymnia physodes

This is a hollow lichen. If you cut the lobes with a sharp object, you will find that the light mineral gray thallus is hollow. This lichen has soredia on the inner surface of its burst lobe tips. It is very common on both hardwoods and conifers.

Myelochroa galbina

The thallus is pale gray to blue-gray. The lower surface is black with unbranched, black rhizines. Short, unbranched, black cilia (hair-like appendages) occur in lobe axils and sometimes on the margins. The medulla is pale yellowish at least under the apothecia or close to the algal layer.

Lichen photos on pages 12 -14



Parmelia squarrosa and Parmelia sulcata

Dr. Stubbs found these species the most prevalent lichens growing on red oak trees. These parmeloid (shieldlike) lichens are identified by the whitish or pale grayish blue color on the upper surface of the thallus and the presence of rhizines on the blackish lower surface. The difference between the two species is technical. *P. squarrosa* has isidia present, while *P. sulcata* has soredia.

Parmeliopsis ambigua

This lichen is often found at the base of deciduous and conifer trees, on bare wood stumps, and logs. The lobes are narrow (1 mm wide). The thallus is light greenish-yellow with extensive areas of soredia on the upper surface.

Phaeophyscia rubropulchra

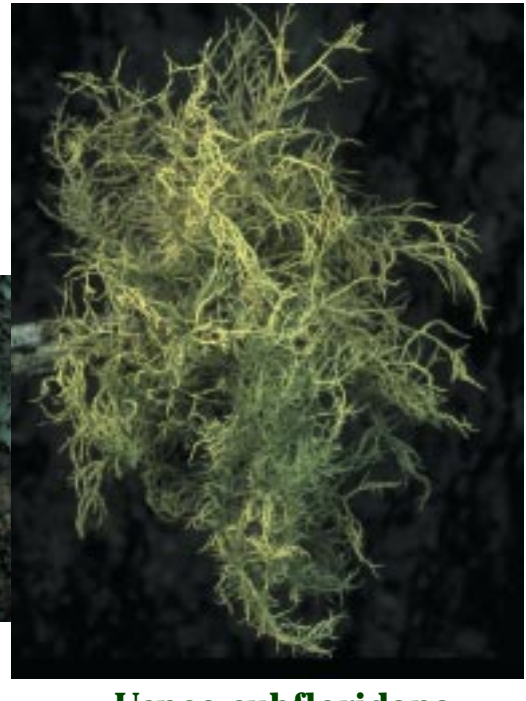
When you scrape this lichen with a sharp object (a razorblade or even your fingernail will do), the interior of the thallus (the medulla) will show a reddish color. This makes this lichen fairly easy to identify. The upper surface is brownish and the thallus lobes are usually linear or elongate.

Punctelia rudecta

This is a pored lichen — its thallus has white pores (pseudocyphellae) on its upper surface. The upper surface of the thallus is greenish mineral gray and the lower surface is tan or pale brown, which distinguishes it from *Parmelia squarrosa* and *Parmelia sulcata*. It has rhizines on its lower surface.

Ramalina dilacerata

This is a shrubby lichen. Its thallus is pale greenish-yellow, tufted, and the branches are irregularly flattened with perforations toward the base. Its branches are partially inflated and hollow (use a hand lens). It has disk-shaped apothecia.



Usnea subfloridana

This is another lichen that is shrubby in appearance. The thallus is greenish-yellow, stiffly tufted, and sorediate. The base of the thallus is constricted and blackish. Mason Hale considered it to to be very common on trees in open woods.

Indestructible Water Bears

An interesting side note about lichens is the presence of tardigrades (tardi = slow; grado = walker), microscopic animals also called "water bears" or "moss piglets" because of their fascinating appearance (see illustration). Water bears resemble gummy bears (a confection most children know well and enjoy) and are bright orange, red, or green with a gummy surface texture. The color of some species is thought to be acquired from their food sources. Bright orange water bears, for example, are thought to derive their striking coloration from the carotenoids available from many lichens.

Water bears are short and plump with claws on their eight legs, and they move in a lumbering fashion like mammalian bears. They live in wet terrestrial habitats including the surface film of mosses; lichens and liverworts; other seed-plant structures (such as leaf axils, pitcher-shaped leaves, rosettes of bracts, etc.); and in soil and leaf litter. Water bears have two needle-like stylets that can be protruded from their mouths to suck the juices of epiphytic algae and bacteria, and the plants (e.g., mosses, liverworts or lichens) upon which they live. Some species also suck the juices of nematodes, rotifers, and other small animals. Mosses, liverworts and lichens also provide camouflage and breeding sites for water bears.

Water bears are famous for their resiliency to extreme environmental conditions. They are especially noted for their ability to tolerate periods of extreme dryness or dehydration; for example, as in a dried moss or lichen growing on a rock exposed to direct sunlight for extended periods. They withstand dehydration in a desiccated barrel-like form called a "tun." Their metabolism is virtually nil in this stage until conditions improve. This ability to play dead and later be revived is known as cryptobiosis. According to Ian Kinchin, cryptobiosis can extend the life-span of a tardigrade from a few months up to several years (possibly over a century), although the active life-span is unaffected (see *The Biology of Tardigrades* by Ian M. Kinchin). Kinchin also noted that tuns can survive conditions "beyond the extremes under which active life has been observed, and beyond those which are normally encountered in nature, such as exposure to vacuums, X-rays, ultra violet radiation and temperatures approaching absolute zero." According to NASA, some tardigrades can survive in temperatures as low as minus 200 degrees Celsius (minus 328 F), while others can survive temperatures as high as 151 degrees C (304 F)!

Dr. Constance Stubbs conducted a study of the distribution of lichens and invertebrates on trunks of red oaks in Maine. Stubbs found a positive correlation between the biomass of lichens and the abundance of invertebrates. Aquatic invertebrates (those requiring moisture to be metabolically active) comprised 75% of all invertebrates that Stubbs collected by use of a commercial vacuum. Of the aquatic invertebrates found in, on, under, or near lichens, rotifers were the most abundant (79% of aquatic invertebrates); followed by water bears at 14%; and nematodes at 7%.

Illustration by Donna Nelson