SHOULD WE THIN YOUNG ASPEN STANDS?

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ABSTRACT

The large aspen (*Populus tremuloides* Michx.) resource in western Canada is rapidly being committed to pulp and flakeboard manufacture. Yet shortfall in annual allowable cut (AAC) is unlikely in the next 20 years. Precommercial thinning, or spacing, can accelerate tree growth and reduce the time needed to grow usable size material; however, this will not increase stand production and AAC, especially with the close utilization of the above products. This paper discusses biological implications and provides financial analysis of several spacing cost-benefit scenarios following the treatment of dense, juvenile aspen stands on productive sites. It touches on the feasibility of merchantable thinning in pole-size stands.

INTRODUCTION

Thinning dense, young stands can shorten the time needed to produce usable (merchantable) wood, but at a substantial extra cost that easily exceeds the benefits. Whether or not to thin depends on the management objective and the value of the products or benefits in that area.

The principal timber management objective for aspen stands in western Canada—by which we mean Manitoba, Saskatchewan, Alberta, and northeastern British Columbia—is the production of low-cost wood fiber for pulp and flakeboard manufacture. Given a stable market price and manufacturing costs for these products, remote markets and associated high transport costs mean that an economically viable operation is guaranteed only by low wood costs. Other objectives and uses—recreation; aesthetics; wildlife habitat improvement (e.g., providing winter food for ruffed grouse by favoring male aspen clones)—are important but are not directly considered in this paper.

When today's researchers talk about thinning, they usually present some fairly complex density management diagrams for the species concerned (Fig. 1). These diagrams show the recommended number of trees left in a stand to attain certain average tree size statistics, which for precommercial thinning may be best expressed in terms of height. The objective is to open the stand to achieve near-optimum growth for a period of time until the next thinning entry, and so on. Although this approach may be suitable for fast-growing, high-value species like Douglas-fir on the coast, it is clearly unfeasible for low-value timber such as trembling aspen.

The current explosion in aspen use in this region means that large areas are harvested and are then regenerating to dense, young, sucker stands. Forest managers are therefore thinking and asking questions about thinning such stands. We will try to answer these questions, taking into consideration aspen stand growth and development within current timber management objectives and within the current financial environment. This approach ensures both the biological and financial viability of such treatments.

The topic of this talk is "Should we thin young aspen stands?" We could give a firm "no" answer without hesitation. As this would likely be much too short for a talk and also unconvincing, we will present supporting information.

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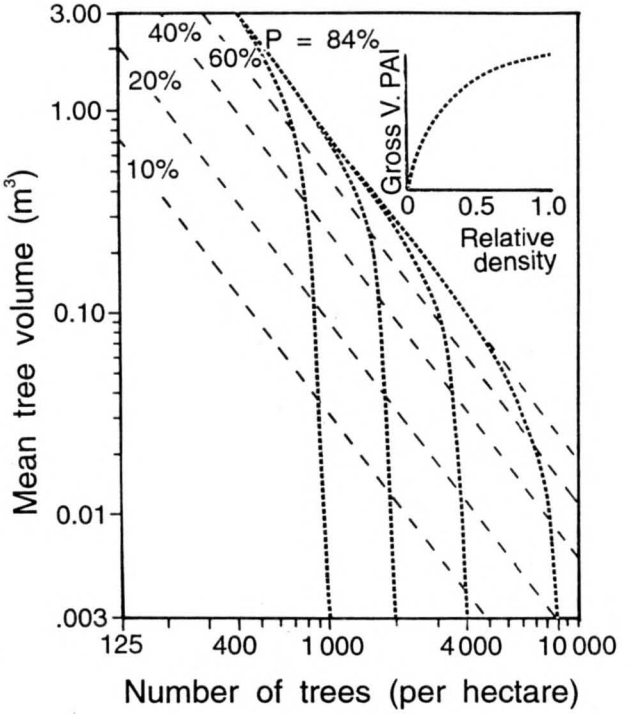

Figure 1. Stand density management diagram for lodgepole pine (from Flewelling and Drew 1985).

SOME BASIC ASSUMPTIONS AND CONSIDERATIONS

1. The principal demand for aspen wood fiber will continue to come from flakeboard (mainly oriented strand board [OSB]) and pulp manufacture. These uses imply close utilization, preference for size uniformity, and no premium on large logs. None of these conditions indicates a need for thinning.
2. Although the age-class distribution of current aspen stands is far from regular, available uncommitted aspen timber resources in the region make any shortfall in AAC unlikely in the next 20-year planning horizon.
3. Although aspen sucker regeneration can reach very high densities, especially under ideal conditions (over 100 000 per hectare; Bella 1986), those densities rapidly decline due to the nature of sucker regeneration (Navratil and Bella 1988) and the extreme intolerance of the species. This again alleviates the need for thinning.

   Although an aspen root segment on a cutover may produce one-half-dozen suckers, only the most vigorous will survive beyond the first two to three years. Mortality is very rapid at high densities at this time; stem numbers drop to below 30 000 by age 6, and to below 15 000 by age 16. This occurs regardless of the season of logging and the amount of slash on the ground (Bella 1986). Although this information is from cutovers in east-central Saskatchewan that were logged in the mid-1960s, they should generally apply to aspen stands in the boreal forests of western Canada under similar logging conditions. This means that young, dense aspen sucker stands will naturally thin themselves and maintain vigorous growth and good production.
4. Thinning treatments in aspen stands—and here we mean precommercial thinning or spacing—that favors the biggest, most vigorous individuals accelerates tree growth, as production is distributed among fewer trees (Bickerstaff 1946; Schlaegel 1972; Perala 1978). Yet total production of the stand is not improved, but reduced (Bickerstaff 1946; Jarvis 1968; Schlaegel 1972), because the area is usually understocked at least for a few years immediately after thinning (Fig. 2). As only stems above a certain size are usable, however, trees in thinned stands reach this size well before those in unthinned stands. This then can mean a reduction in rotation age. As decay losses accelerate with increasing age, reduced rotation length is an advantage.

FINANCIAL IMPLICATIONS

At present, the Alberta Forest Service uses a 60- to 80-year rotation for aspen in AAC calculations, depending mainly on site class and productivity. With precommercial thinning, the 60-year rotation on good sites may be reduced by 10 years, to age 50. We examined the financial feasibility of such a treatment in a hypothetical stand where the rotation is reduced by 10 years, but harvest yield remained the same—a very generous assumption indeed. Our main findings were as follows (see Table 1):

- only at an unrealistically low treatment cost ($100 per hectare) and a very high wood

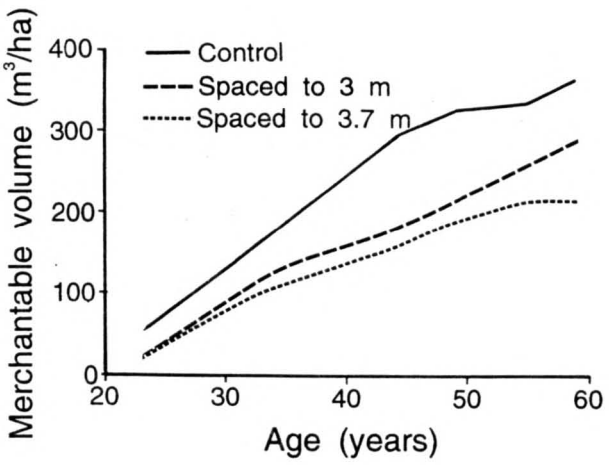

Figure 2. Merchantable stem volume production (stump height 15 cm; top diameter inside bark 8 cm) of aspen thinned at age 23 to three density levels, Riding Mountains, Manitoba.

market price ($10 m^3/ha) is thinning dense 5-year-old aspen financially feasible;

- delaying treatment to age 10 only slightly improves returns;
- no treatment is even remotely viable at realistic thinning costs between $300 to $500 per hectare, even at a wood market price of $15/$m^3$.

A scenario often used to justify the thinning of aspen is when a gap in age-class distribution causes a shortfall in available AAC. Then the financial analysis has to allow for this, possibly through appropriate wood market price adjustment.

CONSIDERATIONS IN FAVOR OF THINNING

1. Thinning provides an opportunity for upgrading stand quality in terms of growth performance and insect and disease resistance (Steneker 1976). Tree growth characteristics and associated stem quality, as well as insect and disease resistance, generally have a strong genetic component. They thus provide an opportunity to improve stand quality through judicious tending practices based on readily observable clonal characteristics. Undesirable clones with poor growth habits or susceptibility to disease can be identified and removed. This "sanitary thinning" is feasible in aspen stands where trees of different clones are intermixed rather than clumped (Navratil 1987).
2. There is opportunity for enhancing aesthetic qualities.
3. Wildlife habitat, both for mammals and birds, may be improved.
4. Aspen is sensitive to water stress (Sucoft 1982), and it may withstand drought from climatic warming in thinned stands with reduced water demand.

WHAT ABOUT MERCHANTABLE THINNING?

Some past studies showed that merchantable thinning could be biologically justified on good sites (Hubbard 1972) at least up to 40 to 45 years of age (Weingartner and Doucet 1990), as the remaining trees may take advantage and respond to the extra available living space. This may sound attractive and reasonable, but several potential problems may arise: 1) the operation and the wood produced is too expensive; 2) virtually any kind of logging—especially mechanized—will cause some stem-bark and root damage that provides entry points for fungi and results in rapid stemwood decay and volume losses (because of thin bark and the lack of strong protective response); 3) increased incidence of Hypoxylon canker (which can kill trees in a relatively short time), sun-scald, and possibly wind and snow damage; 4) canopy opening can lead to the establishment of a shrub and herb layer, which may hinder aspen regeneration. Points 3 and 4 may apply to all thinned, relatively open stands.

CONCLUSIONS

1. Although thinning young, dense aspen stands accelerates tree growth and enhances the production of usable material and allows earlier harvest, such treatment is generally financially unviable and biologically risky.
2. If aspen thinning is undertaken, it should be done as soon as dominance is expressed and readily observed. Trees should be between

Table 1. Financial returns at age 50 after thinning dense 5- and 10-year-old, highly productive (SI = 24 m) aspen stands to 3000 trees/ha using four cost scenarios. Final harvest yield 350 m^3/ha (5000 ft^3/ac.; MAI 100 ft^3), gain for the 10 years 58.3 m^3.

Treatment cost ($/ha)	Age at treatment	Internal rate of return (%) (market value of wood in $/$m^3$)		
		5	10	15
100	5	2.40	4.00	4.94
	10	2.71	4.51	5.57
200	5	0.84	2.41	3.33
	10	0.94	2.71	3.75
300	5	(-0.07)	1.49	2.40
	10	(-0.80)	1.67	2.71
500	5	(-4.12)	(-0.34)	1.25
	10	(-1.34)	0.38	1.41

4 to 6 metres in height and 5 to 10 years of age. This would leave between 1500 to 3000 of the best quality and largest trees per hectare in a sanitation mode based on clonal characteristics.

3. Even under the above conditions, thinning should only be done on good growing sites that have a low risk of Hypoxylon infection.

It is no surprise that Don Perala, Minnesota's Mr. Aspen, gave only a qualified yes to thinning aspen in the Lake States, where wood demand and use are high and supply shortages are anticipated by 2010. Yet he predicts less than 5000 ha of aspen thinned in Minnesota in the next 20 years.

All this would also suggest that rather than getting side tracked on aspen thinning, we need to concentrate on some really critical sivicultural problems that require immediate attention and action, for example, what to do with decadent overmature stands and how to ensure adaquate suckering for full stocking, and rapid growth through the selection of a suitable method and time (season) of logging in a site-soil and climate-weather framework.

LITERATURE CITED

Bella, I.E. 1986. Logging practices and subsequent development of aspen stands in east central Saskatchewan. For. Chron. 62:81-83.

Bickerstaff, A. 1946. The effect of thinning upon growth and yield of aspen stands (for ten year period after treatment). Dom. For. Serv., Ottawa, Ontario. Silv. Res. Notes 80.

Flewelling, J.W.; Drew, T.J. 1985. A stand density management diagram for lodgepole pine. Pages 239-244 *in* Lodgepole pine: the species and its management. Wash. State Univ., Pullman, Washington.

Hubbard, J.W. 1972. Effects of thinning on growth and yield. Pages 126-130 *in* Aspen: symposium proceedings. U.S. Dep. Agric., For. Serv. Gen. Tech. Rep. NC-1.

Jarvis, J.M. 1968. Silviculture and management of natural poplar stands. Pages 70-87 *in* J.S. Maini and J.H. Cayford, editors. Proceedings of growth and utilization of poplars in Canada. Dep. For. Rural Dev., For. Br. Publ. 1205.

Navratil, S. 1987. Aspen management—improved knowledge from research. Pages 97-101 *in* Proceedings of the aspen quality workshop, Feb. 12, 1987, Edmonton, Alberta, Can. For. Serv., North. For. Cent., Edmonton, Alberta.

Navratil, S.; Bella, I.E. 1988. Regeneration development and density management in aspen stands. Pages 19-39 *in* Proceedings of the Management and Utilization of Alberta's Poplars. 10th Annu. Meeting of the Poplar Council of Canada, October 26-28, 1988, Edmonton, Alberta.

Perala, D.A. 1978. Thinning strategies for aspen: a prediction model. U.S. Dep. Agric., For. Serv., North. Cent. For. Exp. Stn., St. Paul, Minnesota. Res. Note NC-161.

Schlaegel, B.E. 1972. Silviculture of aspen forests in the Rocky Mountains and southwest. U.S. Dep. Agric., For. Serv., Rocky Mt. For. Range Exp. Stn., Ft. Collins, Colorado. RM-TT-7.

Steneker, G.A. 1976. Guide to the silvicultural management of trembling aspen in the prairie provinces. Can. For. Serv., North. For. Res. Cent., Edmonton, Alberta. Inf. Rep. NOR-X-164.

Sucoft, E. 1982. Water relations of the aspens. Univ. Minn. Agric. Exp. Stn. Tech. Bull. 333.

Weingartner, D.H.; Doucet, R. 1990. The quest for aspen management in eastern Canada. Pages 61-72 *in* Aspen symposium '89, July 25-27, 1989, Duluth, Minnesota. U.S. Dep. Agric., For. Serv., North. Cent. For. Exp. Stn., St. Paul, Minnesota. Gen. Tech. Rep. NC-140.

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