Lichens on Trees as indicators of environmental change

Notes to accompany the *Lichens of Trees* by Claire Dalby. Written by Pat Wolseley.

This wall chart, produced by the British Lichen Society, shows how lichens on trees have responded to changes made by humans in our air quality and environmental conditions over time. It shows how air quality has influenced lichen communities that we find today on trees and how we can use lichens as indicators of present and past environmental conditions.

Why are lichens good indicators of changes in our environment?

Most lichens depend on the air around them to supply them with necessities for growth, such as moisture, oxygen and carbon dioxide so that their photosynthetic algal partner can use the sun to produce carbohydrates that are the food source of the fungal partner. Lichens do not have a tough membrane to protect them, so they adsorb and respond to elements in the air – hence their use as indicators of air quality. Most of them grow rather slowly so are often responding to conditions over a long time period – sometimes many decades.

You will find lichens growing on the bark of trunks and twigs of trees in most places in the British Isles. Lichens are using the bark as a substrate to attach themselves to. The substrate will vary with the tree species and with the conditions in which the tree is growing - especially the air quality. Lichens are highly sensitive to atmospheric conditions especially to those compounds which humans have added to the atmosphere such as sulphur dioxide from heavy industry, nitrogen as nitrogen oxides from all vehicles and as ammonia produced by intensive agriculture. Some lichens are more tolerant of pollutants than others and you can use the chart below the illustrations to indicate the habitat associated with the lichens in the illustrations. All illustrations show details of the characteristic features needed to identify the lichen. You'll find that x10 hand lens is very helpful for observing these features when you look at lichens in your area!

There are very few lichens (shown on the far left) that can tolerate industrial towns where sulphur dioxide produced from burning fossil fuels is the dominant pollutant. When this pollutant is deposited as acid rain it creates an acidic surface on the bark and very few lichens are tolerant of this. Exceptions include *Lepraria incana* and *Lecanora conizaeoides* (the Pollution Lichen). Once you move into rural areas where agriculture is the dominant industry, the primary pollutant is nitrogen as ammonia from stock and fertilisers. This produces a shift towards lichens tolerant of nitrogen which are represented by a community often dominated by the bright yellow *Xanthoria parietina* and the whiskery species *Physcia tenella* and *Physcia adscendens*. In this rural zone there is an abundance of lichens that can be found growing together, as illustrated in the centre of the wall chart, including closely appressed crusts of *Lecanora chlarotera* and *Lecidella elaeochroma*, leafy foliose species of grey *Parmelias* and brown species of *Melanelixia* together with *Flavoparmelia* and bushy species of *Ramalina* and *Evernia*.

Since the clean air acts of the 1960's onwards and the increase in vehicle transport and intensive agriculture the balance of compounds in our atmosphere has shifted from Sulphur to Nitrogen – so that in our towns and cities where coal is no longer burned many of these rural lichens are appearing on our garden and parkland trees. Look out for the species that have become more frequent in the middle of the wall chart. At the same time the species that were tolerant of acid rain are disappearing and it is now rare to find *Lecanora conizaeoides*.

There is another group of species illustrated in the wall chart that are associated with upland tree species such as pine and oak, where a high rainfall has leached nutrients so that the bark is naturally more acidic. These include *Parmeliopsis ambigua, Parmelia saxatilis* and *Hypogymnia physodes*. When sulphur dioxide was the dominant pollutant, these species spread south on acidified bark but they are now becoming rare under decreasing sulphur dioxide and increasing nitrogen in our atmosphere.

The next branch illustrates many of the species that are associated with warmer climates such as species with ..*physc*.. in their name. Species of *Physcia, Phaeophyscia* and *Physconia* all belong to the family Physciaceae that occurs across the world, often in warmer climates. In the wall chart these are associated with trees in parklands and historic landscapes. These species are ones to watch as they are increasing due to human-induced changes in our climate as it becomes warmer. While *Phaeophyscia orbicularis* was abundant on trees in our cities, it is now found on trees everywhere in our countryside. Two distinctive species are included in this group *Anaptychia ciliaris* and *Teloschistes flavicans,* both of which are rare in Britain now but may increase with global warming.

The section on the far right includes species that are associated with our ancient woodlands, mainly in the west, where there is a high rainfall combined with 'clean' air and conditions that have hardly changed for centuries. This is the home of the clean air lichens, bushy species of *Usnea*, which need atmospheric moisture as well as clean air, together with the leafy species of *Lobaria* including *Lobaria pulmonaria* or Lungwort, and some unusual blue-grey species that use cyanobacteria as their photosynthetic partner. These species need liquid water as well as clean air so are at the extreme end of the sensitive range.

So now you can see that things have changed since this wall chart was printed in 1981, forty years ago! Some of the acid loving species are now rare and some of the warm loving species are increasing. Which species do you find in your area today and what habitat/conditions do you find them in? Is there a difference between tree species? Perhaps there was an OPAL air quality survey in your area using nine common lichens to indicate nitrogen pollution? Some of the results and all of the resources can be found at https://www.imperial.ac.uk/opal/surveys/airsurvey/ Which species can you find now? Investigate OPAL results for the UK, or for your area, at https://nbn.org.uk/news/introducing-opal-data-explorer/ Or use the BLS maps on their website at https://britishlichensociety.org.uk/resources/species-accounts to investigate changes in the distribution of the rarer species that you find.

If you can visit a woodland can you find any species of *Usnea* or other indicator species illustrated on the right of the wall chart or are there more species with ..physc.. in their name indicating climate warming?

More information on lichens can be found on the British Lichen Society website at https://britishlichensociety.org.uk/

Laminated foldout guides to common lichens can be purchased from the Field Studies Council. https://www.field-studies-council.org/product-category/publications/?fwp_keyword_search=lichen&fwp_publication_type=fold-out-guide

Online identification keys:
A guide to lichens on twigs – Natural History Museum https://www.nhm.ac.uk/take-part/identify-nature/lichen-id-guide/index.dsml
A key to common lichens on trees in England – Natural History Museum http://dbiodbs.univ.trieste.it/carso/chiavi_pub21?sc=351 As well as being an online key, there is a printable version and a stand-alone PocketPC version which can go into the field on a phone or tablet.
Lichens on orchard trees – iSpot
https://www.ispotnature.org/webkeys/keyintroduction.jsp?selectedKey=webkeys/orchard-lichen-full.0.8