1976

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Recommended Citation

DeByle, Norbert V. 1976. The aspen forest after harvest. Pages 35-40 in D.L. Hessel et al. (eds) Utilization and marketing as tools for aspen management in the Rocky Mountains, Proceedings of the Symposium. USDA Forest Service, Rocky Mountain Forest and Range Experiment Station, General Technical Report RM-29. Fort Collins, CO.

The Aspen Forest After Harvest[1]

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Abstract.--Aspen is a unique forest tree with respect to regeneration. It produces abundant root suckers, up to 40,000 per acre are common, after clearcutting or fire removes the parent stand. The rapidly growing sucker stand competes well with other vegetation, but is susceptible to destruction by excessive ungulate browsing. Clearcut areas produce more streamflow and more growth on shrubs and herbaceous vegetation than does the uncut forest. The patchwork of age classes that results from even-age management optimizes wildlife habitat requirements for several desired species.

INTRODUCTION

Quaking aspen (Populus tremuloides Michx.) occupies perhaps the greatest geographic range of any North American forest tree species. Its ability to regenerate prolifically with root suckers that grow rapidly and successfully compete with other vegetation may have played a major role in establishing this large range. Aspen is a pioneer seral species that colonizes denuded areas. In the northern parts of its range, where growing seasons are relatively short, cool, and moist, regeneration will be by seed and by root suckering. Here, in the southern part, regeneration is almost exclusively by root suckering.

Some speculate that the ortets (seedling parents) of Rocky Mountain aspen clones may have germinated 10,000 or more years ago, when the climate here was more conducive to aspen seedling survival. With periodic wildfire to return the sites to an early seral stage, these aspen were favored and the clones expanded through many generations of root suckering into the aspen forests we find today in the West, particularly in the central Rocky Mountains.

In relatively recent years man has had considerable impact on the western aspen habitat: (1) His livestock have overgrazed many ranges, which decimated young suckers, especially if they occurred sporadically as advance regeneration in the understory. (2) He has managed big game (deer, moose, and elk) populations to maintain relatively stable numbers near the carrying capacity of the ranges; again, aspen suckers were browsed back repeatedly on many areas. And, most important, (3) he has prevented wildfire from periodically killing the forest, and thus, favoring extensive aspen sprouting.

As a result of these impacts, aspen on millions of acres will be replaced by conifers or by brush and grass within a century. Through proper management this trend can be halted. Harvesting the aspen, and tending the vigorous sucker stands that develop, has been proven through many years of study and experience in the Lake States and adjacent Canada to be an effective way to perpetuate this seral forest type.

HARVESTING AND POSTHARVEST TREATMENTS

Clearcutting is the only harvesting method that will allow a satisfactory stand of suckers to develop (Baker 1925; Graham and others 1963). Partial cuts result in fewer and less vigorous

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[1/] Paper presented at the symposium on Utilization and Marketing as Tools for Aspen Management in the Rocky Mountains, Ft. Collins, Colorado, Sept. 8-9, 1976.

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suckers and encourage invasion by more tolerant species. The size of clearcut units will be dictated by economics, environmental constraints, and expected browsing pressure by wild ungulates on the developing stand. Silvicultural constraints are minimal; except for a trivial strip along shaded boundaries, sucker regeneration should be uniformly dense across the entire clearcut area (Jones 1975). If a reasonably well-stocked aspen stand is harvested, in most instances the recommended minimum (Graham and others 1963) of 6,000 suckers per acre should be produced. Clearcutting in Arizona resulted in approximately 14,000 sprouts per acre (Jones 1975). Smith and others (1972) found 30,000 to 50,000 sprouts per acre after clearcutting in Utah.

The manner in which felled trees are limbed, bucked, and transported, and their degree of utilization, will affect associated forest resources and the amount and success of aspen suckering. In a Minnesota study (Zasada 1972), the common practice of limbing and bucking at the stump followed by skidding or carrying the logs to haul roads resulted in the least disturbance to the residual stand, understory, and soil when compared to tree-length or full-tree harvesting systems. Limbing at the stump and skidding tree-length logs was intermediate. Most destruction of the residual stand and understory came from a mechanized full-tree system. Mechanically harvesting full trees leaves virtually no residue in the forest. Zasada reported that destruction of the residual stand and understory brush was necessary for successful growth and survival of suckers under Lake States conditions. This can be accomplished at the time of clearcutting, or by subsequent treatment.

A requirement to cut all stems over 2 inches d.b.h. on the clearcut also goes a long way toward assuring an adequate postharvest sucker stand.

Western conditions are different enough that full-tree mechanized systems and maximum site disturbance may not be most desirable. Slopes are steeper and longer and species composition in the aspen understory is entirely different. Erosion potential from these mountainous lands must be more seriously considered than in Minnesota.

Postlogging treatment may be necessary to assure a fully stocked stand of vigorous aspen suckers. Broadcast burning within a year of harvesting will aid in killing understory brush and residual trees (Graham and others 1963; Horton and Hopkins 1966). However, western aspen sites are difficult to satisfactorily burn--burning conditions may not be acceptable during the first or even second postharvest years. And, if burning is delayed any further the residual parent aspen roots may not re-sucker sufficiently to fully stock the area after the fire (Perala 1974). Fire can be a very useful tool in aspen management, but one that cannot be relied upon.

An alternative to fire is the use of herbicides. Individual unwanted trees may be killed by using a tree injector, or the entire clearcut may be aerially sprayed in late summer (Perala 1971) to kill the residual overstory and brush. Again, spraying must be done within a year or two of harvesting to avoid damage to the suckering capacity of the aspen roots.

ALTERNATIVES TO HARVESTING

It is not necessary to employ the axe, chain saw, or mechanical tree harvester to manage aspen. If the aspen type has sufficient values in the form of wildlife habitat, forage, watershed protection, natural firebreaks, and esthetic qualities to warrant the investment, or if these values plus anticipated future worth in wood products are sufficient, then prescribed fire or herbicides can be used to kill the overstory, retard the brushy understory, and regenerate decadent stands.

A single aerial spraying of 3 pounds per acre of 2,4-D or 2,4-D/2,4,5-T mixture in late summer will accomplish that objective (Perala 1971). The resulting release of a dense brushy understory may require a later re-spraying.

Prescribed burning will effectively kill both the aspen stand and the understory. Excellent regeneration will follow. I recommend it wherever and whenever it can be used. Unfortunately, proper burning conditions are too infrequent in standing western aspen to make this a very reliable technique. The juxtaposition of aspen with much more flammable vegetation types precludes the use of fire as a controllable tool in aspen stands in many mountainous western areas.

TENDING THE GROWING FOREST

Little care is needed once a fully stocked, rapidly growing, even-aged aspen stand has been established. If too dense, the stand will thin itself with little loss in growth due to competition (Perala 1972).

Thinning has been shown to increase production somewhat on saw-log and veneer quality trees (Hubbard 1972; Graham and others 1963), but under western conditions, with questionable economic return.

From the practical standpoint, one can do virtually nothing to prevent or minimize disease and insect damage to the developing forest. Cultural practices, such as thinning, may increase such damage (Perala 1972).

A dense stand of aspen regeneration (40,000 or 50,000 suckers per acre, for example) can withstand considerable browsing. But, this impact must be controlled during the first 10 to 15 years after stand establishment. Aspen suckers are preferred browse by wild ungulates. They can virtually prevent aspen regeneration on winter ranges, and can cause impact on summer ranges, too. Domestic sheep and, to a lesser extent, cattle should be kept out of aspen clearcuts for the first couple years after harvest. Later use should be carefully managed until regeneration is well out of their reach, about 15 feet tall and 2 inches d.b.h.

IMPACTS ON OTHER FOREST RESOURCES

No one value dominates in the aspen type--it truly has multiple values and thus is a multiple use type. A sample of Rocky Mountain forest managers recently placed wildlife habitat as the top value, followed by esthetics and recreation, water, livestock, forage, and wood products in descending order. They felt wood products would become more valuable in the future, but not to the point of dominating management policy. Therefore, the effects of aspen harvesting and management on associated resources must seriously be considered. Only recently have these resources been given their due attention in research on aspen management in the West. Thus, there are limited data upon which conclusions can be based.

Water Quantity and Quality

Water yields will increase about 4 to 6 area-inches from aspen clearcuts (Johnston and others 1969; Johnston 1970; Verry 1972). This increased streamflow will diminish as the new stand occupies the site and probably will disappear within 10 to 15 years from sites satisfactorily regenerated with aspen. The increment to streamflow will occur as base flow and interflow. It comes from more water being retained in the soil mantle at the end of each growing season during the years following cutting, before the upper 6 to 12 feet of soil again become occupied by aspen roots.

There is very little overland flow in an undisturbed aspen forest. Properly done, clearcutting should not increase overland flow appreciably. On sloping lands, at least 65 percent cover of some kind needs to be maintained (Marston 1952). Serious soil erosion will occur from overland flow if cover is depleted below this level. Some overland flow can be expected from roads and, to a lesser extent, from skid trails. These flows usually can be infiltrated into the forest floor before they reach the stream if the road and skid trail network is correctly designed, located, and properly treated.

Water quality may be slightly altered. Increased flow and the possibility of overland flow from the disturbed area have the potential for increasing stream sediment load. However, if properly conducted, clearcutting should produce very little sediment, and that for only a year or two before the site becomes fully revegetated.

Nutrient cycling is temporarily halted by clearcutting--which may produce an increase in dissolved ions in streamflow. Typically, this will occur as a surge during the first 2 years after harvesting. Prescribed fire is likely to increase the magnitude of this nutrient flush (DeByle, in press). These predicted water quality changes in part are extrapolated from other forest types. Aspen clearcutting, in at least one instance, resulted in no detectable changes in stream-water quality (Verry 1972).

Soil

Except for possible depletion of some plant nutrients with short rotations or with whole-tree utilization over many cutting cycles (Stone 1973; Boyle and others 1973) the soil should not be significantly affected in the long term from careful aspen harvesting. Temporary changes to be expected are decreased amounts of organic matter and total nitrogen and altered contents of available nutrients. These changes are due to increased radiation reaching the forest floor, an altered soil microclimate, less organic debris added annually, and an interrupted nutrient cycle (DeByle 1976). Rapid regeneration of aspen will quickly dampen these effects on good sites (Boyle and others 1973).

If carefully done, aspen clearcutting should not disturb the mineral soil sufficiently to cause significant erosion. Generally, aspen sites revegetate readily; any bared soil again should be protected within a year or two. However, pocket gophers can consume some of the protective mantle of herbaceous vegetation and expose soil to erosion on Rocky Mountain aspen sites (Ellison 1946; Marston and Julander 1961).

Wildlife

Wildlife populations will be affected by aspen harvesting. From man's point of view, most of the effects are favorable. Providing even-aged patches of aspen representing all age classes will benefit deer, moose, elk, and grouse. Browse for ungulates is present in abundance during the early years (Graham and others 1963; Byelich and others 1972) and grouse habitat is best if all aspen age classes are present in close proximity (Gullion and Svoboda 1972). Aspen browse and leaves are often the most abundant components of deer diets (McCaffery and others 1974; Julander 1952). Clearcut harvesting of eastern hardwoods and the resulting even-aged regeneration provide nesting habitat for a greater diversity of bird species than no cutting (Conner and Adkisson 1975). Beaver almost exclusively use aspen and other closely related species for food and dam building (Bailey 1922). In short, merely keeping a diversity of habitats and maximum of edge through maintaining and managing the aspen type will benefit many wildlife species.

Forage and Understory Production

The production of forage as well as the composition and production of all understory plants will be influenced by aspen harvest. There is a paucity of data from the West in this regard. Ellison and Houston (1958) found increased production of selected species in openings and on trenched plots under aspen as compared to plots under undisturbed aspen forest. More recently, research being conducted by the Intermountain Forest and Range Experiment Station indicates what will happen to production during the first year after clearcutting or after burning.

A year after aspen clearcutting in northern Utah approximately 1,850 pounds per acre was produced as current year's growth on shrubs, forbs, grasses, and annuals on cut plots as compared to roughly 1,600 pounds per acre under the undisturbed aspen canopy. A year of precut sampling showed about 100 pounds per acre less production on the plots to be clearcut than on the controls. Thus, there is indication of an increase of 300 to 400 pounds per acre following cutting.

Because of damge to the understory, burning an aspen stand in northwest Wyoming in 1974 produced the opposite results. Production of grasses, forbs, and especially shrubs was markedly decreased. Prior to burning in 1974 there was 1,550 pounds per acre production on the control plots as compared to 1,265 pounds on the plots to be burned, a difference of 18 percent. In 1975 there was 2,012 pounds per acre production on the controls and only 925 pounds on the burned area, a difference of 54 percent.

In both instances, these are only first-year results. The temporary setback in understory production after burning could be negated by high production in succeeding years. The understory reduction from fire favors aspen sucker production during the first few postburn years.

Esthetics

Esthetics will be improved in the long run, but perhaps adversely affected in the short run, by managing and harvesting aspen. Harvesting requires roads for access. To minimize several adverse impacts (erosion, stream sedimentation, visual impact, and unwanted and uncontrolled public access), these roads should be minimal in number and closed and "put to bed" when not needed.

Clearcutting causes adverse visual impact in any forest type. Fortunately in aspen, because of the lush, rapid-growing understory, this impact is minimal and short-lived. Keeping the clearcut patches small and irregular in shape will reduce the visual esthetic impact.

Harvesting, and thus maintaining aspen as a forest type in juxtaposition with conifer forests, brushlands, and grasslands will maintain and improve the amenity of the western mountain landscape. The alternative is to erase much of the aspen from these landscapes within a century through succession to conifers or brushlands.

SUMMARY

On most sites aspen is a seral species, dominating the community for a span of 50 to 200 years or more. Harvesting the aspen forest by clearcutting on approximately 80- or 90-year cycles will set back the successional process and maintain the aspen type on sites where it is desired. The alternatives to clearcut harvesting (fire or herbicides) will accomplish the same objective, but do not utilize the wood. For economic reasons, it is doubtful that much aspen acreage will be managed without wood utilization.

The ideal aspen clearcut several years after harvesting will have about 12,000 vigorously growing sprouts per acre. For the following decade or more it will provide an abundance of browse for big game, will yield a third of a foot more water than the mature aspen

stand, and will be visually acceptable or even pleasing as part of the landscape. During the first year or two after harvest the quality of streamflow may be slightly lowered with dissolved nutrients and sediment. The soil and site are disturbed by the harvesting process, but they rapidly return to preharvest conditions as the aspen suckers again develop a closed forest canopy.

Within 2 decades after harvesting a good site will have essentially returned to the conditions found in a mature aspen stand. Breeding grouse habitat is ideal in these pole-sized stands, increment of wood is now at its peak, and the forest appears most vigorous.

From about 30 years to the end of the cutting cycle at 80 or 90 years, the aspen forest continues to grow and to naturally thin itself to some 300 to 600 stems per acre. Shade-tolerant tree species, such as spruce and fir, begin to invade the stand. It is essentially a mature aspen forest with respect to all resources except wood production. When it matures for production of wood, the stand is clearcut and the cycle begins anew.

LITERATURE CITED

Bailey, Vernon.
1922. Beaver habits, beaver control, and possibilities in beaver farming. U.S. Dep. Agric. Bull. 1078, 32 p.

Baker, Frederic S.
1925. Aspen in the central Rocky Mountain Region. U.S. Dep. Agric. Bull. 1291, 47 p.

Boyle, James R., John J. Phillips, and Alan R. Ek.
1973. "Whole tree" harvesting: nutrient budget evaluation. J. For. 71(12):760-762.

Byelich, John D., Jack L. Cook, and Ralph I. Blouch.
1972. Management for deer. In: Aspen Symposium Proc., p. 120-125. USDA For. Serv. Gen. Tech. Rep. NC-1.

Conner, Richard N., and Curtis S. Adkisson.
1975. Effects of clearcutting on the diversity of breeding birds. J. For. 73(12): 781-785.

DeByle, Norbert V.
In press. Soil fertility as affected by broadcast burning following clearcutting in northern Rocky Mountain larch-fir forests. Fire and Land Management Symposium Proc., Missoula, Montana.

DeByle, Norbert V.
1976. Fire, logging, and debris disposal effects on soil and water in northern coniferous forests. XVI IUFRO World Congr. Proc., Div. 1, p. 201-212.

Ellison, Lincoln.
1946. The pocket gopher in relation to soil erosion on mountain range. Ecology 27(2): 101-114.

Ellison, Lincoln, and Walter R. Houston.
1958. Production of herbaceous vegetation in openings and under canopies of western aspen. Ecology 39(2):337-345.

Graham, Samuel A., Robert P. Harrison, Jr., and Casey E. Westell, Jr.
1963. Aspens: phoenix trees of the Great Lakes region. The Univ. Mich. Press, Ann Arbor. 272 p.

Gullion, Gordon W., and Franklin J. Svoboda.
1972. The basic habitat resource for ruffed grouse. In: Aspen Symposium Proc., p. 113-119. USDA For. Serv. Gen. Tech. Rep. NC-1.

Horton, K. W., and E. J. Hopkins.
1966. Influence of fire on aspen suckering. Can. Dep. For. Publ. 1095, 19 p.

Hubbard, John W.
1972. Effects of thinning on growth and yield. In: Aspen Symposium Proc., p. 126-130. USDA For. Serv. Gen. Tech. Rep. NC-1.

Johnston, Robert S.
1970. Evapotranspiration from bare, herbaceous, and aspen plots: a check on a former study. Water Resour. Res. 6(1): 324-327.

Johnston, Robert S., Ronald K. Tew, and Robert D. Doty.
1969. Soil moisture depletion and estimated evapotranspiration on Utah mountain watersheds. USDA For. Serv. Res. Pap. INT-67, 13 p.

Jones, John R.
1975. Regeneration on an aspen clearcut in Arizona. USDA For. Serv. Res. Note RM-285, 8 p.

Julander, Odell.
1952. Forage habits of mule deer during the late fall as measured by stomach content analyses. U.S. Dep. Agric., For. Serv. Intermt. For. and Range Exp. Stn., Res. Note 2, 5 p.

Marston, Richard B.
1952. Ground cover requirements for summer storm runoff control on aspen sites in northern Utah. J. For. 50(4):303-307.

Marston, Richard B., and Odell Julander.
1961. Plant cover reductions by pocket gophers following experimental removal of aspen from a watershed area in Utah. J. For. 59(2):100-102.

McCaffery, Keith R., John Tranetski, and James Piechurs, Jr.
1974. Summer foods of deer in northern Wisconsin. J. Wildl. Manage. 38(2):215-219.

Perala, Donald A.
1971. Aspen successfully regenerated after killing residual vegetation with herbicides. USDA For. Serv. Res. Note NC-106, 2 p.

Perala, Donald A.
1972. Regeneration: biotic and silvicultural factors. In: Aspen Symposium Proc., p. 97-101. USDA For. Serv. Gen. Tech. Rep. NC-1.

Perala, Donald A.
1974. Prescribed burning in an aspen-mixed hardwood forest. Can. J. For. Res. 4:222-228.

Smith, Arthur D., Paul A. Lucas, Calvin O. Baker, and George W. Scotter.
1972. The effects of deer and domestic livestock on aspen regeneration in Utah. Utah Div. Wildl. Resour., Publ. 72-1, 32 p.

Stone, Earl.
1973. The impact of timber harvest on soils and water. In: Report of the President's advisory panel on timber and the environment, April 1973, p. 427-467.

Verry, Elon S.
1972. Effect of an aspen clearcutting on water yield and quality in northern Minnesota. In: Watersheds in Transition Symp. Proc., p. 276-284. AWRA, Ft. Collins, Colo.

Zasada, Z. A.
1972. Mechanized harvesting systems can aid management. In: Aspen Symposium Proc., p. 131-136. USDA For. Serv. Gen. Tech. Rep. NC-1.