United States
Department of
Agriculture
Forest Service
**Northern
Research Station**
Research Note NRS-115

ESTIMATING ALLOWABLE-CUT BY AREA-SCHEDULING[1]

WILLIAM B. LEAK

Abstract

Estimation of the regulated allowable-cut is an important step in placing a forest property under management and ensuring a continued supply of timber over time. Regular harvests also provide for the maintenance of needed wildlife habitat. There are two basic approaches: (1) volume, and (2) area/volume regulation, with many variations of each. Some require sophisticated computational facilities and expertise along with extensive inventory data. The area-scheduling approach described herein, is a hands-on, low-tech method that provides safeguards against under- or over-cutting.

Citation: Leak, William B. 2011. **Estimating allowable-cut by area scheduling.** Res. Note NRS-115. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northern Research Station. 4 p.

Key Words: allowable-cut, harvest regulation, volume control, area control

Introduction

Regulation of allowable-cut is an essential requirement for placing a forest property under sustainable management. It provides for a continued supply of timber and a steady stream of income. It also ensures the maintenance of any wildlife habitat conditions created by timber management, such as early-successional habitat. The basic approaches to allowable-cut calculation and implementation are (1) volume control, and (2) area/volume control, or various combinations of both approaches. Earlier approaches, some dating back to the 1800s, included several methods based on equations incorporating volume and growth (Meyer et al. 1952). Very simply, volume control seeks to harvest estimated growth; it also incorporates modifications to change the level of growing stock and stand structure. Area/volume control, generally applied to forests under even-age management, is designed to harvest a given acreage; it also entails efforts to efficiently/optimally produce a forest with equal acreages in all age classes. The purpose of this note is to describe very briefly both approaches and then to offer a fairly simple area-scheduling approach that is user-friendly, hands-on, and low-investment, and limits the possibility of over- or under-cutting.

Volume Control

The objective in volume control is to harvest net growth, subject to modifications aimed at moving toward an optimum level of stocking and stand structure. In its simplest form, we might use available growth information from the literature or inventory plots and apply this figure to the operable forest acreage. For example, northern hardwood forests in New England grow about ½ cord per acre per year (Leak and Gove 2008). If we apply this figure to the available acreage (for example, 10,000 acres) we can estimate the allowable cut (5000 cords/year). We can adjust this volume up or

[1] Adapted from a paper presented at the 2004 Northeast Planners Association Meeting, Burlington, Vermont.

down to allow for increases or decreases in stocking or anticipated increases in growth as stands become more intensively managed. This very general approach can be used in forests where either even-age or uneven-age silviculture, or a combination of both, is applied. Usually, volume control is based on detailed inventory data coupled with any of several growth and yield simulators that can provide the required growth estimates by type, site class, and future operating cycles. The next step is to locate stands ready for harvest and schedule the required harvest volumes, or employ one of several harvest scheduling programs if sufficient inventory/mapping data are available.

Area Control

Conventional area control (really area/volume control) is best applied to even-aged forests, where the available acreage can be reasonably split into age classes/forest types and where even-age silviculture will predominate. The objective is twofold: (1) to regenerate (using clearcuts or shelterwoods) a constant acreage per year equal to the forest acreage divided by the rotation age; and (2) to thin immature stands that are operable. Using available yield tables or growth simulators, this approach could be optimized (for example, via linear programming) to determine which stands to harvest so as to maximize yields (or revenue) subject to numerous conditions such as equal areas harvested per entry, increasing yields over time, or thinning in certain age classes. Over a rotation, this approach would produce a balanced, even-aged forest with equal acreages in each age class.

During the last several decades, conventional area/volume control approaches have been supplemented by broad-based computerized systems such as FORPLAN (Hoekstra et al 1987), Woodstock (Walters 1993), and Harvest/Spectrum (Gustafson et al. 2003) that will optimize and schedule activities for a wide range of silvicultural and management options.

Concerns About Volume and Area Control

One of the major concerns in developing a regulation procedure is the inventory. Forest-wide inventories that both collect plot data and conduct stand mapping are extremely expensive and time-consuming. Many companies, organizations and other landowners can afford only the time and cash to keep a step ahead of the timber sales. Another concern centers around availability and accuracy of the growth information. The standard approaches to volume and area control rely on growth data from remeasured plots or growth predictions from simulators. Growth rates may change over time as management proceeds. Markets and utilization standards may vary greatly: what was biomass or pulp in one decade may become log material in the next. Simulators may not be entirely accurate, and sometimes require a high level of computer expertise. In addition, there usually is acreage in sensitive areas that is not available for harvest and not quantified through the inventory process. Accessibility is another complicating factor that may override all other concerns when managers are planning timber harvests and trying to produce a given allowable cut. Another concern is that most forests are managed under a mix of silvicultural approaches; even-aged regeneration harvests, thinnings, uneven-aged harvests including single-tree and group selection, stand improvement, or salvage. And, the silvicultural approach may vary over time due to changes in philosophy, economics, utilization, etc. This means that the approach to regulating the allowable cut must be flexible enough to accommodate both even-aged and uneven-aged approaches.

Area Scheduling—Another Approach

Out of discussions with forest managers has emerged a general approach to allowable-cut that is flexible, low-cost, and hands-on. First, we should set an approximate cutting cycle or return cycle, the period of years between returns to the same area. In this example, we will use 20 years. A 20-year cycle means that each year we would examine treatment options on 5 percent of the available property (100 percent divided by 20). Next, we would prepare a rough list of compartments, habitat units, or whatever property units make sense. Often, compartments consist of natural boundaries, such as a watershed or group of watersheds containing several stands defined by forest type and age. The next step is the important one: we would need to schedule a series of compartments, and stands within compartments, for examination and possible harvest that constitute about 5 percent of the available area. This list of compartments

and stands would include those ready for harvest and those that will be deferred (for 20 years or more) due to immaturity or stocking. The list is a hands-on task based on such variables as knowledge of the property, maturity and condition of the stands, accessibility, time since last treatment, and markets. We then would inventory or examine the scheduled compartments sufficiently to provide an estimate of the proposed stand treatments and volumes to be removed. Alternatively, we could acquire this information during the marking operation.

The process for a 500-acre harvest unit (5 percent of 10,000 acres) is shown in Table 1. The three compartments, and seven stands, comprise 500 acres. These compartments would be those scheduled for early treatment based on maturity, condition, accessibility, and markets. Stand 1 (50 acres) is scheduled for a clearcut: about one-tenth of the scheduled 500 acres or 0.5 percent of the entire 10,000 acres. Stands 2 through 6 are partial harvests, which could include uneven-aged harvests as well as commercial thinnings. Note that one stand (number 7) is not scheduled for harvest for some reason, such as immaturity. Acres multiplied by volume marked equals the estimated harvest per stand; the summation over all stands equals the total projected yield of 2.165 million board feet. This figure divided by total acreage (10,000) equals the estimated harvest of 216 board feet/acre/year. This estimate should be checked against available growth information to see whether it is attainable; 216 board feet is equivalent to about 0.4 cords—well within reason.

Groups of compartments can be scheduled for the future, depending on time and resources available. Stand conditions can be updated using a simple growth percent, providing an estimate of future allowable cuts. The harvests can be a mix of partial cuts, even-aged regeneration cuts, or no-harvest prescriptions. It is important to note that with even-aged harvests, there should be the restriction to regenerate no more than 1 percent of the property acreage per year based on a 100-year rotation. (This estimate can be revised for differing rotation ages). In this example, 100 acres of clearcut/shelterwood would be the upper limit. On small properties, where a harvest might take place every 10 years, the yearly estimates as described above would simply be combined into periodic estimates. For example, on a small property harvested every 10 years but on a cutting cycle of 20 years, half the property (10 years times 5 percent) would be examined and marked.

This approach has the following advantages:

1. It is a low-cost and hands-on method that foresters and the public can readily understand.

2. The process can work with minimal inventory data, which can be collected as needed.

Table 1.—Ordering of compartments and stands within compartments totaling 5 percent (500 acres) of forest acreage (10,000 acres) and summary of volumes to be harvested in a single year based on a silvicultural stand exam or the marking operation.

Compartment	Stand	Acres	Basal Area/ Acre	Volume/ Acre	Marked Basal Area/Acre	Marked Volume/ Acre	Total Cut*
			(sq. ft.)	(board feet)	(sq. ft.)	(board feet)	(board feet)
1	1	50	120	12,000	120	12,000	600,000
	2	125	110	10,000	40	3,600	450,000
2	3	75	150	15,000	50	5,000	375,000
	4	75	140	13,000	40	3,700	277,500
3	5	50	110	11,000	40	4,000	200,000
	6	75	115	9,000	45	3,500	262,500
	7	50	75	0	0	0	0
All		500					2,165,000

*2,165,000/10,000 equals 216 board feet/acre/year

3. The results are spatially explicit and coordinated with the access plan.

4. The process forces a regular examination of the whole forest.

5. The system avoids the possibility of serious over-or under-cutting.

6. The approach is suitable for small to moderate holdings without extensive computer facilities and expertise other than perhaps a simple database system.

The area-scheduling approach has some disadvantages, however. The yields may vary from year to year. The degree of variability depends on how shrewd the manager is in scheduling compartments and making slight adjustments to the annual acreage examined and treated. Appreciable prior on-the-ground knowledge of the forest is required through field experience and photo interpretation.

Literature Cited

Gustafson, E.J.; Rasmussen, L.V.; Leefers, L.A. 2003. **Spec2Harv: Converting Spectrum output to HARVEST input**. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Research Station.Version 1.0b. 11 p. Available at http://nrs.fs.fed.us/tools/Spec2Harv/ (Accessed 15 June 2011).

Hoekstra, T.W.; Dyer, A.A.; LeMaster, D.C., eds. 1987. **FORPLAN: An evaluation of a forest planning tool**. Proceedings of a symposium; 1986 Nov. 4-6; Denver, CO. Gen. Tech. Rep. RM-140. Ft. Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station. 164 p.

Leak, W.B.; Gove, J.H. 2008. **Growth of northern hardwoods in New England:** A 25-year update. Northern Journal of Applied Forestry. 25: 103-105.

Meyer, H.A.; Recknagel, A.B.; Stevenson, D. 1952 **Forest management.** New York, NY: Ronald Press Co. 290 p.

Walters, K.R. 1993. **Design and development of a generalized forest management modeling system: Woodstock.** In: Proceedings of the international symposium on systems analysis and management decisions in forestry; 1993 March 9-12; Valdiva, Chile: 190-196.

MANUSCRIPT RECEIVED FOR PUBLICATION 8 February 2011

Published by:
USDA FOREST SERVICE
11 CAMPUS BLVD., SUITE 200
NEWTOWN SQUARE, PA 19073

July 2011

For additional copies:
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