LS Index: 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).

Fig 1. Old-growth northern hardwood forest in Maine.

On what is the LS Index based?

The northern hardwood LS index is calculated using scores for 2 indicator variables: (1) large-tree (>16" or 40 cm DBH) density (alive or dead), and (2) density of trees with lichens in either of the two genera *Collema* and *Leptogium* (see reverse). These two variables were statistically derived from a large field data set containing many potential LS indicator variables (see Whitman and Hagan FMSN 2004-3). 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. *Collema*/*Leptogium* spp. occur on large/old living hardwoods and cedar, but most frequently on maples, ash, hop hornbeam and basswood. The density of trees with these two LS lichen genera may indicate the degree of ecological continuity of a stand, that is, the amount of time that has passed since the stand has been affected by a large disturbance. 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), diameter tape, and lichen ID photographs.

Field Procedure: Run a hip chain (or pace) for 10 chains (~200 m) and count number of large (≥ 16" DBH) trees (alive or dead) and number of trees (alive or dead) with *Collema*/*Leptogium* spp. within ¼ of a chain (~5 m) on either side of the transect (a ½ x 10 chain plot [½ acre] or ~ a 10 x 200 m plot [0.2 ha]). Tally up the number of large trees, and trees with *Collema*/*Leptogium* spp. 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 large-tree score and the lichen score for your two density numbers. Sum the two scores to get 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 also use the look-up tables accordingly.

Large-tree Score	Number of large (≥ 16" DBH) trees (alive or dead)			
	Percentile of LS stands	/ plot	/ acre	/ ha
0	< 1	0	0	0
1	< 1	1-2	1-4	1-12
2	< 1	3-4	5-8	13-22
3	< 1	5-6	9-12	23-32
4	1-9	7-8	13-16	33-42
5	10-24	9-11	17-22	43-57
6	25-40	12-14	23-28	58-72
7	41-50	15-17	29-34	73-87
8	> 50	>17	>34	>87

Lichen Score	Number of trees (alive or dead) with *Collema*/*Leptogium spp.*			
	Percentile of LS stands	/ plot	/ acre	/ ha
0	< 9	0	0	0
1	10-50	1-3	1-7	1-15
2	> 50	>3	>7	>15

Example: Suppose you tallied up 15 trees ≥ 16" dbh along the 200 m (10 chain) transect, and 3 trees with either *Collema* and/or *Leptogium* spp. The corresponding large-tree score for 15 trees is '7' (table left). The corresponding lichen score is '1' (table above). Thus,

LS Index = 7 + 1 = 8.

(over)

How to Interpret the LS Index

Scores above about '6' 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. Target 16" trees for retention, especially if they have *Collema* and/or *Leptogium* spp. If the stand scores '8' or above, we recommend not harvesting 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.

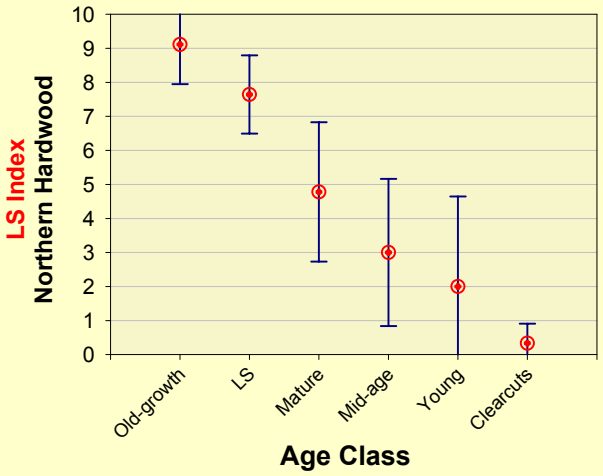

Fig 2. Mean LS Index values for stands in different age classes.

Northern Hardwood Forest Composition: Stands used to generate this index were ≥ 75% shade-tolerant hardwoods (maples, American beech, and yellow birch) and <25% northern conifers. Sugar maple (*Acer saccahrum*) and American beech (*Fagus grandifolia*) were the most abundant tree species, but yellow birch (*Betula allegeniensis*) and red spruce (*Picea rubens*) also frequently occurred. Rich sites included ash spp. (*Fraxinus americana* and/or *F. nigra*) and basswood (*Tilia americana*). Other northern conifers were also present. Most American beech trees were infected with beech-bark disease. Sampled stands occurred at elevations < 2000 ft on moderately well-drained loams and silt loams found on mesic slopes and hill tops. This forest type is subdivided into maple-basswood forest and northern hardwoods. The latter type is more common in northern Maine and was the most commonly sampled in the development of this index. 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.

Maine forest types:

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:
Sugar maple/beech/yellow birch
Hard maple/basswood
Red maple uplands

Collema and *Leptogium* Identification

Collema spp.: (jelly lichens) Black upper surface and dark undersurface; softens to stiff gelatinous consistency when wet (J. Hagan photo).

Leptogium spp.: (jellyskin lichens) Dark grey surface and dark undersurface; softens to stiff gelatinous consistency and darkens when wet (Ron Butler 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) is a fungus with dark black flattened disks, is found on dying or dead wood, and is somewhat shiny when wet, hard, crumbly, and tight like paint to the bark).
For additional photographs of *Collema* and *Leptogium*, visit: 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 in Maine 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 lantinoides*).

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 and grow > 30" at DBH. Large trees, logs, snags, LS lichens, and LS bryophytes are common. Disturbance related tree species (i.e., aspen and paper birch) are rare.