APPENDIX D

HARVEST METHODS

INTRODUCTION

The choice of silvicultural systems for managing the timber resource is based on proven methods that provide suitable conditions for regenerating and tending stands of native tree species. Timber management practices must meet guidelines established in the National Forest Management Act of 1976 and specifically found in Section 6(g)(3), (e)(iv), and (f)(i).

SILVICULTURAL SYSTEMS AND REGENERATION HARVEST METHODS

The principal objective in harvesting timber is to regenerate a stand and maintain it in a healthy, vigorous condition to meet a number of resource management objectives. These include desired conditions for visual management, species composition, wildlife habitat, timber quality and integrated pest management. Achieving the management objective is foremost in selecting the harvest method. Although there are many harvest methods used in managing forest lands, there are only two silvicultural systems that provide sustainable output of Forest products--even-aged and uneven-aged.

Within the even-aged system, there are three regeneration harvest methods recognized by the Society of American Foresters: clearcutting, shelterwood, and seed tree. The uneven-aged system uses a selection cut. Principal variations are single tree and group selection.

UNEVEN-AGED SYSTEM

A stand may be considered uneven-aged if three or more 20-year age classes are developed within the stand (Roach, 1974). With an uneven-aged system, a portion of each age class in each stand must be harvested on a routine cutting cycle such as 10 or 15 years. Under an uneven-aged system with a 15-year cutting cycle there would be harvesting activity on approximately 7% of the assigned landbase each year.

The uneven-aged system may result in less volume growth than the even-aged system (Smith and DeBald 1978). This is due primarily to an increased proportion of slower growing species and increased competition.

Single Tree Selection Methods

Single tree selection is the periodic removal of individual trees. The goal is to maintain a given number of trees in each diameter class. This practice should not be confused with "high-grading" where only the best large trees are cut. In order for the practice to work, some trees must be cut or killed within most, or all, diameter classes. To maintain the desired distribution of trees by diameter classes or diameter group (i.e., basal area in pole-sized timber) it may be necessary to remove trees of less than sawtimber size at different periods of the cutting cycle.

Harvesting, with repeated entries, is an ongoing process in single tree selection. Because this method allows only limited light to reach the forest floor, shade intolerant species are unlikely to regenerate. As the shade-intolerant species, such as oaks, are removed from the stand they will be replaced by shade tolerant species. Shade tolerance is a term which refers to the ability of a tree to survive and grow in shaded conditions.

The single tree selection method meets the needs of most high-forest, cavity dwelling, closed canopy wildlife species. This method is least beneficial for wildlife species which use openings, edges and low browse.

The visual resource is minimally affected by harvesting with the single tree selection method. This method provides for retaining a large-tree character in the landscape. To some, the frequent and repeated harvest operations may be objectionable.

Group Selection Method

In the group selection method, the management area is treated as a single stand and the desired age class structure determines the number of openings to establish. Small groups of trees, 0.25 to 2 acres are removed to establish reproduction. These groups may be natural in occurrence; i.e., small pockets of scarlet oak, or systematically laid out.

The objective of this method is to establish desirable regeneration at each harvest cycle, thereby producing an uneven-aged stand. Because the removal of groups will permit more light to reach the forest floor than with single tree selection, group selection can be used to encourage a higher proportion of shade-intolerant species.

When group cuts are made of a maximum size, often considered to be 2 acres, they resemble small clearcuts. The aesthetic and wildlife benefits of using group selection depend largely upon group size and frequency of occurrence.

Group selection harvest systems develop a vegetative condition with an interconnected canopy and many small openings (0.25 acre to 2 acres). Unbroken stands of timber would not exist. Wildlife that do well in a forested environment with many small openings and in a variety of age classes would do well. Populations of passerine birds and wildlife that require habitat associated with unbroken forest stands, larger openings and a mix of age class would decline.

Improvement Cut

Improvement cuts are used under the uneven-aged managment system to achieve internal stand structure objectives when regeneration is not an objective.

EVEN-AGED SYSTEM

With even-aged harvest methods--seed-tree, shelterwood and clearcutting--the intent is to maintain stands of manageable size of the same age or age class. A stand is considered even-aged if the difference in age between the oldest and youngest trees of the managed stand does not exceed 20% of the length of rotation. This is 16 years for an 80-year rotation and 24 years for a 120-year

rotation. With any of these systems, the size, shape and dispersion of harvest units is done to achieve multiple use management objectives of the area.

The rotation age under an even-aged management system is the number of years between establishment of a stand of timber and when it is considered ready for harvesting and regeneration. If a forested area is being managed on a 120-year rotation, about 8% of the area would be regenerated each decade, or less than 1% per year. During a rotation normally there may be as few as two commercial thinnings prior to the next regeneration harvest. Thus, the area may be directly impacted by harvesting equipment about one third as often as it would with an uneven-aged system.

Even-aged management offers many opportunities for full vegetative diversity, i.e., a mix of conditions from mature forests to large openings and provides the vegetative habitat requirements for wildlife species on the forest.

Seed-Tree Method

This method involves harvesting all but a few well-distributed trees of the desired species to provide seed for natural regeneration. After adequate regeneration has been established the seed trees are harvested. This method is suited mainly to conifers.

Shelterwood Method

In the shelterwood method the mature stand is removed in a series of two or three cuts. The early cuts are designed to improve vigor and seed production of the remaining trees while preparing the site for new seedlings. The final harvest is made when a sufficient amount of desirable reproduction has become established and before the regeneration has reached 20% of its rotation age. This method provides a partial cover of either large or small trees. When the shelter becomes a hindrance to the growth of the seedlings, rather than a benefit, it is necessary to remove the remainder of the mature stand.

The shelterwood method is most appropriate for species or sites where the shelter of a partial overstory is needed for reproduction, or to give desirable regeneration an advantage over less desirable species.

Shelterwood is one technique which researchers believe may regenerate oak on good sites. This has not been consistently demonstrated in practice, however. Shelterwood is often recommended for regenerating hardwood stands. However, the details of the density which should be retained in the shelter and the timing of the shelter removal are still being studied. Shelterwood recommendations commonly contain a statement that details are uncertain and suggest more research (Smith, 1981).

Clearcut Method

With the exception of trees or clumps of trees left for wildlife or visual purposes, all merchantable trees on an area are harvested at one time in clear-cutting. Unmerchantable trees are also felled to eliminate competition with the regeneration. Regeneration develops from natural seeding and stump sprouting. This regeneration method favors the establishment and development of shade intol-erant species which are generally the more desirable commercial species.

Clearcutting is especially appropriate for stands where the residual trees would not be worth retaining for a future crop, when stands have had the best trees removed in past harvests, in areas which have insufficient trees to adequately use growing space, in heavily damaged or declining stands or where a stronger representation of intolerant species is desired.

Intermediate Cut

Intermediate cuts are used in the even-aged management system to improve growth, to utilize volume which would otherwise be foregone, control stocking levels, or adjust species composition of the residual stand.

CHOICE OF HARVEST METHOD

Some forest types can be regenerated by more than one silvicultural system and/or harvest method, but other types can not. Since a management area typically contains several forest types and diversity is desirable within a management area, more than one silvicultural system or harvest method may be used in a management area.

The Forest has five principal timber types within its boundaries. These are Oak-Hickory, Oak-Pine, Shortleaf Pine, Bottomland Hardwoods, and Eastern Redcedar. The desired or most valuable species for which we manage in these timber types are white, black, scarlet, southern red,and northern red oaks, shortleaf pine, eastern redcedar, sycamore, sweetgum, and ash. The primary harvest cutting methods for managing these timber types on the Forest are those which are used under the even-aged management system, namely clearcutting, shelterwood, and seed-tree. The uneven-aged management system is applied to some of these timber types based on species composition, site productivity or multiple use objectives. When the uneven-aged management system is applied, the group selection cutting method will normally be used.

Descriptions of silvicultural systems and their applicability by forest type and geographic area are found in Appendix C of the Regional Guide for the Eastern Region.

Documentation of silvicultural systems for these timber types is found in two publications which have compiled all relevent research data into concise, usable form (Silvics of Forest Trees of the United States-Agriculture Handbook No. 271 and Silvicultural Systems for the Major Forest Types of the United States-Agricultural Handbook 445).

The decision on which harvest cutting method, i.e. clearcutting, shelterwood, seed tree, or selection, to use in any given stand is based on management objectives, stand conditions, and the silvical characteristics of the species present or desired. Uneven-age management could be appropriate on areas with high public use or special environmental sensitivity. Even-age management is excellent for increasing intolerant species and can be used to harvest overmature, diseased, or insect-inhabited stands. Sometimes because of previous stand practices, an even-age silvicultural system allows the manager to start over. This is a need that occurs in many stands in the Ozarks. The silvical characteristics of the desired species are of major importance and determine the type of management system.

Oak-Hickory Forest Type

If the management objective is to perpetuate the oak-hickory type, even-aged systems will best satisfy the reproduction and growth requirements. Of the three even-aged reproduction methods; seed-tree, shelterwood, and clearcutting, the seed-tree method is least useful for reproducing oaks and hickories. If the regeneration objective is to reproduce oaks, whether to use clearcutting or the shelterwood method depends on the potential of existing advance reproduction and stump sprouting to replace the stand.

Using the single tree selection cutting method in the oak-hickory type will not perpetuate the oaks or other intolerant species. Harvesting single trees as they mature and cutting to maintain the specified size (age) class distribution results in an essentially complete crown cover at all times. Although oak seedlings will become established, they will be unable to survive and grow into the sapling and larger size classes. Furthermore, as the existing pole and small sawtimber size oaks pass through succeedingly larger size classes and are harvested, the sapling and small tree component will become dominated by whatever shade-tolerant species are present. Eventually the entire stand will be composed of these shade-tolerant species. However, if maintaining an almost continuous canopy is more important than species composition, the single tree selection cutting method can be used.

The single tree selection cutting method limits wildlife habitat diversity. Edge habitat does not exist, browse production is low, and although mast production is high initially, it will decline as the oaks and hickories are harvested and replaced by other species. The vertical structure of uneven-aged stands provides good habitat for some birds. The same structure can be provided when even-aged stands are left well beyond normal rotation age and become overmature.

Group selection is a successful regeneration method when used in the oak-hickory type. The individual openings are considered integral parts of the entire stand being managed. Improvement cuts and/or single tree selection may be done between the groups to develop the desired stand structure of the uneven-aged prescription. Regulation of size classes and a uniform sustained flow of products may be difficult to achieve. If regulation and sustained yield are not of primary importance, small openings can be used for regeneration.

Shortleaf Pine Forest Type

Shortleaf pine is generally managed in even-aged stands, primarily because it is intolerant of shade. Both natural and artificial regeneration methods are used to establish even-aged stands. Even-aged stands of shortleaf pine are established artificially by planting or direct seeding. Establishment of even-aged stands with natural regeneration may be accomplished by clearcutting strips or patches no greater than 200 feet wide to allow seeding from nearby trees, felling the entire stand after seed fall or cone ripening, leaving seed trees, or shelterwood cutting. A major disadvantage of depending on natural regeneration is the lack of adequate seed production every year, especially in the inland and westerly areas of the species' botanical range.

Felling the entire stand in conjunction with cone and seed maturity, has been successful in some areas. The seed-tree method involves leaving 10 to 16 of the best seed producing trees per acre to regenerate the area.

The shelterwood cutting method has been successful, particularly where summer rainfall is sufficient for good first-year survival and where half of the stand or approximately 50 to 60 square feet of basal area per acre in dominant trees remains.

Shortleaf pine can be managed in uneven-aged stands with group selection as the regeneration method, an alternative that may be attractive to managers of small tracts. Selection harvesting has been primarily used in understocked stands where cutting of trees and controlling hardwoods has created openings large enough for reproduction to become established. Usually, the primary product target is sawlogs, but smaller trees are removed to achieve the desired number of trees in each diameter class. In general, the method is more difficult to use, requires more care, and is economically less efficient than alternative methods.

Oak-Pine Forest Type

Shortleaf pine of the oak-pine type is intolerant of shade and is best suited to an even-aged system of management. Natural pine regeneration can be obtained with shelterwood, seed-tree, and patch or strip clearcut harvest cutting methods, providing suitable seedbed preparation and competition control measures are achieved. Clearcutting followed by site preparation, hardwood control, and seeding or planting has been the most effective and desirable method to regenerate southern pines. Although intermediate in tolerance, desirable oak species also attain optimum growth under relatively open conditions, and openings of l/2 acre or more are recommended.

Mixed uneven-aged oak-pine forests are aesthetically pleasing and provide a diversity of habitat for many game and nongame wildlife species. However, without some hardwood control in regeneration openings, the group selection cutting method favors tolerant noncommercial hardwood species. Fire cannot be used for seedbed preparation, since seedlings in nearby regeneration openings would be killed. Group selection openings are generally too small for machine operation and sites must be prepared by scarification incidental with logging. If desirable reproduction is not obtained promptly, more expensive hand methods will be needed to control undesirable hardwoods that usually dominate the small openings. Single tree selection cutting is not recommended for management in the oak-pine type because it discriminates against the more light-demanding species. Openings created by removal of individual trees are usually too small to insure adequate reproduction of shortleaf pine and most upland oak species that dominate the oak-pine type. Successful regeneration of these species requires forest openings of at least 0.3 acre but preferably larger.

Eastern Redcedar Forest Type

Studies in north Arkansas indicate that even-aged management is suitable for eastern redcedar. Many of the better natural stands tend to be even aged, particularly on old fields and pastures where fire or other catastrophes have reduced competition from other tree species. On the cedar glades, eastern redcedar stands tend to be uneven aged. This occurs because these sites are not capable of supporting a closed forest canopy.

Shelterwood, seed-tree, and clearcut harvest cutting methods are all suitable for regenerating eastern redcedar. Control of competing vegetation and protection of seedlings from livestock are essential under all methods. The shelterwood

cutting method is effective in cedar and cedar-hardwood stands if the understory competition is sparse. The seed-tree cutting method requires leaving 10 or more well-dispersed trees of seed-bearing age per acre. The clearcut method is appropriate where the stand is mature or where establishment of new redcedar stands is the management objective.

Use of patch or strip clearcuts may be desirable for managing stands of eastern redcedar on small ownerships, since they form a mosaic of even-aged stands. However, these cutting methods require a more extensive access road network, make site preparation more difficult, increase the potential for fire damage to residual trees from fuel build-up, and in general are more costly to implement. The more extensive road network would, however, provide firebreaks and added protection against extensive fire losses.

Uneven-aged management of eastern redcedar on medium to good sites is probably not practical, since the species requires closed canopies to maintain good height, growth. Opening up such stands through individual tree selection would stimulate growth of undesirable species, reduce height growth of redcedar, and allow excessive branching to develop on individual trees. On glade sites, individual tree selection may be a suitable alternative, since these sites are only capable of supporting sparse stands of redcedar intermixed with grasses. Natural regeneration on these sites can be obtained by providing brush control and fire protection. On many such areas, grazing by livestock is often considered to be the primary management objective.

Bottomland Hardwood Forest Type

Most desirable bottomland hardwoods are intolerant or moderately tolerant of shade. Some exceptions are hickories, elms, hackberry, sugarberry, red maple, and boxelder. Even moderately tolerant trees establish and develop slowly in small openings; they may become understory trees when the crowns of overstory trees close. Trees of tolerant and sometimes moderately tolerant species will respond to overhead release at ages greater than 20 years. Those of moderately tolerant species that start from seed in dense shade will usually die within 3 years if not released. Seedlings of intolerant species seldom occur in the understory; those that do will not survive the first year.

Mixed stands were essentially even-aged and predominantly of the faster growing, light-demanding species before cutting practices and natural mortality modified stand structure and composition. Thus, even-aged management is recommended for timber production. If adequate advance reproduction is present and if sprouting will be adequate, as it often is, clearcutting or patch cutting, the two methods found most favorable for fast development of desirable species, can be used to release the regeneration. Full release is essential; trees of commercial species greater than 2 inches d.b.h. should be cut, sheared, or otherwise brought back to ground level. Choppers have been successfully used, but the giant machines can destroy root systems. Deadening trees of unwanted species is recommended. They may be cut but stump sprouts will have rapid early growth. None-the-less, trees of more desirable species will ultimately become dominant in the stand.

Where advance reproduction is inadequate, special attention should be given to stump sprouting. A high proportion of trees under 8 inches d.b.h. will produce satisfactory stump sprouts. Many bottomland species may produce sprouts from even larger stumps.

The conditions likely to be found under dense stands of large trees would favor germination of light seeds in a situation where new seedlings are most needed. Some of these seeds may already be lying dormant and will germinate when the overstory is removed. Still, complete dependence on seed regeneration is a gamble.

The alternative to clearcutting and patch cutting in stands where regeneration may be a problem is a light shelterwood cut about 10 years before final harvest. Seedlings of moderately shade tolerant species, such as the oaks, can remain alive with only 2 or 3 hours of full daily sunlight. Thus, evenly dispersed openings that approximate the size following group selection should be adequate for establishment of the shelterwood. If openings are too large, boles of leave trees will develop epicormic branches. Removal of shelterwood trees, which should be done within 5 years after adequate reproduction is established, should pose no serious problems, since broken seedlings will resprout.

Under all regeneration methods, the reproduction of most mixed stands will be composed of the same species as those in the overstory, but proportions will differ. Within a few years, however, shade intolerant species, which are usually the most commercially desirable, will die unless steps are taken to provide ample sunlight. Small openings created through single tree selection will thus ultimately result in a stand of more shade tolerant species unless openings are enlarged within 10 years. Development of reproduction in openings of less than half an acre is generally much slower than in openings of 2 acres or more. Group selection is a suitable compromise method, but only the interior of openings will favor more shade intolerant species with a tree development rate near to that in clearcuts. The seed-tree method is seldom successful because of the conditions required to establish new seedlings.

Where possible, smaller trees should be left around the perimeter of regeneration cuts to shade the boles of surrounding crop trees and thus reduce epicormic branching. Openings of a size that will allow tree development in bottomland forests are quickly covered by lush vegetation. The vine growth, common in this situation, will not prevent well-stocked reproduction stands from developing, but they do tend to equalize development rates of all species.

RECOMMENDATIONS

The main requirement for life and growth which determines the required silvicultural system for a particular tree species is light. All of the more desirable or valuable tree species in each of the five timber types are intolerant or intermediate in tolerance to shading. That is, they need a partial or total removal of the overstory to become established and to put on acceptable volume growth. Under medium to heavy shade the desirable species either do not become established or grow more slowly than their competition and are crowded out by less desirable species of timber or shrubs, i.e., red maple, sassafras. In the course of just a few years it would be possible to begin converting a stand from shade-intolerant species to shade-tolerant ones. With full sunlight or light shade the intolerant species can outgrow their competitors and remain the dominant species in the stand.

This need for light establishes the desirability of featuring the even-aged management system for growing the desired timber species. A choice between three different regeneration methods is necessary. Each of these three has a place in the management of certain species depending on existing conditions and regeneration needs.

In four of the timber types, oak-hickory, oak-pine, eastern redcedar and pine, the method chosen most often is clearcutting since regeneration will be by advanced reproduction or stump sprouting from oaks and most other hardwoods, the release of existing seedlings, planting or seeding. All these types require total or almost total removal of the overstory timber to achieve desirable reproduction.

Clearcutting may be considered optimum where:

- residue trees left from partial cutting would be damaged or lost to windthrow because of soil conditions or location.

- there is a multiple use managment objective that requires the continuence of shade intolerant tree species to be regenerated on relatively short rotations (less than 80 years).

- living, dead and declining tree species must be harvested at one time to obtain stump sprouting from the declining trees while this option is still viable (before starch reserves are depleted and while trees can still sprout).

- past fires, windstorms or disease, etc., have resulted in insufficient quantities of healthy undamaged trees that could be retained if only a partial harvest be made at this time.

- it is part of the multiple use management prescription to reduce vehicular access and to minimize the frequency of entry for the purpose of timber harvesting.

- the visual objectives can best be met by providing forest opening and vistas that can best be achieved by clearcutting.

- the existing value of the trees are low due to species composition, damaged and degrading of merchantable stem quality and their harvesting is uneconomical by partial cutting methods provided the stand has reached the culmination of mean annual increment.

- there is a primary need for a great variety of early successional plants to meet wildlife habitat needs in the form of temporary forage and the stands have reached culmination of mean annual increment and tree sizes have reached a point of economic maturity.

In summary, where oak-hickory reproduction is not a problem, clearcutting is optimum. It offers more flexibility of location to manage timber for other purposes, higher revenues, lower costs, and less risk.

An exception to this occurs in oak stands where reproduction is inadequate. In these stands shelterwood cuts are the present recommended management technique for establishing the necessary advance reproduction. Another exception is where the seed bed is satisfactory for natural pine seeding, there are adequate seed trees, and a good seed crop is anticipated. Under these conditions a seed-tree cut for pine might be implemented.

Whether a shelterwood or a seed tree method is used, the removal of the overstory timber shortly after the stand is regenerated is necessary because the species, although they may become established under the shade, do not grow as well there as they should.

The uneven-aged management system will be applied to a number of specific areas where the opportunity for success is likely or where it will further overall management area objectives.

CONCLUSIONS

An issue in the Forest Plan is the ability of the Forest to respond to timber demand. Other issues include the need to improve wildlife habitat and ensure the retention of desirable environments.

Analysis has shown the Forest can meet timber demand. It also shows that this demand can be met while effectively meeting wildlife habitat and recreation needs. The situation provides considerable flexibility in using silvicultural systems and cutting methods to the best advantage of the overall management area objective.

The even-aged management system is applied to the majority of the Forest simply because under proper coordination it provides the best opportunity to achieve overall management objectives. Standards and guidelines in Chapter IV of the Forest Plan limits the amount of suitable timber producing lands regenerated during the Plan period to that necessary to meet the wildlife habitat objective for the 0-9 year age class of vegetation while meeting other management objectives. The shelterwood method will be used where advanced oak regeneration is inadequate to meet stand composition objectives or where it can effectively contribute to resource coordination needs; i.e., aesthetics. The seed tree method may be used in managing shortleaf pine when stand conditions, the presence of seed trees, and annual seed crop are favorable.

The uneven-aged management system will be applied on the Forest to the extent it effectively contributes to overall management area objectives. Current research for the oak-hickory forest of the Ozarks does not support widespread application of the system. An emphasis during the 10-15 year Forest Plan period will be to apply and evaluate the uneven-aged system. Both group selection and some single tree selection along with improvement cutting may be applied and will impact approximately 166,000 acres. During this plan period the uneven-aged system will be applied to:

- The bottomland hardwood forest type.
- Riparian areas.
- Specialized wildlife habitats listed in Chapter IV of the Forest Plan.

- Approximately 39,045 acres of Management Prescription 6.1 including Smith Creek, Van East Mountain, Lower Rock Creek, Swan Creek, Spring Creek, North Fork area, and Big Springs Addition.

- Lands suitable for timber management on the Cedar Creek District.

- Ecological Landtypes 7 and 18 when species composition will allow the management of a white oak component.

- Ecological Landtypes 7 and 18 in Management Area 3.2 regardless of species composition.

- Eastern Redcedar in the Cedar Glades LTA.

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