THE APPLICATION OF SOIL SURVEY INFORMATION TO FOREST-GAME HABITAT MANAGEMENT ON THE CUMBERLAND NATIONAL FOREST*

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INTRODUCTION

Skillful coordination of land-use objectives and practices is the key to successful forest-game habitat management. Such land-use coordination is facilitated through a fundamental knowledge of soils. Soil survey reports contain information on soil characteristics, behavior, distribution, and potential for many uses including forest-game management.

On National Forests standard soil surveys are conducted cooperatively by the U. S. Forest Service, Soil Conservation Service, and State Agriculture Experimental Stations. These surveys are published for both public and private land including forested areas. This paper describes how information from such a report is being used to guide wildlife habitat management on the Stearns Ranger District, Cumberland National Forest, McCreary County, Kentucky.

DEVELOPMENT

Soil science provides a common meeting ground for coordinating timber and wildlife management. Timber management uses soils information to decide what commercially desirable tree species can be economically grown on an area. Wildlife management employs soils knowledge to determine the potential of the land to support various game habitat types. Timber management and other land uses affect the quality and quantity of habitat elements produced plus the period of time these elements remain available to game. However, the present-day distribution of habitat types reflects past land use rather than the soil potential to produce forest-game habitat. Rarely has the soil potential to produce habitat elements been considered in multiple-use land management; although, Allan, et. al. (1) explored the possibilities of relating woodland, farm, and wetland game to land use in agricultural areas. A few papers (5, 6) mention fitting game species to timber management practices based on soils information and the ecological environment.

Timber and wildlife habitat management function by adjusting the rate and direction of plant succession. Natural plant succession is the orderly replacement of one plant community by another—a process which varies by soils (3, 4, 7). Some sequences proceed at a rapid rate and have only a few different stages; others proceed very slowly and have many stages. The rate of change and species composition of these various stages strongly influence the character and stability of the habitat. With each different stage the availability of food and cover varies and consequently the potential for wildlife of different species.

Where forest-game management is an important land use, the wildlife manager should know what plant communities occur by soils at different times and under various intensities of forest practice. Such knowledge facilitates: (a) selecting for emphasis those game species most compatible with timber management objectives; (b) evaluating the likelihood of success for game management programs incompatible with a soils-based timber program; and (c) the feasibility of modifying timber management practices by soils for the sake of wildlife habitat.

Silviculture is the tool by which plant succession is manipulated to attain forestry objectives. It also may be used to attain game

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management objectives so long as both economic and soil-related limitations are recognized. Silviculture may be employed to create deer browse or evergreen cover within forest stands or to perpetuate a vigorous nut-yielding hardwood forest provided it is within the potential of the soil.

Successful timber management selects a successional stage which yields maximum returns for a minimum investment. Usually the best successional stage (forest type) has several commercially preferred species which can be economically regenerated and maintained. Occasionally only one tree species might be selected, but generally, for ecological and silvicultural reasons, it is better to choose a combination of species from the most favorable naturally occurring successional stage. On the Cumberland National Forest, this stage is known as the "desired management type."

When a desired management type has been selected for a soil, silviculture and economics determines the optimum length of cutting cycles and rotations. A timber management system encompassing one or more management types by soils establishes an independent base upon which other land uses may coordinate their long-term programs by specific land units such as those delineated on soils maps.

APPLYING THE INFORMATION FROM SOILS MAPS

Each soil mapping unit has its own characteristics such as soil type, slope, stoniness, etc. On the Cumberland National Forest mapping units which average between 10 and 50 acres are used for direct planning on specific sites. From soils information one may predict the character and distribution of vegetation whch will develop following silvicultural treatment. Therefore, one may also predict the character of the wildlife habitat which will occupy a mapping unit at any stage in the timber rotation.

Soil scientists also divide survey areas into large, relatively homogeneous landscapes called soil associations. Each soil association is described in detail, including the proportion of different soils and how they occur on the landscape. General management interpretations made for an association are valid throughout its extent. The value of soil associations for wildlife management is primarily for long-term habitat planning for game species whose range exceeds a soil-mapping unit and in analyzing the overall potential of an area for an individual forest-game species.

TIMBER-WILDLIFE COORDINATION BY SOILS

Some typical soils on the Cumberland National Forest are described below to illustrate timber and wildlife management coordination based on soils informations obtained from a standard soil survey.

DEKALB SOIL

Dekalb is a moderately deep (24 to 30 in.), sandy soil that occurs on ridgetops and upper side slopes. It is somewhat excessively drained (droughty), very strongly acid, and low in natural fertility. Since the amount of available soil moisture is low, xerophytic plant communities dominate and the rate of succession from pine to hardwoods is very slow. Braun (2) suggests that southern yellow pines—shortleaf, Virginia, and pitch—may be the climax type. Site index for shortleaf pine is 60. Occasionally associated hardwoods are post, blackjack, black, and southern red oaks, black gum, and mockernut hickory. These hardwoods are of low timber quality. Predominant shrub vegetation includes mountain-laurel, flowering dogwood, sassafras, azalea, blueberry, and sawbrier.

Ecologically and economically, the preferred timber management type for this soil is southern yellow pines. Production of commercially desirable hardwood species is very difficult with presently known cultural methods and under existing economic conditions. Management

for pine with a silvicultural rotation of 60 years and two or more intermediate thinnings is recommended.

Production of abundant browse plants and evergreen cover, ideal habitat for whitetail deer, is favored by the timber management direction. Dependable mast needed by wild turkey and grey squirrels cannot be achieved without sacrifice of timber production. Ecologically a dense understory, unfavorable for wild turkeys, can be expected.

HARTSELLS SOIL

Hartsells is a moderately deep to deep (26 to 42 inches) soil occurring on level to gently rolling upland ridgetops. It is well drained, very strongly acid, and low in natural fertility. Hartsells soil is deeper, has a finer textured subsoil, and better water storage potential than Dekalb soil, resulting in more mesophytic conditions for plant growth. Although pines dominate in early successional stages, the climax type is probably oak-southern pine. Site index on Hartsells soils is 65 for oak, 70 for shortleaf pine.

The preferred timber management type is pine-hardwood favoring shortleaf pine with a minor component of (up to 25%) black, scarlet, chestnut, and white oaks. Shrub species are similar but the stocking is less dense than on Dekalb, because the overstory is denser in maturing stands. The pine type can be maintained with a minimum of cultural treatment. An 80-year rotation is recommended.

For wildlife purposes this soil is best suited for deer browse production but dependable mast producing species, particularly scarlet, black, white, and chestnut oaks, black gum, and hickories respond to treatment. Game species most compatible with timber management are deer and grouse. Limited possibility for squirrel and turkey management exists if the hardwood component is favored and the rotation extended.

ALBERTVILLE SOIL

Albertville is a moderately deep (30 to 36 in.), moderately fine-textured soil developed from clay shales on rolling ridgetops and sideslopes. It is well drained, moderately permeable, very strongly acid, and low in natural fertility.

Shortleaf and Virginia pines occur in the pioneer stage following severe disturbance. However, this stage is difficult to maintain because plant succession proceeds rather quickly to the upland oak-hickory type, composed of black, scarlet, white, and chestnut oaks, black gum, pignut and mockernut hickories. The preferred timber management type is hardwood-pine favoring white, chestnut and black oaks, and shortleaf pine. Site index is 65 for oak and shortleaf pine.

The recommended silvicultural rotation for hardwoods on Albertville soil is 100-120 years, 60 years or less for pine. At least two thinnings are required.

This soil will support a wide variety of mast-producing trees. Browse production and evergreen cover is sparse in the understory of intermediate stands, to the detriment of deer management. Normal silviculture practices on this soil will produce good quantities of mast for turkey and squirrel. Stimulating the growth of deer browse foods requires frequent cuttings and understocked stands which are not recommended for timber management. Coniferous cover can be maintained only through frequent herbicidal treatment. The open glade-like condition often associated with turkey habitat is characteristic of undisturbed stands or stands managed by the evenaged system of silviculture.

JEFFERSON SOIL

Jefferson is a deep, well-drained soil developed from colluvium oc-

curring on middle and lower sideslopes. It is strongly acid, low in natural fertility, but has a high available water storage capacity.

Plant succession develops quicker on northerly aspects than on southerly aspects. Upland oak site index varies with aspect from 85 to 60. This soil supports the oak-hickory or cove hardwood types except where southerly aspect and steep slopes combine to create droughty conditions. In this case, the oak-pine type prevails, with dense understories of mountain laurel and greenbrier.

Rhododendron, strawberry-bush, ninebark, hydrangea, hazelnut, wild grape, maple leaved viburnum, and American holly are typical shrubs of northerly aspects; mountain-laurel, flowering dogwood, greenbrier, and blueberry on south slopes. Jefferson soil supports highly productive timber stands and a variety of dependable mast producers. Cove hardwoods (yellow poplar, white, black and red oaks, hemlock, and beech) are desired for timber management on northerly slopes; mixed oak-pine or pin-oak on southerly slopes. Rotations of from 80 to 120 years are recommended with several intermediate thinnings. Browse quickly grows out of reach but maturing stands on south slopes support moderately dense shrub layers. Evergreen cover for grouse, such as mountain-laurel, rhododendron, or hemlock thickets, can be readily perpetuated depending on aspect and position on slope.

High mast production from a wide variety of species commonly growing on the northerly aspect of this soil provides excellent squirrel and turkey habitat. Management for squirrels requires that this wide variety of species be maintained. Maintaining ideal deer and grouse habitat on Jefferson soil of northerly aspects requires frequent cuttings to create an open forest canopy and must be somewhat at the expense of high-value timber production.

WELLSTON SOIL

Wellston is a deep (36 to 48 inches) medium-textured soil developed on the broad ridgetops from siltstone and shale. It is well drained, very strongly acid, and low in natural fertility but has a high available water storage capacity.

Plant succession develops quickly from pure pine stands which are difficult to perpetuate to oak-pine or upland hardwood types. Quality hardwoods including black, white, and chestnut oaks and yellow poplar can be economically produced. A variety of other hardwoods occurs in admixture. Oak site index for Wellston soil is 75. Shrub vegetation typically includes strawberry bush, blackberry, sumac, beggar's tick, greenbrier, and flowering dogwood. The desired timber management type is oak-pine, including white, black, chestnut and scarlet oaks, and shortleaf pine. The recommended rotation is 80-100 years, with several intermediate treatments required.

This is an ideal upland soil for the production of mast and tree fruits. Browse grows out of reach rather quickly following clear cutting, and is not well represented in well-stocked intermediate stands. Where turkey management is the objective, this soil is of key importance for producing upland oak mast, flowering dogwood fruits and a rather open understory condition.

TIMBER-WILDLIFE COORDINATION BY SOIL ASSOCIATIONS

Two soil associations, widespread in the Stearns Ranger District of the Cumberland National Forest, have been selected to illustrate their use in long-range habitat management planning. The key to successful wildlife planning within soil associations is selecting game species adaptable to the timber management direction and then achieving the desired patterns of food and cover types on the soil mapping units most capable of supporting them.

JEFFERSON - HARTSELLS - DEKALB ASSOCIATION

This soil association occupies 34,723 acres *(17 per cent)* of the District. It is composed of 60 per cent Jefferson, 20 per cent Hartsells

and 20 per cent Dekalb soils (Figure 1). Small acreage of Wellston and Albertville soils may occur on the ridgetops.

This association supports both hardwoods and pines, with pines predominating. Pure pine stands occur on narrow ridgetops, sandstone outcrops, and south-facing slopes. Hardwoods occupy northerly aspects and the broader ridgetops. Soil productivity potential indicates that approximately 65 per cent of this area is adapted to growing pine or pine-oak stands as the desired management type. Expected rotation is 80 years or less. Only 35 per cent of the association is adapted to growing hardwoods as the desired management type.

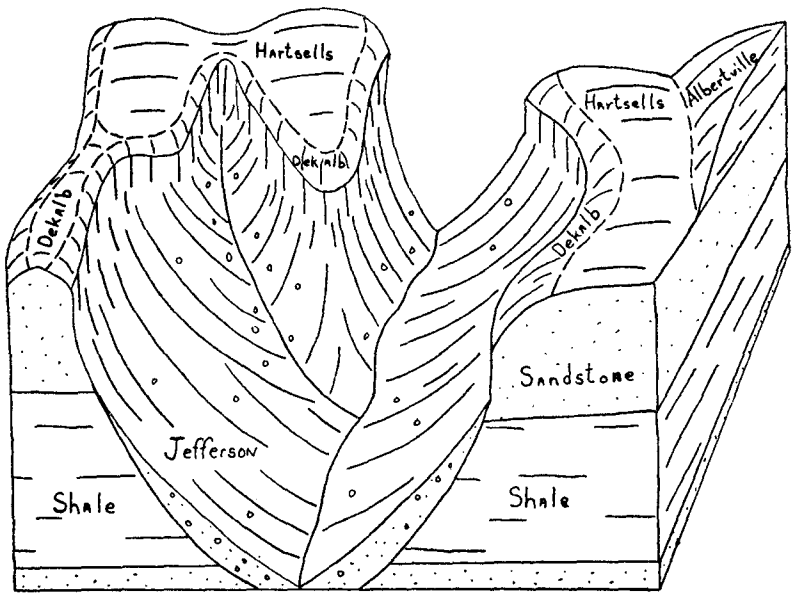

Fig. 1: Jefferson - Hartsells - Dekalb

Abundant browse production and evergreen cover will occur naturally from timber management activities. Mast and other desirable tree-fruit will be relatively scarce. Mast production will be concentrated on the northerly slopes of Jefferson soil and the minor acreage of Albertville and Wellston soils. Abundant evergreen cover will continue to be produced on Dekalb and Hartsells soils by pine stands in early growth stages. Highly preferred and heavily browsed greenbriers and blueberries will continually be abundant on Hartsells and Dekalb soils and on Jefferson soil with a southerly aspect.

This soil association lends itself best to intensive management of whitetail deer and grouse habitat. There is a moderate opportunity for squirrel management only on northerly aspects of Jefferson soil. Turkey habitat management is handicapped by the low proportion of mast bearing stands and a tendency toward the dense shrub understories usually avoided by turkeys.

JEFFERSON-ALBERTVILLE-DEKALB ASSOCIATION

This association occupies 84,716 acres *(41 per cent)* in the Stearns Ranger District. It is composed of 50 per cent Jefferson, 25 per cent Albertville, and 10 per cent Dekalb soils with Wellston, Hartsells, and other soils 15 per cent (Figure 2).

Seventy per cent of this association is well adapted to cove hardwood, upland oaks, and oak-pine as the desired management types.

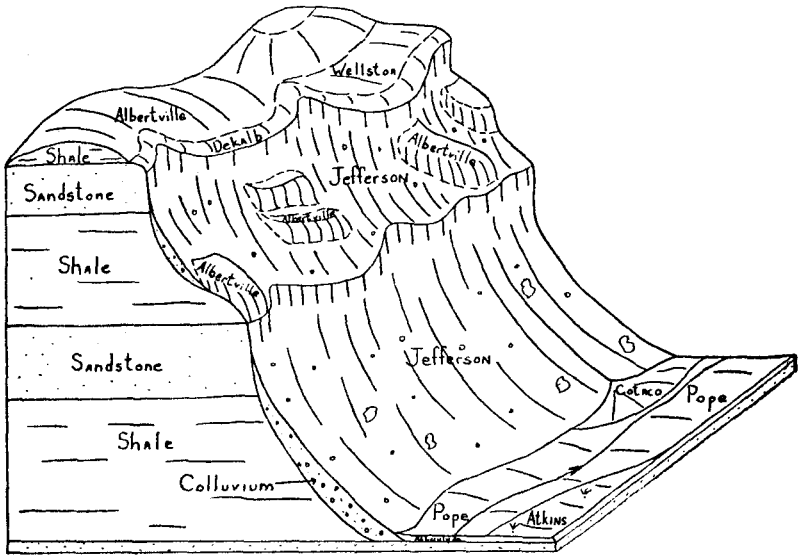

Fig. 2: Jefferson - Albertville - Dekalb

The expected rotation for these types is 100 years or more. Thirty per cent of the area is adapted to pine and pine-oak management types. Expected rotation is 60 years for these types on Dekalb, and Hartsells soils and southerly aspect of Jefferson soil.

This association produces a dependable mast crop and a variety of desirable tree fruits. Expected timber management direction will continually result in habitat types that are heavy mast yielders. Therefore, turkey and squirrel have been selected for intensive, long-range management. Opportunities to produce abundant browse and evergreen cover are limited. Long-range efforts to maximize deer and grouse habitat in this association would conflict more with timber use than would be experienced in the Jefferson-Hartsells-Dekalb association, although moderate populations of both species can be maintained. The best opportunity to improve this area for deer and grouse are with manipulating the pine and pine-oak stands of the Dekalb and southerly Jefferson soils, or by increasing the frequency of treatments of the hardwood stands on the other soils.

Long-range coordination of game habitat with timber management illustrated above applied a knowledge of the soil-vegetative relationships to specific management situations. Any proposed modification of silvicultural practices could be weighed by its total effect on both timber and wildlife habitat production on the soil unit.

DIRECT HABITAT IMPROVEMENTS

Information on soil distributions and quantities is valuable when choosing sites for direct habitat improvements. For instance, ridgetop waterholes are easy to construct and maintain on Wellston and Albertville soils but are difficult to build on Dekalb and Hartsells soils. In the above soil associations where available surface water is a limiting management factor for deer or turkey, needed waterholes are best constructed on the Wellston and Albertville soils. Such soil areas constitute a high priority for game habitat management versus other land uses. Consulting a soil survey report saves time in planning waterhole sites and pre-determining construction problems.

Soils information is useful in selecting areas for pasture-type sod clearings. Wellston soil is particularly well suited for sod clearing

because of a high water-holding capacity and moderate slopes. Annual crops as well as Bluegrass-white clover pastures are easily established and maintained on this soil. On Dekalb soil, only less palatable fescues or lespedeza can be easily established and maintained. However, sprout clearings for browse established on Dekalb soil tend to produce desirable natural shrubs, particularly blueberry and greenbrier. Sprout clearings on Wellston soil quickly close and grow out of reach.

Table 1. Common and Scientific Names[1] of Plants Mentioned in Text

Common Name	*Scientific Name*
American Holly	Ilex opaca Ait.
Azalea	Rhododendron nudiflorum (L) Torr.
Beech	Fagus grandifolia Ehrh.
Beggar's ticks	Desmodium spp.
Black Oak	Quercus velutina Lam.
Blackberry	Rhubus spp.
Blackjack Oak	Quercus marilandica Muenchh.
Black Gum	Nyssa sylvatica March.
Blueberries	Vaccinium spp.
Bluegrass	Poa pratensis L.
Chestnut Oak	Quercus prinus L.
Fescue	Festuca sp.
Flowering Dogwood	Cornus florida L.
Greenbrier	Smilax rotundifolia L.
Hazelnut	Corylus americana Walt.
Hemlock	Tsuga canadensis (L) Carr.
Hydrangea	Hydrangea arborescens L.
Lespedeza	Lespedeza spp.
Maple Leaved Viburnum	Viburnum acerifolium L.
Mockernut Hickory	Carya tomentosa Nutt.
Mountain-Laurel	Kalmia latifolia L.
Ninebark	Physocarpus opulifolius (L) Maxim.
Pignut Hickory	Carya glabra (Mill.)
Pitch Pine	Pinus rigida Mill.
Post Oak	Quercus stellata Wang.
Red Oak	Quercus rubra L.
Rhododendron	Rhododendron maximum L.
Sassafras	Sassafras albidum (Nutt.) Nees.
Sawbrier	Smilax glauca Walt.
Scarlet Oak	Quercus coccinea Muenchh.
Shortleaf Pine	Pinus echinata Mill.
Southern Red Oak	Quercus falcata Sarg.
Strawberry-bush	Euonymus americanus L.
Sumac	Rhus spp.
Virginia Pine	Pinus virginiana Mill.
White Clover	Trifolium repens L.
White Oak	Quercus alba L.
Wild Grape	Vitis spp.
Yellow Poplar	Liriodendron tulipifera L.

[1] From Gray's Manual of Botany, Eighth Edition, M. L. Fernold, 1950.

SUMMARY

Multiple-use management requires knowledge of the relationship between soils and vegetation. Soil survey information provides a basis for multiple-use management coordination over the long run. Coordination based on existing patterns of vegetation without regard to soils is faulty because present vegetation reflects past land use and not the site potential.

Soils information applied to forest-wildlife management helps determine the game species to emphasize, identifies specific sites for development, protection, and enhancement of key habitat elements and

can be used as a basis for preparing area-wide habitat maps reflecting projected conditions.

Multiple land use begins from a common base — soil. Coordination can be planned more specifically through the application of soils information as contained in the soil survey report.

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RESOLUTION

FARM GAME COMMITTEE

SOUTHEASTERN SECTION OF THE WILDLIFE SOCIETY

MARCH 1965

WHEREAS, the Farm Game Committee of the Southeastern Section of the Wildlife Society in deliberation over the past several years has become increasingly aware of a decreasing hunting opportunity for sportsmen, and

WHEREAS, it is recognized, in general, that wildlife habitat on privately owned tracts is being destroyed at an alarming rate resulting in declining wildlife populations, and

WHEREAS, hunter access to wildlife populations on private property is also decreasing and,

WHEREAS, one solution to the problem is the provision of publicly owned and managed tracts for hunting and other recreational pursuits, and

WHEREAS, the 36,000-acre Camp Breckinridge Military Reservation in western Kentucky, declared surplus by the Department of Defense and now awaiting final disposition by the General Services Administration, has all the attributes of a fine farm game hunting area, and

WHEREAS, the sale of a major share of this Reservation to private interests for farming activities (as planned) is unwarranted in the light of: (1) the surplus farm crop situation, and (2) a statement by Secretary of Agriculture Orville L. Freeman at the White House Conference on Conservation in May 1962 that by 1980 the United States will be able to meet all needs for crop products with 50 million *fewer* acres than then presently used, and