



TECHNICAL NOTE



Forestry FL-20

August 2000

Planning Guidelines for Forest Stand Improvement, Code 666

Forest stand improvement may be performed for a number of different reasons (see Conservation Practice Standard, Forest Stand Improvement, Code 666), but the basic practice is to cut or kill part or all of a forest stand. Once the objectives are decided, forest stand improvement may be achieved through the techniques of Intermediate Cutting, Harvest or Regeneration Cutting, Precommercial Thinning, or Forest Weeding. (A good glossary of forestry technical terms is "Forest Terminology for Multiple-Use Management.") Following is a description of these techniques.

INTERMEDIATE CUTTING

Intermediate cuttings are treatments conducted to modify an existing crop of trees, but not to replace it with a new one. They involve selective removal of some trees to allow the expansion of the remaining trees. Considerations for planning intermediate cuttings involve decisions on the species of trees to leave, the stocking rates, the cutting cycles based on soil productivity, and multiple use objectives other than timber production. For more information on site quality and stand density, visit the IFAS website below:
<http://www.sfrc.ufl.edu/Extension/ffws/sd.htm>

A. Trees to Leave: The selection of trees to leave in intermediate cuttings should be based on management objectives, adaptability of species to certain soils, the condition of individual trees as related to insects and diseases, and the form and vigor of individual trees. Merchantable trees and trees which are likely to die should be harvested during periodic thinning. General information on species to favor on various soils is listed in the IFAS website below:
<http://www.sfrc.ufl.edu/Extension/ffws/sotimb.htm>

B. Stocking: *Stand density* is a measure of the stocking of a stand of trees. *Basal area* (in square feet) is the common method used by foresters to measure stand density.

Stands should be thinned to the desired basal area or spacing according to the species and DBH, following guidelines in Table 1 below:

Table 1 - Desired Stocking After Thinning ^{1/}

Avg. DBH Main Stand	Spacing		# Trees per Ac.
	(Ft.)	BA	
<i>Hardwoods</i>			
4	7 - 9	50 - 80	575 - 920
6	10 - 12	60 - 90	307 - 460
8	12 - 16	60 - 110	172 - 315
10	14 - 18	70 - 120	129 - 221
12	17 - 22	70 - 120	90 - 153
14	19 - 25	75 - 125	71 - 117
16	21 - 27	80 - 135	58 - 97
<i>Pine</i>			
4	8-10	40- 60	460 - 690
6	10-12	60- 80	307 - 409
8	12-14	80-105	230 - 301
10	14-17	85-115	156 - 212
12	17-20	90-120	115 - 153
14	19-22	95-130	89 - 122
16	22-25	95-130	69 - 94

^{1/} The smallest number under basal area (BA) and # of trees per ac. is the "thin to" criteria. The largest number indicates when the stand needs to be thinned.

C. Cutting Cycles: The time between commercial thinnings will vary according to site quality, with the degree of thinning based on a diameter increase of 2 inches at breast height for pine and upland hardwoods and a diameter increase of 4 inches at breast height for the other hardwood species (see Table 2). The site index for a soil type is found in Section II, FOTG – Forest Interpretations.

Table 2 - Cutting Cycle by Forest Type

Site Index	Forest Type		
	Pine & Upland Oak	Bottomland Hardwood	Sweetgum & Yellow - Poplar
	Cutting Cycle (years)		
60	8	--	--
70	7	--	--
80	6	11	12

D. Multiple Use Considerations:

1. Grazing - Where grazing is a management objective, the residual basal area should be approximately 60 sq. ft.
2. Wildlife – Mast-bearing hardwoods should be retained where possible when wildlife is a management objective.
3. Aesthetics - Flowering trees and shrubs should be favored when aesthetics is a management objective.
4. Recreation - Intermediate thinnings should be timed in order not to conflict with recreational activities.

HARVEST OR REGENERATION CUTTING

- A. Definition: Harvesting merchantable trees that are either financially or biologically mature, in a way that will provide for regeneration of a forest stand.
- B. Purpose: To harvest forest products and to ensure that the forest is regenerated for both soil protection and the production of wood products and other multiple uses. *To create openings for regeneration*, harvest trees should be removed in groups, strips, or blocks. Openings should be at least 100 feet wide to permit sufficient sunlight. Sawtimber rotations are generally from 35 to 60 years, and pulpwood/chip-n-saw rotations are usually 25 to 30 years. *To maintain a sustained yield of forest products*, a percentage of the total forest acreage can be harvest cut and regenerated each cutting cycle. This percentage is calculated by dividing the cutting cycle by the number of years in the rotation. *To maintain a sustained yield of forest products on large acreages (1000 acres or more)*, a percentage of the total forest acreage can be clearcut and regenerated each year. This percentage is calculated by dividing the total acreage by the number of years in the rotation.

C. Pine Stands:

1. Seed Tree Method: A seed tree cut is removal of an old stand with a *small number* of trees left for natural regeneration. Seed trees should be dominant trees (of the species wanted) of good quality that are at least 9 to 10 inches in diameter. After regeneration, seed trees should be removed within 3 to 5 years to reduce damage to seedlings (see Table 3).

Table 3 - Minimum Recommended Number of Seed Trees To Be Left (Per Acre)

	DBH			
	10	12	14	16+
Shortleaf	20	14	12	12
Loblolly	12	9	6	4
Slash	12	9	6	4
Longleaf**	55	38	28	21

** Shelterwood cut of 30 sq. ft. of basal area.

2. Shelterwood Cut: A shelterwood cut involves leaving a *large number* of seed trees per acre. The trees are thinned to approximately 30 to 60 sq. feet of basal area depending on species. The residual stand of trees should be removed within 3 to 5 years to reduce damage to seedlings.
3. Clearcutting: *All* merchantable trees are removed. Site preparation is usually needed to enhance regeneration. See NRCS conservation practice standard Forest Site Preparation, Code 490.

Natural regeneration methods such as seed-in-place, seedlings in place and seeding from the side may be used with clearcuts.

Tree planting and direct seeding are artificial regeneration options. Improved seedlings and improved seed should be used when possible. See NRCS conservation practice standard Tree/Shrub Planting, Code 612.

4. Individual Tree Selection: The removal of trees individually or in small clumps. This type of harvesting creates an uneven-aged stand of timber. The stand is regulated by periodic volume removal. Regeneration occurs either continuously or periodically.

D. Hardwood Stands:

1. Clearcutting: Clearcutting is one method of regenerating bottomland hardwoods. All merchantable trees should be harvested and small trees should be removed either mechanically or by the use of herbicides.
2. Shelterwood Cut: The shelterwood system can be used to obtain oak regeneration. The shelterwood system is preferable from a wildlife perspective. Stand density is reduced to 60% stocking to allow seedling establishment. When a stand of 500 or more seedlings per acre is 4.5 feet or higher, the overstory stand should be removed. It may take as long as 15 to 20 years to obtain the desired reproduction once stand density is reduced.

E. Multiple Use Considerations:

1. Grazing - Areas to be regenerated should have a tree spacing of 8'x10' or 8'x12' where forest grazing is a management objective.
2. Wildlife - Mast bearing hardwoods should be retained where possible when wildlife is a management objective. Openings should be retained or developed as needed. See 645-Wildlife Upland Habitat Management.
3. Aesthetics - Clearcuts and harvested areas should be irregular in shape where practical and flowering trees and shrubs should be favored after regeneration.
4. Recreation - Harvesting should be timed in areas used for recreation in order to avoid conflicts with recreational activities.

F. Release of Established Seedlings:

Competing vegetation may be controlled by one or more of the methods listed under part C of the next section, Forest Weeding. If necessary, seedlings should be released from overtopping trees and shrubs no later than the end of the second growing season.

- G. Protection of Young Trees: Livestock should be excluded from stands of desirable hardwoods and overgrazing should be prevented on areas planted to pine. Control of wildfire is necessary throughout the life of all stands of trees.

FOREST WEEDING

Weeding is killing of undesirable species to release trees of desired species.

- A. Trees to Release: Trees to release are determined by the owner's objectives, by species adaptation and desirability, and by the form and vigor of individual trees. Favor the most vigorous and best formed trees of desired species.
- A. Spacing and Number of Release Trees: For pine trees less than 4 inches in diameter, released trees should average no farther apart than 12 feet or about 300 trees per acre. Release pine trees 4 to 8 inches in diameter at intervals of 12 to 16 feet or about 200 to 300 trees per acre. Release hardwood trees 4 to 8 inches in diameter at intervals of 14 to 19 feet or about 120 to 220 trees per acre. If the minimum number of desired trees is not present, either replant or interplant according to specifications in 612-Tree/Shrub Planting.
- B. Methods of Removal or Control: Either remove or control unwanted trees, shrubs, vines, and weeds by either chemical treatment, mechanical treatment, or prescribed burning.

Factors to consider when choosing a method are:

- species and size of trees and other vegetation to be killed,
 - presence of desired trees,
 - density of unwanted trees and other plants,
 - site quality,
 - size and location of the area to be treated, and
 - costs of equipment and materials.
1. Mechanical treatment: Trees can be girdled with either an axe or a mechanical tree girdler. Trees smaller than 12 inches in diameter may sprout, and such trees should be treated with a herbicide.
 2. Cut and fell: Larger trees may be removed by the cut and fell method. Trees should be utilized for firewood where feasible. Tree stumps 14 inches in diameter or less should be treated with herbicides to prevent sprouting.
 3. Tree injection: Herbicides are applied to individual stems at the rate of 1 to 2 ml

per inch of stem diameter. Advice on herbicides to use can be obtained from the Florida Division of Forestry and private forestry consultants.

4. Spraying: Both high volume and low volume herbicidal sprays may be used to kill undesirable woody plants. Low volume sprays are usually applied by either aircraft or mistblowers.
5. Soil treatment: Certain herbicides may be applied to the soil to control undesirable plants. Application rates will vary according to soil types and plant species.
6. Prescribed burning: Prescribed burning can be used to control undesirable hardwoods usually 2 inches or less in diameter. For specifications, see 338-Prescribed Burning.

Caution: If not properly handled and applied, herbicides can be injurious to people, domestic animals, beneficial insects, desirable plants, and to fish and other wildlife. Use herbicides selectively and carefully, following label directions. Follow recommendations when disposing of surplus herbicides and herbicide containers.

PRECOMMERCIAL THINNING

Precommercial thinning is needed 1) where stands of desirable trees are of unmerchantable size and are overstocked, thereby preventing satisfactory growth, and 2) where thinning will either increase the growth of remaining trees or enhance the beauty of the stand.

Precommercial thinnings are usually applied to seedling and sapling-sized stands (stands with trees less than 5 inches in diameter).

- A. Species to Favor: Favor trees according to desirable species, form, vigor, and crown development. See Section II, FOTG – Forest Interpretations for species to favor on various soils.

1. Selecting Trees to Leave:

- a. Seedling-Sized Stands: In seedling-sized stands where all trees are about the same size, it is usually best to leave clumps of seedlings 6 to 10 feet apart.

- b. Sapling-Sized Stands: In sapling-sized stands, release the best trees at 10 to 12 foot intervals.

2. Removing Trees: Remove trees by one or more of the following methods:

- a. Mowing Machine: Where trees are generally less than 2 inches DBH, mow strips 6 to 10 feet wide and either cross-check or cross-mow strips of the same width. Remaining clumps should be 2 feet wide.
- b. Bush and Bog Harrow, Chopper, or Bulldozer Strips: Disk trees in the seedling to small sapling size with a bush and bog harrow or knock them down with either a bulldozer or chopper. Remove in strips of the same width and crosscheck in the same manner as for mowing. To prevent root damage, strips that remain should be 2 feet wide.
- c. Hand Tools: Seedlings and saplings may be thinned with machetes, axes, bush hooks, hoes, or with power equipment such as chain saws. Seedlings up to 20 inches tall should be cut near the ground level. Seedlings and saplings taller than 20 inches may be cut at waist height if they are cut below living branches and stem needles.

3. Optimum Seasons for Thinning:

- a. Pine Types: In pine stands, precommercial thinnings should be done from October through March. Thinnings at that time reduce the possibility of insect infestation.
- b. Hardwood Types: Precommercial thinnings should be done in hardwood stands during midsummer because there is less sprouting then than during other seasons.
- c. Pine-Hardwood Types: Precommercial thinnings should be done in pine-hardwood stands in late fall and winter. Sprouting of hardwoods may be controlled by herbicides.

4. Slash Disposal: To reduce the possibility of loss from insects and fire, leave no trees cut in precommercial thinnings either leaning against remaining trees or touching them. In high fire-risk areas, cut trees should be removed.

OTHER CONSIDERATIONS

The impact of forest stand improvement operations on any threatened and/or endangered species present must be evaluated.

Wildlife food and cover can be retained by minimizing modifications to composition and spacing regardless of the purpose for treatment. Forested wildlife corridors can minimize fragmentation effects. Timing of treatment and retaining dead or dying trees will minimize impacts on wildlife.

Select appropriate tree removal techniques that would reduce the potential for erosion and sedimentation.

Erosion rates and sediment yields may increase as a result of harvesting activities.

Proper selection and application of pesticides should be considered to minimize surface water transport and potential leaching to ground water. Additional information on vegetation management may be found at the following IFAS website:
<http://www.sfrc.ufl.edu/Extension/vegman.htm>

REFERENCES

NRCS Florida FOTG, Section II – Forestland Interpretations

NRCS Florida Conservation Practice Standards
Forest Stand Improvement, Code 666
Prescribed Burning, Code 338
Forest Site Preparation, Code 490
Tree/Shrub Planting, Code 612
Wildlife Upland Habitat Management, Code 645

University of Florida, Institute of Food and Agricultural Sciences, School of Forest Resources and Conservation, Florida Forestry Information
<http://www.sfrc.ufl.edu/Extension/ffws/ffwshome.htm>

University of Florida, Cooperative Extension Service, "Forestry Terminology for Multiple-use Management." See
http://edis.ifas.ufl.edu/MENU_FR