



# LS Index (Revised): Northern Hardwood Forest

*forest mosaic science notes*

## Introduction

The LS Index is a simple scoring system that allows the user to estimate the degree to which any forest stand is in a late-successional condition. The LS Index can be applied to a stand in less than 30 minutes. It can be conducted at any time of year. The LS Index was designed to provide a quick, accurate estimate of late-successional condition of a stand to help foresters manage and conserve this uncommon and diminishing forest age class. This document describes the LS Index for northern hardwood forest (Fig. 1).

## The basis of the LS Index

The northern hardwood LS Index is calculated using a score for 1 indicator: large-tree (>16" or 40 cm DBH) density (alive or dead). This variable was statistically derived from a large field data set containing many potential LS indicator variables (see Whitman and Hagan FMSN 2009-1). Large tree density correlates with other attributes of old forest, including the volume and density of large snags and logs, as well as the density of trees with LS lichens and bryophytes. The index ranges from 0 to 10 and increases with forest age.

## How to calculate the LS Index

**Equipment needed:** stand map, compass, hip chain (or use pacing), and diameter tape.

**Field Procedure:** Run a hip chain (or pace) for 10 chains (~200 m) and count the number of large ( $\geq 16"$  DBH) trees (alive or dead) within  $\frac{1}{4}$  of a chain (~5 m) on either side of the transect (a  $\frac{1}{2} \times 10$  chain plot [ $\frac{1}{2}$  acre] or ~ a 10 x 200 m plot [0.2 ha]). The number of samples required to precisely estimate a stands LS Index will vary depending on how much the LS Index varies throughout a stand and the size of the stand. We recommend 1-3 transects per stand.

**Calculating the LS Index:** Use the look-up tables below to derive the **LS Index**. If you chose to sample some other fixed area, you can convert the densities to a per-acre or per-hectare scale, and use the look-up tables accordingly.



Fig 1. Old-growth northern hardwood forest, Ragged Mtn (T9R11 WELS) Maine (A. Whitman photo).

LS Index Score	Number of large ( $\geq 16"$ DBH) trees (alive or dead)			
	Percentile of OG stands	/ plot	/ acre	/ ha
0	0	0	0	0
1	0	1	1-2	1-9
2	0	2	3-5	10-14
3	0	3-4	6-9	15-24
4	0	5-6	10-13	25-34
5	0	7-8	14-17	35-44
6	< 4	9-10	18-21	45-54
7	20	11-13	22-27	55-69
8	48	14-17	28-35	70-89
9	76	18-20	36-40	90-100
10	100	>20	>40	>100

**Example:** Suppose you tallied up 15 trees  $\geq 16"$  DBH along the 200 m (10 chain) transect. The corresponding LS Index score for 15 trees is '8' (table left).

Threshold between economic mature and LS stages

Threshold above which a stand is old-growth or is statistically similar to old-growth.

(over)

## How to Interpret the LS Index

Scores above '5' strongly suggest that the stand contains significant LS value (Fig. 2). Stands above '8' suggest that the stand may be an old-growth stand. If the stand scores '5' to '8', we recommend applying a harvest prescription that retains as much LS value as possible. Trees  $\geq 16"$  DBH should be targeted for retention, especially if they have epiphytic lichens such as *Collema* spp or *Lobaria quercizans*. If the stand scores '8' or above, we recommend not harvesting a stand or asking for expert advice on how to harvest the stand with careful consideration of LS attributes. In most cases, stands that score below a '5' require no special management attention for LS conservation. Occasionally the LS Index may not reflect the true LS condition of the stand because either the stand is outside the range of conditions under which the LS Index was developed (e.g., post-ag. hardwoods) or is erroneously classified (the LS Index is a probabilistic tool, hence it will occasionally be wrong). Common sense usually can resolve the rare occasion when the LS Index and stand conditions are conflicting.

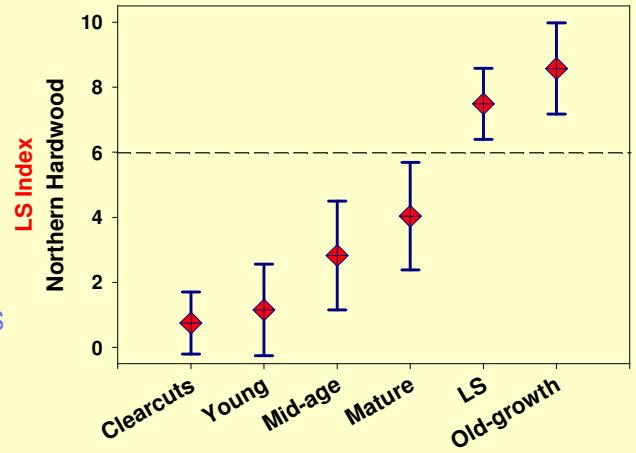


Fig 2. Mean LS Index values for stands in different age classes.

**Northern Hardwood Forest Composition:** Stands used to generate this index were  $\geq 75\%$  shade-tolerant hardwoods (maples, American beech, and yellow birch) and  $<25\%$  northern conifers. Sugar maple (*Acer saccharum*) and American beech (*Fagus grandifolia*) were dominant tree species, but yellow birch (*Betula alleghaniensis*) and red spruce (*Picea rubens*) also frequently occurred. Rich sites included ash spp. (*Fraxinus americana* and/or *F. nigra*) and basswood (*Tilia americana*). Other conifers were also present. Most beech trees were infected with beech-bark disease. Sampled stands occurred at elevations  $< 2000$  ft on moderately well-drained loamy soils found on mesic slopes and hill tops. Sampled stands included some sites with maple-basswood forest. Rich sites (often maple-basswood forest) have rich wildflower communities that often include rare plant species. LS stands contain many lichen and bryophyte species that are rare or absent in younger stands.

### NE forest type system & types:

#### NH Natural Areas Program:

Beech forest  
Hemlock-beech-n. hardwoods forest  
N. hardwoods-spruce-fir forest  
Rich mesic forest  
Semi-rich sugar maple forest  
Sugar maple-beech-yellow birch forest

#### Maine Natural Areas Program:

Beech - birch - maple forest  
Maple - basswood - ash forest

#### Society of American Foresters:

25 - Sugar maple-beech-yellow birch  
26 - Sugar maple-basswood  
27 - Sugar maple  
60 - Beech-sugar maple

#### NatureServe:

Laurentian-Acadian N. Hardwoods Forest.

#### USDA Forest Service:

801 Sugar maple/beech/yellow birch  
805 Hard maple / basswood  
809 Red maple / upland

### LS indicator lichen species identification: *Collema* spp. and *Lobaria quercizans*



***Collema* spp.** (Jelly lichen): Black upper surface and dark underside; softens to stiff gelatinous consistency when wet (J. Hagan photo).

#### Confusing taxa include:

***Nephroma* spp.** is a brown or brownish lichen  
***Peltigera* spp.** is a brown to mineral gray lichen, may have "tufts" underneath, is usually off white underneath, and occurs on soil, logs, or base of trees)  
***Exidia glandulosa*** (black witch's butter) - a fungus with dark black flattened disks, on dying or dead wood, & is shiny when wet, crumbly, & tight like paint to the bark).



***Lobaria quercizans*** (Smooth lungwort): Pale light green when dry, dark blue green when wet. Under side is light or pale tan. Interior of apotheca (structures that look like reverse suction cups) are reddish brown (see photo) (A. Whitman photo).

#### Confusing taxa include:

***Parmelia* spp.** are more common but are dark or blackish on the underside and have apotheca that are greenish or brown (not reddish brown).

For additional photographs of *Collema* and *Leptogium*, visit: [www.manometmaine.org](http://www.manometmaine.org).

**Current Status and Past Harvest History:** Lack of interest in intensive harvesting of hardwoods in the past has resulted in more acres of LS hardwood today than other LS forest types, and many townships still contain significant acreages of LS northern hardwoods. Old-growth (OG) northern hardwoods are rare but more common than OG of other forest types. Because many northern hardwood stands are now under even-aged management in order to grow quality logs and improve forest regeneration, LS northern hardwood acreage is expected to decline rapidly. Before the 1960s many LS stands were lightly harvested for spruce, white pine, and high-quality yellow birch. From the 1960s to the 1990s many LS stands were lightly harvested, favoring unmerchantable American beech, striped maple (*A. pensylvanicum*), and hobblebush (*Viburnum lantinooides*).

**LS Ecology:** LS and OG northern hardwood stands maintain themselves over several centuries unless severely disturbed by logging, wind throw, or fire. The most common form of natural disturbance comes from small canopy openings created by single trees or small groups of trees dying or being wind thrown. Stands may be infrequently (averaging about 500 years intervals) disturbed by relatively cool fires where fire has been common. Disturbances affect on average about 1% of the forest/yr. Trees can live up to 250 years old and grow  $> 30"$  DBH. Large trees, logs, snags, LS lichens, and LS bryophytes are common. Disturbance related tree species (i.e., aspen and paper birch) are rare.