
Forest Inventory and Analysis (FIA)

Fact Sheet Series

Lichen Communities Indicator

Lichens are fungi that live in intimate association with algae. Lichens are very responsive to environmental stressors in forests, including changes in forest structure, air quality, and climate. In Forest Inventory and Analysis (FIA), we collect data on epiphytic lichens, those species growing on trees and shrubs.

Why Lichen Communities?

A lichen community is a group of various species of lichens present at a site. The composition of an epiphytic lichen community is one of the best biological indicators of nitrogen and sulfur-based air pollution in forests. Their sensitivity results from their total reliance on atmospheric sources of nutrition. Because lichens are so sensitive to these pollutants, they are useful as an early indicator of improving or deteriorating air quality. Using lichens, we can answer the following questions:

- Is regional air quality (specifically nitrogen- and sulfur-based pollutants) changing over time? If so, is it improving or deteriorating?
- In what fraction of an area do lichens indicate the possibility of air pollution impacts on forest productivity and biodiversity?

Since the effects of air pollutants on trees can be difficult to separate from other influences on growth (such as soil variations), epiphytic lichens provide a clear indication of potential air quality impacts on total forest productivity.

Epiphytic lichens also have important biological roles in many forests, including nitrogen fixation, food for animals (deer, caribou, voles, and flying squirrels), and nesting material for small mammals and birds. Typically we find about 10 to 50 lichen species per FIA plot. So, in addition to indicating air quality, we will monitor lichens as an important component of biodiversity.

Lichen community information contributes to the investigation of several key forest ecosystem concerns: the contamination of natural resources, biodiversity, and productivity/sustainability. The conceptual model, Figure 1, shows how the lichen community indicator relates to the condition of the forest resource, and some environmental stressors.

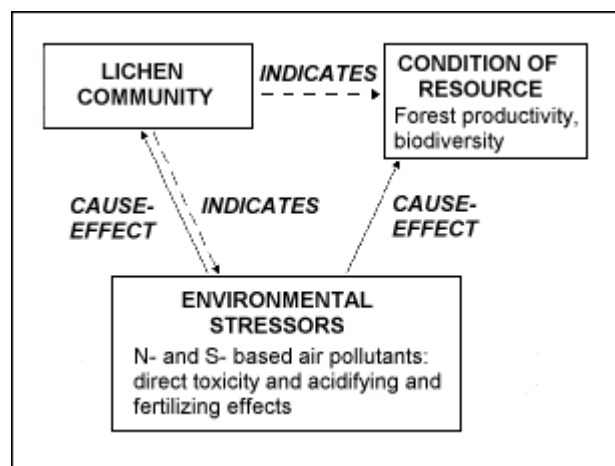


Figure 1. Conceptual Model of the lichen community indicator

How are Lichen Communities Measured?

Lichen community data can be collected easily and quickly; only two hours are needed by one person in the field. Field personnel working in the FIA program receive thorough training on field procedures at the beginning of each field season. They are trained to observe the presence or absence of lichen species, to estimate the abundance of each species, and to collect lichen specimens for identification by a specialist, a lichenologist. Identifications by the lichenologist are part of quality assurance and quality control procedures.

Errors are further minimized by audits of the field personnel. Potential sources of error are identified in complementary quality assurance studies.

Where and When are Lichen Communities Measured?

Lichen community measurements are made within a 120-foot-radius circle centered on each FIA field plot. Additional data are collected from urban and industrial sites to help define lichen community responses to air pollution in each region.

FIA field personnel collect lichen community data during the normal field season which begins in early June and ends in early September.

Are There any Special Concerns When Measuring Lichen Communities?

There is almost no seasonal or diurnal variation in lichen communities, making field surveys possible at any time and season. Fluctuations in weather condition do not affect lichen communities, but over long time periods, climatic change will be reflected in lichen appearance or abundance.

What About Data Analysis?

Two procedures for constructing plot-level indices are being used:

1. *Species richness*: A component of diversity, species richness is the total number of epiphytic macrolichen species found in the lichen plot.
2. *Community gradients*: The dominant gradients across the region are determined using accepted statistical methods. Relationships of these gradients to forest structure, climate and air quality are then analyzed. Scores for air quality and climate are calculated for each plot and are used to answer questions about air quality and forest productivity/sustainability and biodiversity.

Figures 2 and 3 illustrate the geographic distribution of lichen community scores for air quality and

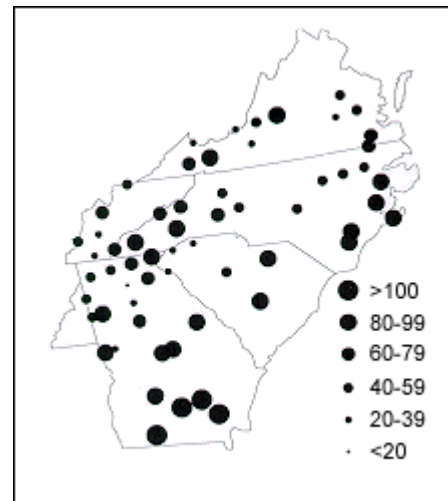


Figure 2. Regional distribution of scores on the air quality gradient as expressed by the lichen community. Larger circles indicate better air quality. Regional

climate gradients in the southeast U.S. These are examples of how lichen community data can be displayed.

Are Related Data Sets Used?

Yes, several data sets, in addition to FIA data, are used in the lichen community analyses.

- Air quality data for sulfur dioxide, sulfate, and nitrate monitoring stations are obtained through the National Air Data Branch of the US EPA.
- Climatic data are obtained from the nearest National Oceanic and Atmospheric Administration weather stations, the National Trade Data Bank, and published scientific literature.

For More Information...

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reductions in N- and S-based pollutants should result in larger circles over time.

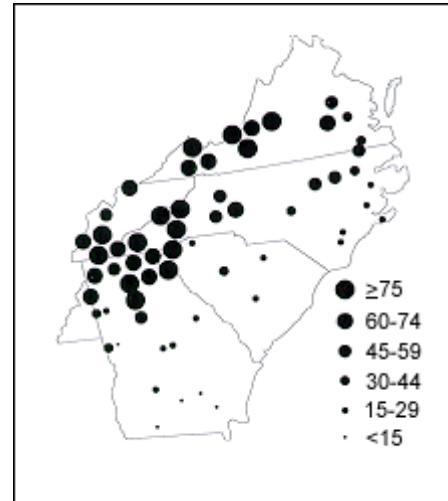


Figure 3. Regional distribution of scores on the climatic gradient as expressed by the lichen community. Larger circles indicate lichens associated with cooler climates. With climatic warming, the circles would be expected to get smaller through time.