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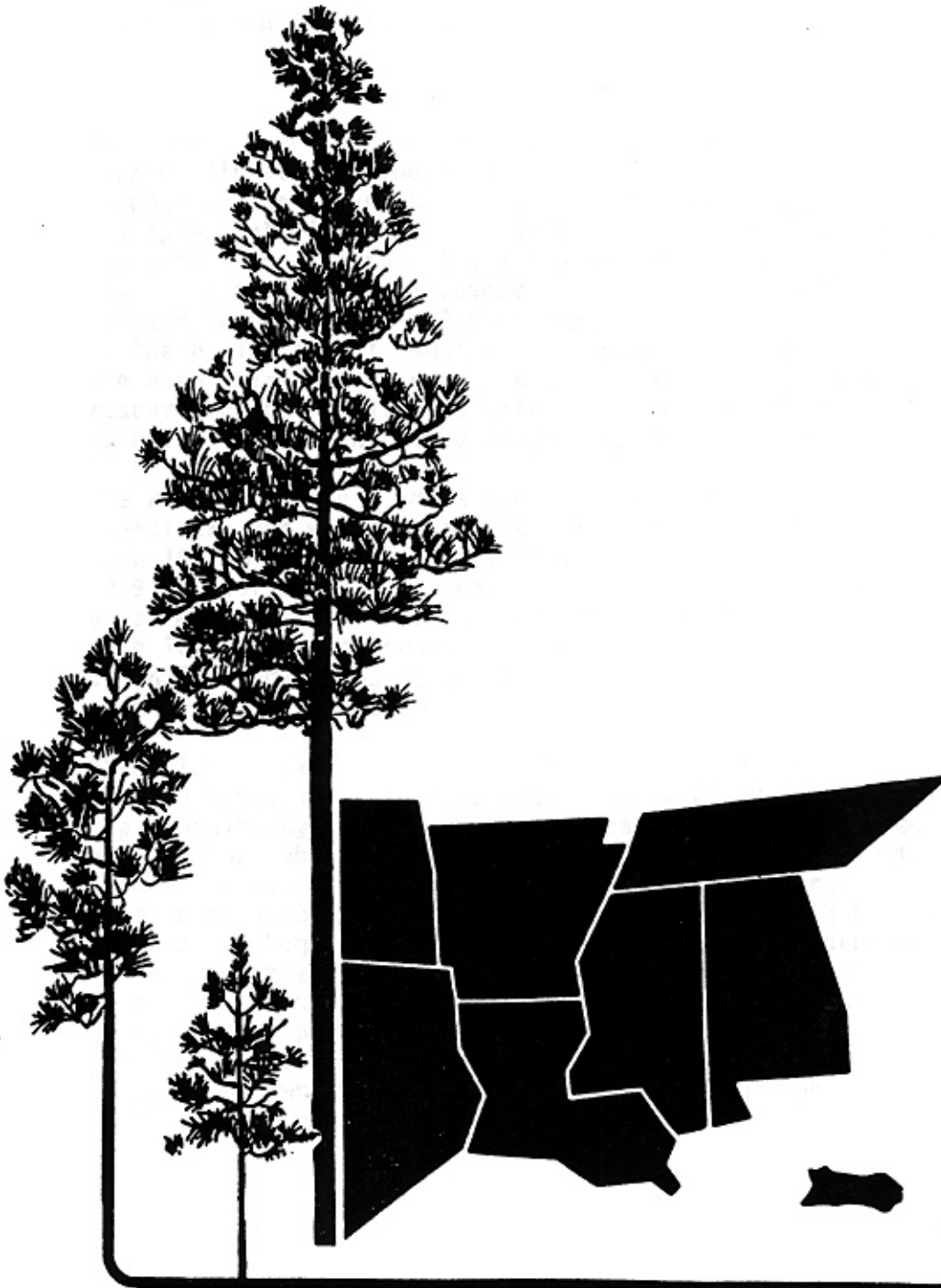
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Agroforestry

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Abstract

This paper described multiple-use interrelationships of forage, livestock, pine timber, and wildlife on the southern forest range. Major concerns affecting agroforestry are defined. Forest range practices and guidelines to achieve improvement are discussed. A program to achieve success in research, education, and Extension is outlined.

Introduction

This paper discusses multiple-use interrelationships of agroforestry involving forage, livestock, pine timber, and wildlife on the southern forest range. The purpose of the paper is to acquaint the workshop group "Public Interest in Multiple Use" with resource conflicts and trade-offs in integrated management, concerns affecting forest grazing management, and available forest range practices to achieve improvement. The scope of the presentation is mainly limited to biological relationships among forage, cattle, pines, and deer on southern pine forest ranges. Multiple-use economics involving cattle and pines are also briefly mentioned. Most of the problems identified are being researched, but additional information is needed to refine multiple-use management guidelines in a manner acceptable to the public.

The region has the climate and soils necessary to effectively combine timber, livestock, and wildlife on the same area. Precipitation varies from 110 to more than 150 cm and is uniformly distributed throughout the year (Nelson and Zillgitt 1969). Most of the area has at least a 7-month growing season while the coastal areas may be frost-free for more than 9 months. Soils generally are moist to wet with low amounts of organic matter. Herbage yields vary from 250 kg/ha on sandhills under dense tree canopy to 4,500 kg/ha on deep sandy loams under an open canopy (Leithead 1973).

Three forest-range types have the greatest multiple-use potential in the South: (1) the longleaf-slash pine (*Pinus palustris*-*P. elliotii*) - bluestem (*Andropogon* spp., *Schizachyrium* spp.), (2) longleaf-slash pine - wiregrass (*Aristida stricta*) and (3) the loblolly-shortleaf pine (*P. taeda*-*P. echinata*) - hardwood-bluestem. Longleaf-slash pine forests, the leading forage producer, occupies about 12 million ha along the Lower Coastal Plain from South Carolina to East Texas (Carter and Hughes 1974; Grelen 1974). Periodic burning is common and forage yields may exceed 2 tons per ha on cutover forests or under sparse tree canopies. About 22 million ha of the loblolly-shortleaf pine-hardwood type are found on the Upper Coastal Plain. This type occurs in a belt 240 to 485 km wide from eastern Texas to northeastern Virginia (Walters and Wilhite 1974). This forest type, which has denser timber stocking than the long-slash pine type, usually produces less herbage even though it can produce more than 4 tons per ha (Walters et al. 1982).

Concerns

Multiple-use management of livestock, wildlife, and timber presents some new challenges compared with single-use management. Probably the most important are the social and economic barriers. For instance, some foresters fear that livestock will damage, by browsing or trampling, young pine plantations or that cattlemen will burn the young trees in an effort to provide fresh green forage in early spring. Few foresters have been good examples of integrated management but many are familiar with situations involving damage from uncontrolled numbers of livestock with little or no management.

Wildlife biologists contend that cattle consume excessively large quantities of deer food, especially during winter. Cattlemen counter with the argument that well-managed livestock operations pose no threat to wildlife or timber stands, but that some benefits accrue from well-managed grazing. Many foresters also believe that stockmen are not willing to pay enough for the grazing resource to offset the efforts and expense of management (Sullivan and Matney 1980).

More intensive management is necessary to coordinate multiple-use on a single piece of land. Some trade-off may occur in the single-product yield when multiple-use management occurs. Reductions in goods and services, however, are not always as great as anticipated. Intensive management may also bring additional problems. For instance, forage fertilization could accelerate tree growth and increase the incidence of insects and diseases (Lewis 1980).

Research and technology transfer needs affecting forest grassing management or agroforestry in the South are:

1. Describe the tree overstory-understory forage relationships for the major pine species.
2. Determine the effects of prescribed burning on forage and trees.
3. Develop intensive systems of grazing management that are compatible with pine regeneration.
4. Design economical livestock supplemental feeding regimes including the use of improved forages for winter grazing.
5. Determine livestock-wildlife relationships (particularly cattle and deer).
6. Provide avenues to attain social acceptance of multiple-use management, including forest grazing.

Relationships and Practices Forage Relationships

Overstory tree density, or canopy, has the greatest influence in determining forage yields. Yields decrease as tree canopies increase (Wolters 1973, Lewis et al. 1982, Grelen and Lohrey 1978). On regularly burned forest range, grasses and forbs usually make up large portions of the yields. In unburned forest range, shrubs and vines become the predominant forage under dense canopies (Schuster and Halls 1962, Wolters et al. 1982). Canopy influences even forage nutrients; for instance, forage crude protein content is higher under shade than in the open (Wolters 1973).

Grazing intensity of the native forest range does not significantly affect total herbage yields although botanical composition does change (Clary 1979). For instance, bluestems are reduced while carpetgrass (*Axonopus affinis*) increases with grazing intensity. However, bluestems are generally preferred, especially for yearlong grazing since carpetgrass deteriorates during winter.

Rotational burning and grazing improves forage palatability and nutritive value (Duvall and Whitaker 1964). Cattle concentrate on newly burned range within 1 to 4 weeks depending on the date of burning and grass growth. Usually, grazing is uniformly heavy through the summer on the fresh burns with little selectivity among grass species.

Exotic grasses or legumes in the native forest range in the southeast have succeeded only with land preparation, fertilization, and shrub control (Burton 1973). Some improved forages, however, have been established in longleaf-slash pine forests when litter is removed by burning and fertilizer is applied (Halls and Suman 1954).

In some situations, supplementing the forest range with adjacent improved pasture (about 0.2 ha/cow) is better than growing trees and improved pasture together (Lewis and McCormick 1971; Burton 1973). One option is to produce feed on land cleared for fall and winter use and to graze the native forest range in spring and summer. Grazed firebreaks (9 m or more wide) are a practical way to integrate forest trees and improved pasture forages (Halls et al. 1960).

Cool-season exotic grasses, such as fescue (*Festuca arundinacea*), grown under pine stands provide green forage during the winter when natives are dormant (Pearson 1975). Nagela variety of subterranean clover (*Trifolium subterraneum*) is not only shade tolerant but it has good forage quality in winter (Watson et al. 1984, Davis et al. 1984). Crude protein values in subterranean clover are 18 to 23 percent even without nitrogen fertilizer.

Forest Grazing and Pine Regeneration

The key to success in multiple-use management is maintaining a balance between forage and animals. Management guidelines developed to reduce cattle damage to pine regeneration include prescribed winter rotational burning and control of grazing intensity (Duval and Whitaker 1964; Pearson et al. 1971, Pearson 1980). Avoiding late winter and spring grazing during the first year of pine establishment alleviates most damage problems, even with high stocking rates. Deferred or seasonal grazing until trees are 2 to 3 m tall will also reduce damage (Cassady et al. 1955). Even in grazed subterranean pastures, preliminary results indicate that pine regeneration can be successful (Pearson 1983).

Furthermore, pine appear highly resistant to grazing damage. In an attempt to stimulate grazing damage on pines in Georgia, several types of injury were inflicted on slash pine seedlings, including removal of needles, removal of the growing shoot, bending of the stem parallel to the ground, and stem girdling (Lewis 1973, 1980b,c,d). Mortality was negligible except after complete girdling. In earlier studies, shortleaf and loblolly pines browsed within an inch or two of the ground by rabbits were found to survive and grow as well as unbrowsed trees (Wakely 1970).

Some tree benefits may accrue through a multiple-use management program where grazing reduces competition and removes hazardous fuels before and during pine regeneration (Pearson 1974).

Prescribed Burning

Prescribed burning is helpful because it reduces fire hazards, controls brownspot disease in longleaf pines, reduces plant competition, increases visibility for tree marking and logging, and reduces logging slash. Burning also top-kills brush, reduces litter accumulations, provides early green forage in the spring which is highly palatable and nutritious, and may be used to pull animals away from new plantations (Lay 1957; Grelen and Epps 1967a; Duval and Whitaker 1964). Burning of ranges in February through March meets cattle management needs because the burning occurs before the onset of spring growth. Spring burns stimulate growth in longleaf pine (Grelen 1978) and some burns may enhance aesthetic values by maintaining open parklike stands, emphasizing vegetation changes, and by increasing flowering plant visibility (Mobley 1974). Yield and nutrient content of herbage increases on burned range but differs little from other forage removal practices, such as mowing and raking (Grelen and Epps 1967b). Lay (1957) found that burning at any season increased the protein and phosphorus content of browse but most benefits disappear within a year or two.

Cattle and Deer

Livestock and wildlife programs can be mutually beneficial. For instance, livestock grazing can benefit wildlife by stimulating new plant growth. Range livestock management usually provides water and supplemental feed that can be used by wildlife. Hunting leases can provide an additional source of revenue for the forest landowner. These uses, when properly managed, also foster good will in the local community.

Substantial diet overlap occurs between white-tailed deer and cattle during winter and early spring on forested loblolly-shortleaf pine-hardwood sites, but diets are largely complementary during the remainder of the year (Thrill 1984). Diets on clearcuts are complementary yearlong with deer selecting primarily browse and forbs while cattle eat mostly grasses and grasslike plants.

When livestock and wildlife numbers exceed food supplies, tough, undesirable competition exists and resources may be damaged. Overuse by livestock for long periods is detrimental to plant composition and yield and can cause soil and site conditions to deteriorate (Duval and Linnartz 1967). Excessive use by big game have similar effects and may cause damage to nearby agricultural crops.

Economics

Multiple-use land management with cattle, wildlife, and trees provides economic flexibility for forest-range landowners of the South. Regeneration, growth, and economic gains were reported recently along with estimated 40-year returns (Pearson 1982). Highest livestock returns occurred during the first 10 years of a pine rotation. Lowest returns occurred when the tree stand was allowed to remain fully stocked. Intermediate returns occurred following thinning. Timber returns were low during the first 20 years but were greatly increased during the remainder of the rotation. Wildlife returns could be maintained throughout the rotation and provide both income and recreation.

PROGRAM

The potential for combined production of timber, livestock, and wildlife in the South is unexcelled in any other region of comparable size in the United States and possibly the world. More than 80 million ha of forest land covers the region and about half of it can serve as forest range for livestock (Shiflet 1980). The South has the climate and soils necessary to produce large amounts of both forage and timber.

Attaining multiple-resource potentials of livestock, wildlife, and timber hinges on coordinated management, technology transfer, and population demands. Some biological, social, and economic situations can be barriers but not insurmountable ones. Population demands for food (livestock) and fiber (trees) will probably determine whether agroforestry potentials on the southern forest range are achieved. When energy becomes scarce, grain supplies for livestock becomes inadequate, and when fertilizer is not readily available or is cost prohibitive, a program to attain the multiple-use potentials of the South will be realized. Until that time we need to prepare through sound research, education, and extension development programs. Suggested steps for an appropriate program on the southern forest range are:

1. Conduct basic and applied research in forest range management, including biological and socio-economic studies.
2. Establish forest range management demonstrations in strategic locations in the South.
3. Initiate a comprehensive plan of technology transfer regarding range resource supplies and demands based on available research and demonstrations.
4. Design appropriate incentives to develop forest range management in the South on public and private lands.

Conclusions

Agroforestry presents some new challenges over single-use management and planning is more difficult. However, the benefits for meeting future food and fiber demands seem worthy of the task. Land managers must understand the biological, social, and economic interrelationships and trade-offs from multiple-use on the forest range. Equally important in today's market, managers must realize that flexibility in land management aids in surviving market fluctuations.

Literature Cited

- Burton, G.W. 1973. Integrating forest trees and improved pastures. p. 41-49. In Range Resources of the Southeastern United States. R.S. Campbell and W.T. Keller, eds. Am. Soc. Agron. Spec. Publ. No. 21. 78p
- Carter, C.W., and R.H. Hughes. 1974. Longleaf-slash pine-wiregrass range. p.13-16. In Range Resources of the South. South. Sect. Soc. for Range Manage. in cooperation with Ga. Agric. Exp. Stn., Univ. Ga., Ga. College of Agric. Bull. N.S. 9 33 p.
- Cassady, J.T., W. Hopkins, and L. B. Whitaker. 1955. Cattle grazing damage to pine seedlings. USDA For. Serv. South. For. Exp. Stn. Occas. Pap. 141, 14 p
- Clary, W. P. 1979. Grazing and overstory effects on rotationally burned slash pine plantation ranges. J. Range Manage. 32:264-266.
- Davis, L. B., M. K. Johnson, and H. A. Pearson, 1984. Subclover in pine forests. pp. 89-104. In N.E. Linnartz and M.K. Johnson, eds. Agroforestry in the Southern United States. 33rd Annu. For. Symp. Louisiana State Univ. Agric. Center, Baton Rouge, LA. 183 p.
- Duval, V. L., and N.E. Linnartz. 1967. Influences of grazing and fire on vegetation and soil of longleaf pine-bluestem range. J. Range Manage. 20:241-247.
- Duval, V. L., and L.B. Whitaker. 1964. Rotation burning: a forage management system for longleaf pine bluestem ranges. J. Range Manage. 17:322-326.
- Grelen, H. E. 1974. Longleaf-slash pine-bluestem range. p. 9-12. In Range resources of the South. South. Sect. Soc. for Range Manage. in cooperation with Ga. Agric. Exp. Stn., Univ. Ga., Ga. College of Agric. Bull. N.S. 9. 33 pp.
- Grelen, H. E. 1978. May burns stimulate growth of longleaf pine seedlings. USDA For. Serv. Res. Note SO-234, 5 pp.
- Grelen, H. E., and E. A. Epps, Jr. 1967a. Season of burning affects herbage quality and yield on pine-bluestem range. J. Range Manage. 20:31-33.
- Grelen, H.E., and E.A. Epps, Jr. 1967b. Herbage responses to fire and litter removal on southern bluestem range. J. Range Manage. 20:403-404
- Grelen, H.W., and R.E. Lohrey. 1978. Herbage yield related to basal area and rainfall in a thinned longleaf plantation. U.S. Dep. Agric. For. Serv. Res. Note SO-232, 4 pp.
- Halls, L.K. 1973. Managing deer habitat in loblolly-shortleaf pine forest. J. For. 71:752-757.
- Halls, L. K., and R.F. Suman. 1954. Improved forage under southern pines. J. For. 52:848-851.

- Halls, L. K., R.H. Hughes, and F.A. Peavy. 1960. Grazed firebreaks in southern forests. U.S. Dep. Agric. Inform. Bull. 226. 8 p.
- Lay, D.M. 1957. Browse quality and the effects of prescribed burning in southern pine forests. *J. For.* 55:342-347.
- Leithead, H.L. 1973. Soil surveys—guides to forage quantity and quality. p. 25-33. In *Range Resources of the Southeastern United States*. R.S. Campbell and M.T. Keller, eds. Am. Soc. Agron. Spec. Publ. 21 78 pp.
- Lewis, C.E. 1973. Integrating management of forest and range resources. p. 69-78. In *Range Resources of the Southeastern United States*. R.S. Campbell and M.T. Keller, eds. Am. Soc. Agron. Spec. Publ. No. 21. 78 pp.
- Lewis, C.E. 1980a. Some research examples of intensive management of pines and pasture. p. 221-228. In *Proc. South. For. Range and Past. Resour. Symp.*, New Orleans, LA. Mar. 13-14, 1980. 268 pp.
- Lewis, C.E. 1980b. Simulating cattle injury to planted slash pine: girdling. *J. Range Manage.* 33:337-340.
- Lewis, C.E. 1980c. Simulating cattle injury to planted slash pine: Combinations of defoliation, browsing and trampling. *J. Range Manage.* 33:340-345.
- Lewis, C.E. 1980d. Simulating cattle injury to planted slash pine: defoliation. *J. Range Manage.* 33:345-348.
- Lewis, C.E., and M.C. McCormick. 1971. Supplementing pine-wiregrass range with improved pasture in south Georgia. *J. Range Manage.* 23:334-339.
- Lewis, C.E., G.M. Tanner, and M.S. Terry. 1982. Multiple use management practices for the flatwoods. p. 71-83. In *Symp. Proc. Impacts of intensive forest management practices*. S.S. Coleman, A.C. Mace, Jr., and B.F. Swindel, eds. Univ. Florida, Gainesville, FL. Mar. 9-10, 1982. 110 p.
- Mobley, H.E. 1974. Fire—its impact on the environment. *J. For.* 72:414-417.
- Nelson, T.C., and W.M. Zillgitt. 1969. A forest atlas of the South. USDA For. Serv. South. and Southeast. Exp. Stns. Unnumbered. 27 p. South. For. Exp. Stn., New Orleans, LA.
- Pearson, H.M. 1974. Range and wildlife opportunities. p. 19-27. In *Proc. Symp. on Management of Young Pines*. USDA For. Serv. Southeast. Area, State and Private For., South. and Southeast. For. Exp. Stns. Alexandria, LA. Oct. 22-24, 1974 and Charleston, SC. Dec. 3-5, 1974. 349 p.
- Pearson, H.A. 1975. Exotic grass yields under southern pines. U.S. Dep. Agric. For. Serv. Res. Note 50-201, 3 p. South. For. Exp. Stn., New Orleans, LA
- Pearson, H.A. 1980. Livestock in multiple-use management of southern forest range. p. 75-88. In *Proc. Southern Forest Range and Past. Resour. Symp.* New Orleans, LA. Mar. 13-14, 1980. 268 p.

Pearson, H.A. 1982. Economic analysis of forest grazing. p. 77-88. In Proc. of Symp. Multiple use land management for nonindustrial pine forest land-owners. T. Clason, etd. Ruston, LA. Mar. 17-18, 1982. 110 p.

Pearson, Henry A. 1983. Forest grazing in the southern United States. Oregon State Univ. Coll. Agric. Sci. Symp. Series No. 2--Foothills for Food and Forests. David B. Hannaway, Editor. Timber Press, Beaverton, OR. pp. 247-260.

Pearson, H.A., L.B. Whitaker, and V.L. Duvall, 1971. Slash pine regeneration under regulated grazing. J. For. 69:744-746.

Schuster, J.L., and L.K. Halls. 1962. Timber overstory determines deer forage in shortleaf-loblolly pine-hardwood forests. p. 165-167. In Proc. Soc. Am. For., Washington, D.C.

Shiflet, T.M. 1980. What is the resource. P. 17-28. In Proc. South. For. Range and Past. Resour. Symp., New Orleans, LA. Mar. 13-14, 1980. 268 p.

Sullivan, A.D. and T.G. Matney. 1980. Trade-offs in wood and forage production. p. 67-74. In Proc. South. For. Range and Past. Resour. Symp., New Orleans, LA. Mar. 13-14, 1980. 268 p.

Till, R.E. 1984. Deer and cattle diets on Louisiana pine-hardwood sites. J Wild. Manage. 48:788-798.

Wakely, P.C. 1970. Long-term effects of damage by rabbits to newly planted southern pines. Tree Planters' Notes 21(2):6-9.

Watson, V.H., H.A. Pearson, W.E. Knight, and C. Hagedorn. 1984. Cool season forages for use in pine forests. pp. 79-88. In N.E. Linnartz and M.K. Johnson, eds. Agroforestry in the Southern United States. 33rd Annu. For. Symp. Louisiana State Univ. Agric. Center, Baton Rouge, LA 183 p.

Wolters, G.L. 1973. Southern pine overstories influence herbage quality. J. Range manage. 26:423-426.

Wolters, G.L., and A.T. Wilhite, Jr. 1974. Loblolly-shortleaf pine-hardwood range. p. 20-23. In Range Resources of the South. South. Sec. Soc. for Range Manage. in cooperation with Ga. Agric. Exp. Stn. Univ. Ga., Ga. College of Agric. Bull. N.S. 9. 33 p.

Wolters, G. L., A. Martin, and H.A. Pearson. 1982. Forage response to overstory reduction on loblolly-shortleaf pine-hardwood forest range. J. Range Manage. 35:443-446.