



LS Index: Upland Spruce-fir 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 the 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 upland spruce-fir forest (Fig. 1).

On what is the LS Index based?

The upland spruce-fir LS index is calculated using scores for 2 indicator variables: (1) large-tree (>16" or 40 cm DBH, alive or dead) density and (2) density of trees (alive or dead) with long (≥ 6" long) *Usnea* spp. (beard lichen, 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 the density of large snags and logs, as well as density of trees with LS lichens and bryophytes. Long *Usnea* spp. commonly occur on balsam fir and start to appear on red spruce and hardwood spp. in older stands. The density of trees with Long *Usnea* spp. 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 long (≥ 6") *Usnea* 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 the number of trees with long *Usnea* 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 stand size. 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.



Fig 1. Old-growth upland spruce-fir forest in Maine.

Large-tree Score	Number of large (≥ 16" DBH) trees (alive or dead)			
	Percentile of LS stands	/ plot	/ acre	/ ha
0	0	0	0	0
1	0	1-2	1-4	1-12
2	0	3-4	5-8	13-22
3	>0-4	5-6	9-12	23-32
4	5-9	7-8	13-17	33-42
5	10-24	9	18-19	43-47
6	25-33	10	20-21	48-52
7	34-42	11	22-23	53-57
8	43-49	12	24	58-60
9	> 49	>12	>24	> 60

Lichen Score	Number of trees (alive or dead) with long (≥ 6") <i>Usnea</i> spp.			
	Percentile of LS stands	/ plot	/ acre	/ ha
0	0-49	0-48	0-95	0-238
1	> 49	>48	>95	> 238

Example: Suppose you tallied up 11 trees ≥ 16" dbh along the 200 m (10 chain) transect, and 55 trees with long *Usnea* spp. The corresponding large-tree score for 11 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: LS Index scores for stands in different age classes are shown in Fig. 2. Scores above about '6' strongly suggest that the stand contains significant LS value. 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 long *Usnea* spp. or other LS arboreal lichens such as *Bryoria* spp. If the stand scores '8' or above, we recommend setting the stand aside from harvesting 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.

Upland Spruce-fir Forest Composition: Sites used to generate this

index were $\geq 75\%$ spruce and $<25\%$ hardwoods (aspen, paper birch, maples, and American beech). They occurred on soils ranging from moderately well drained loams to poorly drained clay loams on slopes. Balsam fir (*Abies balsamea*) and red spruce (*Picea rubens*) were the most abundant tree species, but northern white cedar (*Thuja occidentalis*), yellow birch (*Betula alleghaniensis*) and red maple (*Acer rubrum*) frequently occurred in most stands, as well as paper birch (*Betula papyrifera* and *B. cordifolia*) and aspens (*Populus* spp.). Other northern conifers were also present (*Tsuga canadensis* and *Pinus* spp.). This forest type most frequently occurs at elevations below 3000 feet on flat to rolling terrain, hill tops, rocky slopes, and lower slopes. Upland spruce-fir forest has red spruce as the dominant spruce and often includes some yellow birch. In contrast, lowland spruce-fir forest usually has black spruce (*Picea mariana*) as the dominant spruce, lacks yellow birch, and occupies sites with poor drainage on low, relatively flat ground. Old stands contain many lichen, moss, and liverwort species that are rare or absent from younger stands.

Maine forest types:

Maine Natural Areas Program:

- Mixed hardwood-conifer forest
- Spruce slope forest

Society of American Foresters:

- 5 - Balsam fir
- 30 - Red spruce-yellow birch
- 32 - Red spruce
- 33 - Red spruce-balsam fir
- 35 - Paper birch-red spruce-balsam fir

NatureServe:

- Acadian-Appalachian Lowland Spruce-Fir-Hardwood Forest
- Acadian-Appalachian Montane Spruce-Fir-Hardwood Forest.

USDA Forest Service:

- Balsam fir
- Red spruce
- Red spruce/balsam fir

Current Status and Past Harvest History: Upland-spruce fir forests have been extensively harvested in Maine for over 3 centuries. Over the last 100 years many stands have been commercially clearcut (where merchantable trees are removed). During the interval spanning the 1960s to the 1990s, the chief silvicultural strategy was one of silvicultural clearcuts in which all trees are removed and herbicides and pre-commercial thinning are applied. Most stands are now managed using even-aged management strategies such as clearcuts or shelterwood harvests. Hence most timber harvests have resulted in the retention of relatively few old trees and few large logs. OG upland spruce-fir stands are now rare due to a long-term, high demand for building materials and pulpwood. LS upland spruce-fir stands are now very uncommon as well.

LS Ecology: LS and OG upland spruce-fir stands are affected by disturbance regimes characterized by canopy gaps created by wind and snow, infrequent spruce-budworm outbreaks (decades between events), and rare fire events (several centuries between fire events). Severe disturbances often leave many trees, including large trees, in the stand. Openings in the canopy generated by natural disturbance cover about 1% of the forest per year. Saplings will live in the understory until a gap opens in the canopy. The oldest trees can live up to 300 years and grow to greater than 20" at DBH. Disturbance tree species, such as aspen or paper birch, are usually rare except in areas of extensive blow down or fire. Most areas (but not all) of aspen or paper birch will return to upland spruce-fir forest.

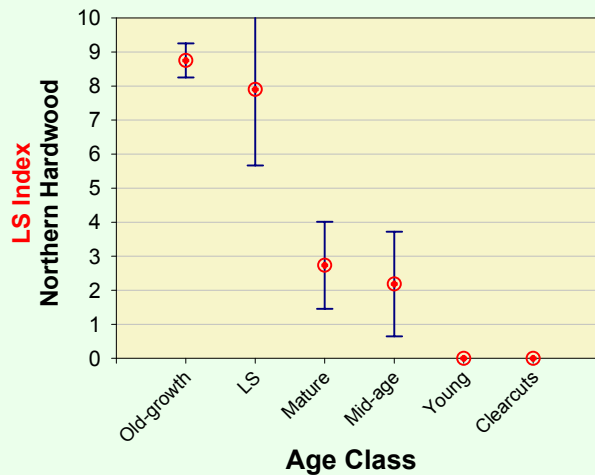


Fig 2. Mean LS Index values for stands in different age classes.



Red Spruce with a heavy load of the lichen *Usnea longissima* (Methuselah's beard lichen). This species can grow up to 3 m long. This species also occurs in Europe, and may have been the original "tinsel" on Christmas trees. For additional photographs of *Usnea*, visit our web site:

www.manometmaine.org