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SHEARING RESTORES FULL PRODUCTIVITY TO SPARSE ASPEN STANDS

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ABSTRACT.—Four mature but grossly understocked (15 to 23 percent of normal) aspen stands were regenerated by suckering following shearing. Eight years later, aspen standing crop varied with site quality from 3.4 to 8.0 tons per acre—nearly the potential for these sites at this age. Shearing is as effective as complete clearcutting for regenerating aspen.

KEY WORDS: *Populus tremuloides, Populus grandidentata,* root suckers, regeneration, site preparation.

Mature but sparsely stocked quaking and bigtooth aspen (*Populus tremuloides* Michx., *P. grandidentata* Michx.) stands are difficult to regenerate. Most are economically inoperable because of their low volumes, others because of their remoteness or inaccessibility. Even mechanized timber harvesting, the best known way to regenerate aspen, may not be feasible under some circumstances (Perala 1977). So some other means of eliminating the parent stand and reducing competing trees or tall shrubs is needed to stimulate the initiation and development of root sprouts (suckers) to form a new fully stocked stand (Perala 1977, Schier 1981).

Chainsaw felling, prescribed burning, and poisoning are all useful regeneration tools and each has its advantages and disadvantages. Another possibility is shearing—cutting, and felling trees with a sharp blade mounted on a crawler tractor. Shearing should not be confused with "bulldozing" where trees are merely broken down or uprooted with little or no stimulation of suckering (Forbes and Harvey 1952, Gysel 1957).

Although shearing has been practiced in aspen stands for some time, the minimum stocking required of the parent stand, the soils on which the practice is applicable, and the subsequent development of the sucker stand for timber production have not been documented. To obtain more information on the potential of shearing to regenerate aspen stands, we began a study in 1973 in Sawyer County, Wisconsin. This note summarizes 8 years of aspen development following shearing of understocked aspen stands on soils differing mainly in their drainage characteristics.

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METHODS

In April 1973, about a month before the initiation of shoot growth, four aspen stands in Sawyer County, Wisconsin, were sheared using a sharpened Rome[1] K G blade mounted on a D6 Caterpillar tractor. Although the winter snowpack had melted and the ground was not frozen, soil and root disturbance was minimal. Trees were severed and felled in place without windrowing. Much of the shrub layer was crushed by the equipment, but there was no deliberate attempt to uproot or otherwise destroy it.

Because of the small areas treated, time studies were not kept. Current operational shearing rates are about 2 acres per hour.

The stands were all about 50 years old and ranged in site quality from good to poor (Table 1). The soils were silt loams, varying primarily in soil moisture characteristics (Table 2). Moisture is a prime determinant in the productivity of aspen (Perala 1977).

Within each stand, a 2-acre square study area was established and inventoried from four 0.1 acre circular sample plots prior to shearing. In November 1973, after the first year's production of suckers, 25 1-milacre circular plots were used to systematically sample each stand. Numbers and dominant heights of all woody stems were recorded by species. After 8 years' growth, each stand was again inventoried using the method of nonoverlapping triangles (Loetsch *et al.* 1973) on a 4 x 5 (=20) sample point grid. Dominant and codominant aspens measured for total height and d.b.h. defined the corners of the triangles. Intermediate and suppressed aspens and other hardwoods were counted within each triangle. The data were summarized and expanded to an area basis according to Loetsch *et al.* (1973). An index of biomass, BH (basal area x mean height), was computed for the dominant trees. Total aspen BH was estimated from a cumulative BH over cumulative stem number function.[2] Total aspen biomass was estimated from Perala (1973).

RESULTS AND DISCUSSION

The first- and especially the eighth-year inventories showed dramatic responses to shearing and to site quality (Table 3). The number of suckers regenerated and surviving was inversely related to site quality. Indeed, the number of suckers regenerated on the best site was sufficient to give only 68 percent initial stocking. However, by age 8 all stands were fully stocked with 650 to 810 potential crop trees (dominants and codominants) per acre.

Height growth and biomass production were directly related to site quality (Table 3). The sucker stand on the Antigo soil was particularly productive and compared favorably with some highly productive stands of the same age reported elsewhere in the U.S. and Canada (Bella and DeFranceschi 1980; Perala 1973, 1979). Even the least productive stands (Freer soil) were growing at full site potential, judging from comparison with aspen biomass yield tables published by Bella and DeFranceschi (1980).

Hardwood stocking was also directly related to the productivity of these soils (Table 3). Hazel (*Corylus cornuta* Marsh.) and willow (*Salix* spp.) were common in all regenerated stands as was alder (*Alnus rugosa* (Du Roi) Spreng.) on the Antigo soil. The shrubs and hardwoods were developing as an understory beneath the aspens.

Table 1.—*Aspen parent stand characteristics*

Stand	Basal area	Trees per acre	Mean d.b.h.	Total volume[1]	Site index[2]
	Ft²/acre	*Number*	*In.*	*Ft³/acre*	*Ft*
1	21	55	8.3	570 (15)	(70)[3]
2	29	195	5.3	760 (23)	(65)
3	18	145	4.8	460 (15)	63
4	23	183	4.8	470 (22)	52

[1]Numbers in parentheses are percent of "normal" stocking (Perala 1977).
[2]At age 50.
[3]Values in parentheses are estimates based on soil characteristics (Perala 1977); others are measured.

Table 2.—*Soil moisture characteristics (USDA, SCS 1975, 1976)*

Stand	Soil series	Depth to water table	Permeability	Zone of prominent mottles
		Feet		*Inches*
1	ANTIGO	>5	moderate to rapid	none
2	AUBURNDALE	1-3	moderate	6 to 43
3	FREER	1-3	moderately slow	7 to 32
4	FREER	1-3	moderately slow	7 to 32

[1]*Mention of trade names is for the convenience of the reader and does not constitute endorsement by the USDA Forest Service over other products equally suitable.*

[2]*On file, Forestry Sciences Laboratory, Grand Rapids, MN.*

Table 3.—*Regeneration and sucker development*

Stand	Age 1 stocking	Dominant height		Total aspen stem density		Hardwood[2] stem density	Aspen biomass, age 8			
		Age 1	Age 8	Age 1	Age 8	Age 8	D&C[3]	I&S[4]	Total	Total annual productivity
	Percent[1]	----*Feet*----		-----*Number/acre*-----			---------*Dry tons/acre*---------			
1	68	3.9	30	5,700	1,500	3,200	6.2	1.8	8.0	1.0
2	100	4.6	25	9,800	2,300	850	3.5	2.3	5.8	0.7
3	100	4.3	20	11,900	3,400	740	2.3	1.9	4.2	0.5
4	96	4.6	18	20,500	3,500	560	1.5	1.9	3.4	0.4

[1]Milacre basis.
[2]Northern red oak (*Quercus rubra* L.), paper birch (*Betula papyrifera* Marsh.), red maple (*Acer rubrum* L.).
[3]Dominants and codominants.
[4]Intermediates and suppressed.

This study did not define the lower limit of parent aspen stocking needed for successful regeneration of aspen stands, but it is in the neighborhood of 55 aspens or 18 ft^2 of basal area per acre. Another study (Perala 1981) showed that stocking density of quaking aspen suckers is not diminished up to 17 ft away from mature parent trees. This means that about 50 aspens per acre are needed to provide fully productive stands. That study also showed that sucker stocking was still about 325 stems per acre at 30 ft away. Therefore, about 15 trees per acre will regenerate an irregularly stocked stand that may be acceptably productive, and most likely fully productive after another regeneration cut. For bigtooth aspen, higher parent stand stocking is needed (Perala 1981). Obviously, regular spacing of parent trees is just as important as density to assure full, uniform sucker stocking.

CONCLUSIONS

Shearing is highly effective in restoring full productivity to severely understocked aspen stands. Based on the relatively high productivity of these sucker stands, there is no reason to believe that shearing is any less effective than complete clearcutting for regenerating aspen. The success of shearing can be attributed mostly to the same reasons that make clearcutting so effective—*i.e.*, the elimination of the aspen overstory which encourages suckering by relieving the apical dominance effect and by allowing warming of the soil with the reduction in shade (Perala 1977, Schier 1981). Reduction of competition by shrubs may have secondary importance.

This study showed that frozen ground is not essential for shearing, if care is taken to avoid excessive scarification and disturbance to aspen roots. However, research is needed to determine if resistance to uprooting and soil compaction differs significantly among soil textures and moisture regimes.

This study was not designed to determine if shearing effectiveness varies between dormant and growing season. Laboratory and greenhouse studies (Schier 1981) suggest that the period of most active shoot growth (when aspen root carbohydrate levels and, therefore, sucker growth potential are lowest) may be the most sensitive. Field studies by Stoeckeler (1947) and Zehngraff (1946) found reduced sucker numbers and height growth following summer cutting of aspen. Thus, shearing anytime during the dormant period from leaf coloration to bud burst would seem to be most prudent.

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