Measuring Site Quality
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Understanding Forestry Concepts: A Forest Ecology Series for Loggers, Landowners and Foresters

UNIT FIVE

MEASURING SITE QUALITY

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Introduction

This bulletin series is designed to introduce information that loggers, landowners and foresters should know to properly manage forest lands while understanding how forest systems work and interact so that long-term forest productivity is maintained. These bulletins are not an exhaustive discussion of important forest ecology topics. Instead, they are a brief introduction to the depth and breadth of knowledge that is necessary to manage forest stands properly. This fifth bulletin provides a background on the different methods for determining site quality: the site characteristics that impact tree growth.

When foresters talk about site quality and site productivity, often in the same breath, they usually are referring to the inherent ability of a site to produce wood. However, other uses besides producing wood are becoming increasingly important to landowners (5). For wildlife biologists, for instance, site quality may be a reference to the ability of a site to maintain certain wildlife populations. In other words, the terms site quality and site productivity are relative to the profession and the geographic location. This is apparent when talking with someone working in a geographic area predominated by jack pine and with another individual working in an area with fine upland hardwoods. For these two people, their perspective on high site quality or high site productivity would differ drastically. Therefore, over time, foresters and loggers in different parts of the Lake States have developed an understanding of site quality or site productivity relative to their prevailing site conditions.

Approaches to calculating site productivity include habitat typing, ecological classification, and site index (10). Habitat typing in the Lake States relies upon identifying the presence or absence of certain understory plants that are associated with known soil productivity levels (6). Ecological classification also relies upon understory vegetation but combines that information with information on landform, soil type and other identifiable factors that affect site productivity levels (4).

While these first two methods are gaining wider acceptance and use throughout the Lake States, the use of site index is by far the most common on-the-ground approach to determining site quality. Site index is based on the following idea: If you have two trees of the same age and species growing on two different sites, the taller one is growing on a more productive site. To make this determination, site index measures height and age of the tallest trees within the forest. For example, if both trees are 50 years old (this is the usual index age), and the average height of the tallest trees at site one is 65 feet tall and at site two 75 feet, the site index (SI) is listed as SI 65 for site one and SI 75 for site two (11). Sets of curves have been developed for many tree species within the Lake States region to determine site index for

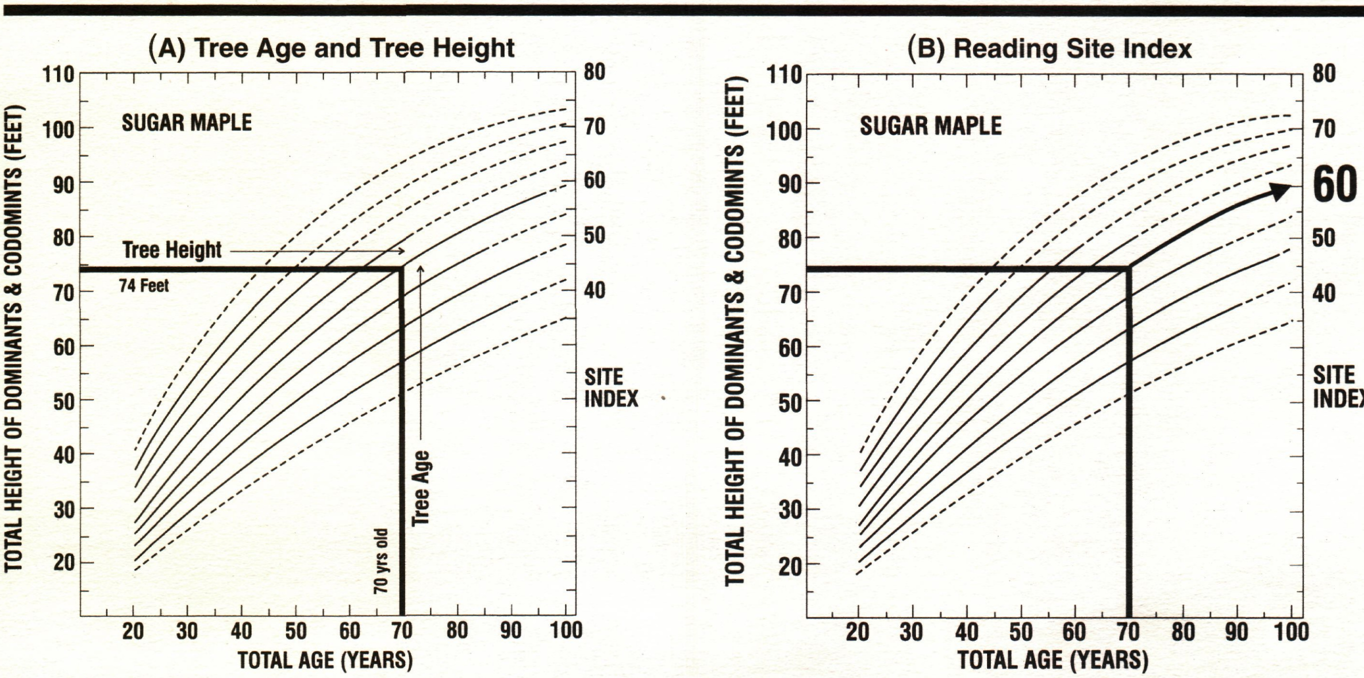

Figure 1: These sugar maple site index curves were developed for northern Wisconsin and upper Michigan (Carmean, 1978). To use site index curves, find the point where tree age and height intersect on the graph (A). Follow a curve upwards to the site index value (B). The example shows that a site with a 70-year-old sugar maple tree, 74 feet tall, has a site index of 60.

trees that are not 50 years old (2, 3). Site index curves are developed for individual commercial tree species because the rate of height growth varies with tree species. Site index curves should only be applied to the species and in the region where they were developed.

To determine a site index value you need three things: a set of site index curves for each major tree species and both the age and height of at least two trees (11) (Fig. 1). Trees selected for measurement should be healthy, free-growing trees with crowns in or above the main forest canopy (10). For accurate estimates of site index it is necessary to have reliable measurements of age and height (10). To determine tree age, foresters use an increment bore, a hollow tube that is drilled into a tree by hand to extract a wooden core (5). The growth rings on the core are counted to determine tree age (Fig. 2).

In addition to tree age, the rate of tree growth can be determined from this core. To determine the current rate of growth, count the number of growth rings in the outside one inch of growth. These numbers are reported as rings per inch (9). The fewer number of rings per inch, the faster the tree growth. For example, if a tree had six rings per inch, that tree added two inches of diameter (remember to double for estimated diameter growth) in six growing seasons. If a tree had 10 rings per inch, it took 10 years to add 2 inches of diameter. These measurements can be used to calculate expected rotation lengths required to reach minimum diameter size requirements for standing trees. Remember that diameter growth can vary greatly from year to year and usually declines as the tree ages. It is important to monitor tree growth to determine the accuracy of the growth predictions over time.

Tree height can be determined by tools such as clinometers, Abney levels, and relascopes (5), which rely on a knowledge of trigonometry to determine height. If you know your distance from the base of the tree and the angles from your eye to the tree base and to the tree top, you can determine tree height. The tools listed above allow the user to directly read tree heights to avoid having to make calculations in the field.

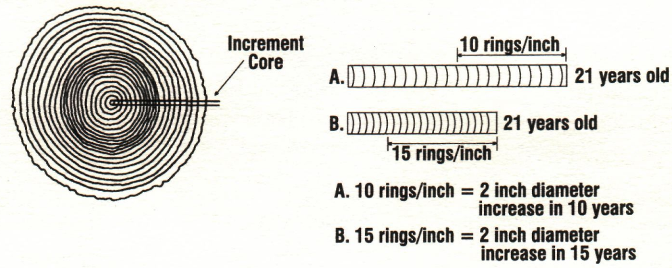

Figure 2: Besides age, the increment core removed from a tree can also indicate the rate of diameter growth. This information can be used to estimate diameter growth by counting the rings per inch on the end of the extracted core. This provides an estimate of how long it will take to grow the next two inches of diameter. For example, a tree with a 10-inch diameter and growing at 5 rings per inch will have a 12-inch diameter in 5 years.

Loggers have developed an eye for evaluating site productivity without a formal measure of tree height and age. Foresters also make determinations of site quality on factors other than tree age and height. As with loggers, they pay attention to factors such as size and form of trees, size and health of tree crowns, bark characteristics, and understory plant species composition (9) (Table 1).

There is a danger, however, in using only these visual cues to evaluate sites. For instance, past harvesting may have removed high quality trees leaving a growing stock of poor form, quality, and genetics. Past harvesting practices, such as skidder traffic not following designated trails or harvesting when soil moisture levels are high, can cause soil compaction and extensive root and stem damage leaving a forest with many dead limbs in the crowns, extensive stem rot and epicormic sprouts (small branches that grow along a tree stem). These trees may not be indicative of the sites' actual potential productivity.

Site productivity is best maintained by minimizing stem and root damage on remaining trees during harvest,

Table 1: Some examples of visual cues to site quality.

Tree or Forest Characteristic	Good Sites	Poor Sites
Size and Form	Taller, straighter, clear stems (no defects), little stem taper, good branch pruning	Shorter, rough stem appearance, heavy stem taper, dead branches, *epicormic branches, stem rot*
Crowns	Large, full, uniform	Small, sparse foliage, rough looking branches, top dieback, dead branches
Bark	Smooth, stretched bark	Rough, blocky bark
Understory Herbs	Trillium, wild leek, large-leaf aster, club mosses, lilly of the valley, starflower, solomon's seal, sarsaparilla	Reindeer moss, sedges, bracken fern, blueberry, juneberry, wintergreen, huckleberry, sweetfern

leaving tree species that are best suited to the site and those that exhibit characteristics of good breeding stock. The remaining growing stock (residual trees) should be well distributed over the site (9). Loggers, through careful harvesting, are instrumental in helping to leave a productive growing forest for the next generation of loggers, landowners and foresters.

Summary

Understanding the basis of site productivity is important in developing forest management plans (7). In general, sites with a higher productivity produce more timber, more wildlife, and more diversity and respond more favorably to thinning and other silvicultural treatments. The faster the tree growth response following treatment, the better the rate of return to the landowner. In addition, activities designed to enhance other site characteristics, such as wildflowers and tree regeneration, are also apt to respond more vigorously to management on a productive site. Therefore, working in forest stands of low productivity that do not show improved tree growth after treatment is not a wise economic decision unless benefits other than tree growth are the objective (8). However, even some non-timber objectives are more difficult to attain and manage on a site of lower quality.

Acknowledgment

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