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Nontimber Values of East Texas Timberland

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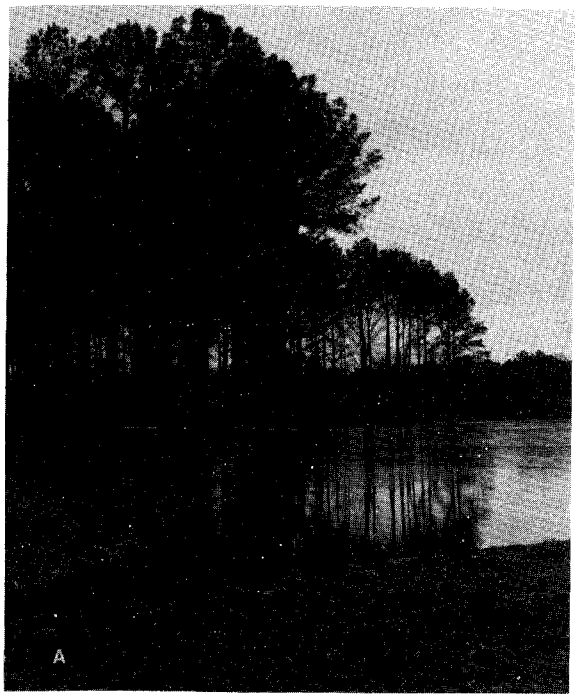

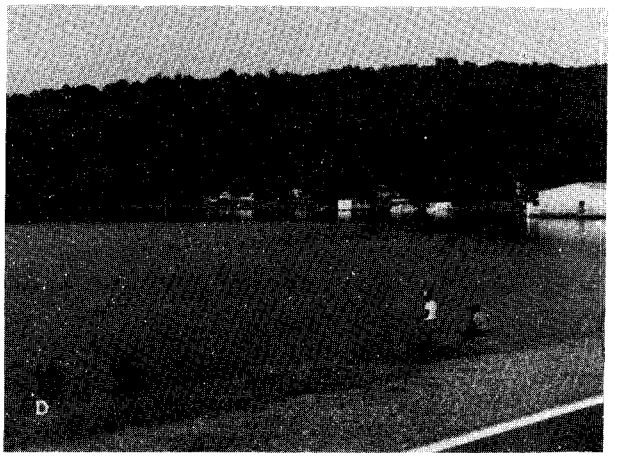

Front Cover

East Texas timberland is described in terms of (A) water and soils, (B) range or livestock use, (C) wildlife habitat, and (D) recreation.

The results presented in this report provide information about East Texas' forest resource in terms of nontimber values. Data were gathered while surveying timberland for regional forest management and planning. Further evaluation and critical assessment at appropriate levels of aggregation is encouraged. More detailed information is available at cost and through cooperative agreements with research institutions. Address inquiries to: Project Leader, Forest Inventory and Analysis Unit, Southern Forest Experiment Station, P.O. Box 906, 201 Lincoln Green, Starkville, MS 39759.

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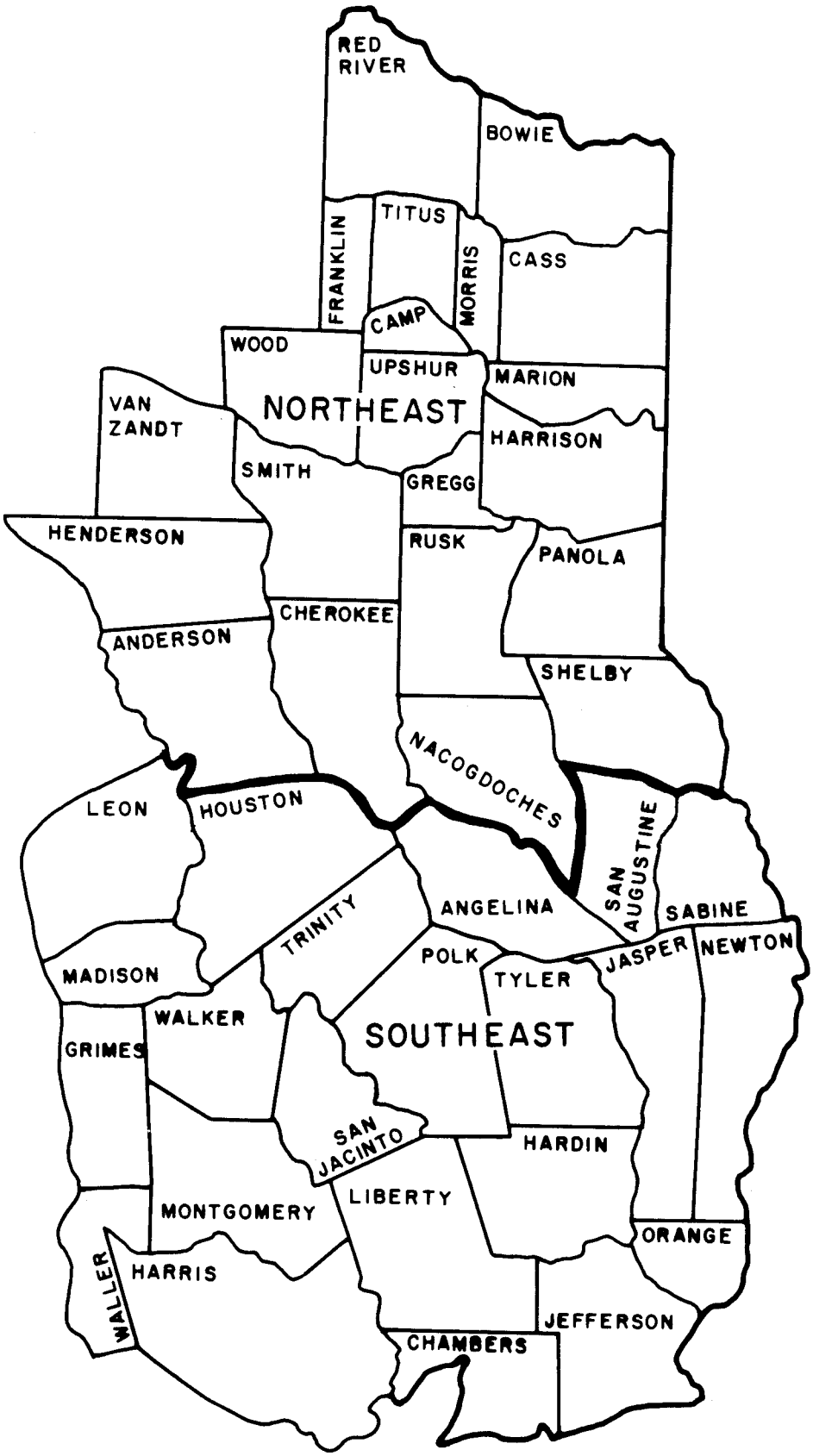

Figure 1.— *The forest survey regions of East Texas.*

Nontimber Values of East Texas Timberland

Victor A. Rudis

HIGHLIGHTS

As a companion to the East Texas timber report (McWilliams and Lord 1988), this document presents information about the other forest values associated with timberland. These "nontimber" values include water, soils, range, wildlife, and recreation. Data are presented to provide information for assessing the geographic distribution and relative scarcity of these nontimber values. Data also can serve as a benchmark for future assessment of trends. Attributes include frequency of occurrence data by population planning districts, slope class, presence of vegetative debris, evidence of livestock use, fire, garbage dumping and littering, and proximity of timberland to water bodies, urban areas, agricultural areas, and roads. Briefly presented or referenced are secondary data sources (information collected by other agencies) associated with timberland. Highlights are as follows:

- A third of the timberland area is within 1,600 feet of permanent water sources (water bodies ⅛ acre or larger or water courses 40 feet or more in width); 18 percent is within 800 feet of water sources.
- Timberland with greater than 15 percent slope and within 1,600 feet of water sources represents 116,500 acres (138 million cubic feet of growing-stock volume), 1 percent of the total in the region.
- Timberland with evidence of livestock use occurs on 23 percent of the acreage, mostly in the survey region's western counties that represent transition areas between forest and rangeland.
- Potential red-cockaded woodpecker nesting habitat on timberland is scarce. Estimates vary with assumptions, but range from 84,100 acres to 545,600. Between ¼ and ½ of the potential nesting habitat occurs on public timberland.
- Timberland acreage has declined by less than 1 percent. In pine forest types, shifts have occurred toward sapling and seedling stands and loblolly pine over shortleaf pine. In hardwood forest types, shifts have occurred toward oak-pine sapling and seedling stands and oak-hickory forest type in all stand size classes. Acreage by forest ownership has changed little. Shifts in private timberland have been toward younger-aged sapling and seedling stands.
- Snags and large diameter live trees are relatively uncommon in pine forests and on forest industry lands. Most large diameter snags, large diameter live trees, and mast trees occur in bottomlands or oak-hickory forests.
- Physical access to timberland is good, as 86 percent of the acreage is within ¼ mile of roads. Remote timberland ½ mile or more from roads and as part of forest tracts 2,500 acres or larger represents 4 percent of the acreage.
- Adjacent land uses influence and are influenced by timber utilization. Nearly 13.5 percent of the region's acreage (14.6 percent of the growing-stock volume) is within 1,200 feet of roads and within one mile of urban or built-up land. Approximately 16.7 percent of the region's acreage (11.6 percent of the growing-stock volume) is within 200 feet of agricultural land.

INTRODUCTION

This Bulletin provides an overview of the fifth survey of East Texas forest resources. Information about the nontimber values (watershed maintenance, soil retention, range potential for livestock, wildlife habitat, and recreation opportunities) is presented. A companion report, Resource Bulletin SO-136 (McWilliams and Lord 1988), discusses the forest resource in terms of timber values. Data summaries by county are provided in Resource Bulletin SO-118 (Lang and Bertelson 1987). Earlier surveys were conducted in 1935, 1935-55, 1965, and 1975 (see McWilliams and Lord 1988). Comparisons between 1975 (Murphy 1976) and 1986 take into account the slight change of counties surveyed.

Timberland's value is more than just the sum of so many cubic feet of wood. While wood production helps the region's economy, other values of timberland contribute to the economy as well.

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Forest management and planning that considers only timber values has hidden costs in terms of other values foregone. Management to retain nontimber values also may reduce the economic efficiency of timber management. Wise stewardship of timberland ultimately depends upon all forest values—no one value can be emphasized without impacting the others.

Timberland managed for marketable values in addition to timber (e.g., livestock or hunting leases) can have fewer financial risks, particularly when wood prices are unstable, and can supplement income between timber harvests. Nonmarket values of timberland (e.g., maintenance of water supplies and water quality, aesthetics) are important to the tourism industry, enhance the standard-of-living of local communities, and help attract industries not dependent on wood production, particularly those in the service sector.

Some of the "other forest values," or nontimber values, of timberland include watershed maintenance, soil retention, range (livestock) potential, game and nongame wildlife habitat, and opportunities for dispersed recreation. In East Texas, as elsewhere in the United States, other forest values depend upon characteristics of forested land, its adjacent and nearby land uses, and distance from population centers. Some forests help maintain water quality, others are used for livestock grazing, and still others provide habitat for rare and endangered wildlife. Many forests are valuable for hunting and other outdoor recreation activities, but some are more distant from users, inaccessible by roads, or otherwise restricted from public use. The interplay of forest land with other land uses and timber management practices produces a regional pattern of land development that varies uniquely from county to county.

These "other forest values" are examined where possible in terms of physical, geographic, and socioeconomic attributes. Also given are the more traditional estimates of area, volume, and stand structure characteristics of timberland. Definitions of terms used in the text, estimates of statistical reliability, a species list, species occurrence data, and estimates of relative importance are tabulated in the Appendix. A brief portion of the data and analyses from other agencies are presented to assist in this examination. Readers are urged to seek further details about particular values by direct examination of the referenced reports or by contacting the Texas agencies charged with responsibility for assessing the other values and land areas in the State.

BACKGROUND

This report focuses on the nontimber values of East Texas timberland as recorded in field surveys between April 1985 and February 1986. Earlier surveys, originally mandated by the McSweeney-McNary Act of 1928, provided basic periodic assessments of public and private forest resources—mainly in terms of timber values. More recent legislation, the Forest and Rangeland Renewable Resources Planning Act of 1974 and the Forest and Rangeland Renewable Resources Research Act of 1978, mandated that the Forest service make and keep current comprehensive assessments of forested areas, thereby broadening the survey to consider nontimber values.

Data in this report apply to the 43 counties comprising the Southeast and Northeast forest survey regions (fig. 1). Permanent sample field plots are distributed systematically throughout East Texas on a virtual 3-mile grid. Of the 3,761 plots, 1,910 are classified as timberland and sampled for detailed tree- and plot-level information. Approximate timberland plot locations are shown in figure 2.

The total land base for the 43 counties is 21,593,700 acres. Of this, 9,794,200 acres are classified as agriculture, urban, residential, highways and other rights-of-way, and small wooded lots or strips too small to meet the classification of timberland. The remaining 11,799,500 acres are forested, with 119,700 acres classed as productive reserved and 114,500 classed as unproductive. This leaves 11,565,300 acres classed as timberland.

WATER AND SOILS

Enhancement of water supplies is an important role of timberland. Stands with adequate vegetative cover intercept most of the precipitation that otherwise would cause soil erosion, stream siltation, and downstream flooding. Such stands help retain soil and recharge underground water supplies. Conversion of timberland to cropland and urban uses not only increases water yield through added surface runoff but also increases soil erosion and the potential for downstream flooding that ultimately reduce water quality.

Important benefits to sport fishing and reduced logging road maintenance costs can accrue to timberland owners while protecting water quality values (Dissmeyer and Foster 1987). Timber management practices that limit water pollution—such as proper placement of roads and skidding operations, retaining riparian areas in clearcuts, and remedial treatments after harvest (Jackson and

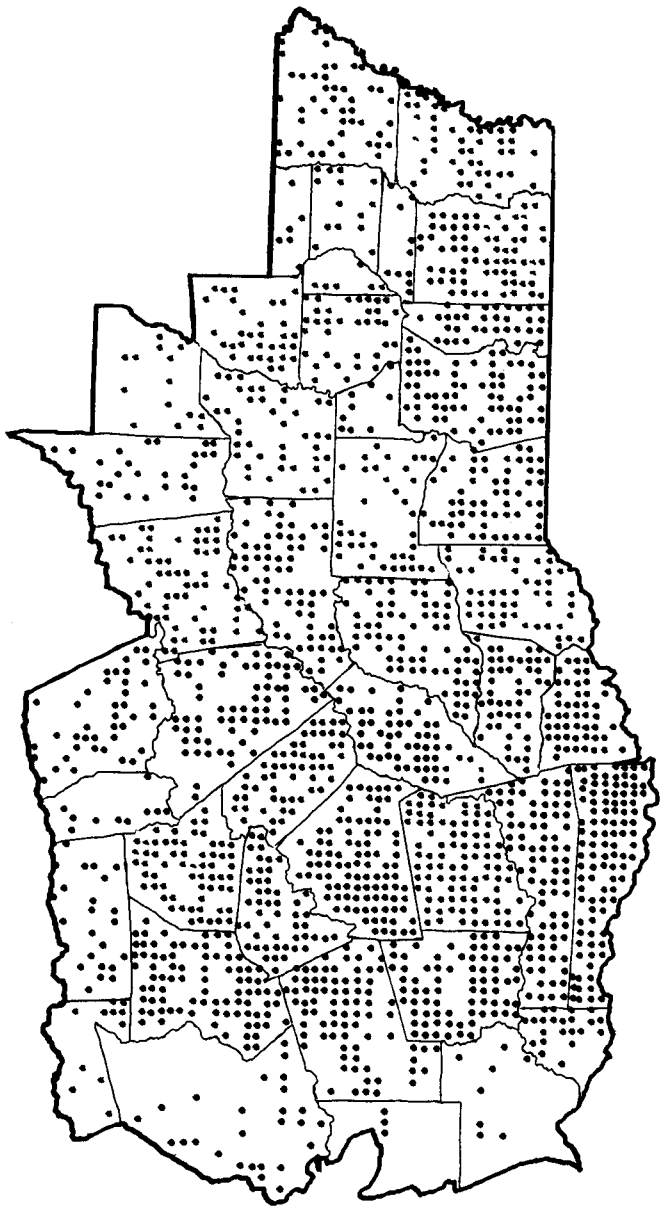


Figure 2.— *Distribution of plots classified as timberland, East Texas, 1986.*

others 1981)—may be needed to maintain water quality values. Restricting the amount and size of harvests in a given year and a given watershed also may benefit water values by reducing negative regional impacts.

Effects of timber harvesting on water quality are believed to be highest near water with steep slopes or with erodable soils. A third of East Texas timberland is within 1,600 feet of permanent water sources[1]; 18 percent is within 800 feet of water sources. Forests near permanent water are widely distributed (fig. 3). Rolling or hilly terrain associated with East Texas timberland is common in the northeastern portion in and around Cass County and in scattered locations in the central portion (fig. 4). Timberland with slopes greater than 15 percent accounts for 387,000 acres, 3 percent of the region's total timberland (table 1).

Construction of logging roads in these areas may be more difficult without adversely affecting other forest values. Some of this acreage is not managed for timber, as water quality values and

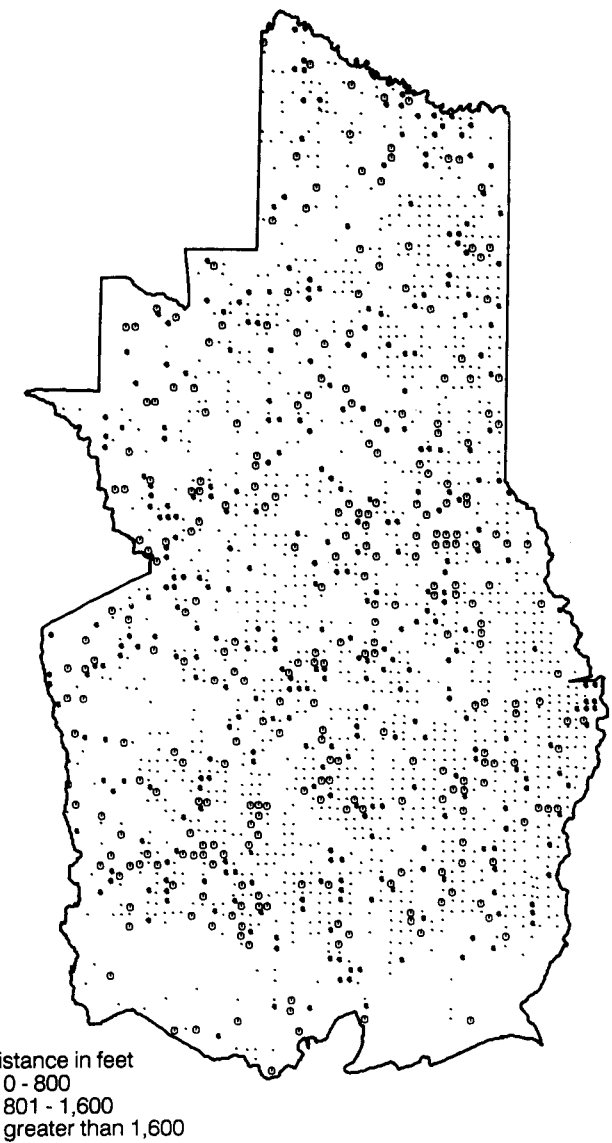


Figure 3.— *Timberland by distance from permanent water sources, East Texas, 1986.*

[1]All water sources—permanent and temporary—are important to the maintenance of water quality values in or near timberland. But limitations on what can be detected readily from feasible photography reduces this discussion to "permanent water sources" defined as water bodies ⅛ acre or larger or water courses 40 feet or more in width.

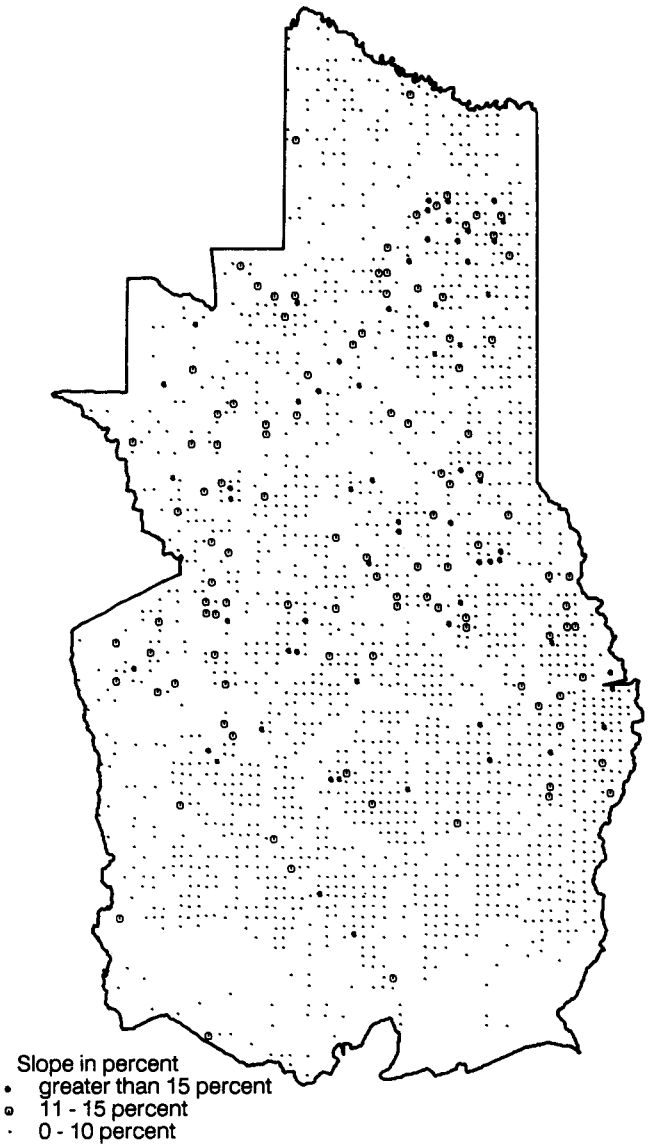


Figure 4.— *Timberland by percent slope, East Texas, 1986.*

associated recreation uses may preclude harvesting. (Such areas are nevertheless classified as "timberland" as there are no statutes excluding timber production.) Timberland areas with greater than 15 percent slope and within 1,600 feet of permanent water sources represent 116,500 acres (138 million cubic feet of growing-stock volume) or about 1 percent of the region's total. Most of the areas with steep slopes are found alongside lakes and ridges of river valley floodplains.

Major soil groups, or land resource areas, are shown in figure 5. East Texas timberland is dominated by Coastal Plain soils consisting of sandy loams and sand with subsoils of finer texture. In forested areas, erosion rates are greatest in the Coastal Plain (0.46 tons/acre/year), and somewhat less in the Flatwoods (0.32), Claypan Area (0.28), and Blackland Prairie (0.24). The few forests along streams of the Gulf Coast Prairie and Saline Prairie have limited erosion potential (0.05 tons/acre/year) (Greiner 1982).

Because Coastal Plain soils have moderate erosion potential, they are more suited to continuous vegetative cover, such as timberland than cropland. Erosion on cropland can be more than 10 times the rate for timberland. Erosion potential is somewhat greater for the ridges that separate the Neches and Sabine River Basin, and somewhat less in the flat areas. Pine and oak-pine are the dominant forest types, while remaining land resource areas are dominated by oak-hickory in savannahs (grassy areas with scattered trees) and bottomland hardwoods along streams and rivers. In the Claypan Area, much of the timberland is leased for hunting or used in livestock production (Godfrey and others, no date). The Blackland Prairie and Gulf Coast Prairie are used mainly for crop and livestock production or for urban development (Greiner 1982). Much of the Gulf Coast Marsh is used for wildlife needs (as a refuge, management area, or leased for hunting).

Table 1—*Area of timberland by slope class and distance from water bodies, East Texas, 1986*[1]

Slope class	Total area	Distance from water bodies (feet)				
		over 1,600	1,201-1,600	801-1,200	401-800	0-400
Percent	*Thousand acres*					
0-5	8,617.7	5,670.8	649.1	661.4	806.6	829.7
6-10	1,920.9	1,418.6	150.5	107.1	133.5	111.2
11-15	640.1	428.2	44.7	56.4	47.5	63.2
16 or over	386.7	270.2	39.5	. . . .	19.8	57.2
Total	11,565.3	7,787.9	883.8	824.9	1,007.4	1,061.3

[1]Rows and columns may not sum to totals due to rounding.

RANGE

Farmers traditionally have used forests as grazing areas and seasonal shelter for livestock. Growing trees for wood products and raising livestock in combination offers potentially more income per acre, and can help stabilize periodic income by providing more market production options (Mosher 1984). Occasional use of timberland by livestock benefits older stands by reducing understory competition and providing fertilizer. In areas where herbicide use is not cost-effective, or where environmental objectives outweigh their use, livestock may be a feasible alternative for controlling competing vegetation in pine plantations (Doescher and others 1987).

Combining grazing with timber harvests, forage production, and other management practices such as prescribed fires requires careful scheduling to permit adequate regeneration. Forest grazing damages trees and compacts the soil, thereby limiting water percolation, increasing surface runoff, and reducing downstream water quality. However, such damage may be restricted only to areas that are heavily grazed (Patric and Helvey 1986). Where game production is important, competition for forage limits livestock grazing potential. Guidelines for managing southern pine forests for livestock and timber production are available (Byrd and others 1984).

In East Texas, timberland with evidence of livestock use represents 23 percent of the acreage (19 percent of the growing-stock volume) (table 2). Acreage with livestock evidence varies more by location than by forest type. Much livestock grazing on timberland occurs in the transition counties between the region's forests and rangelands (fig. 6). The potential for timber and livestock production is greatest in this area and in portions of other counties where markets for livestock production are important. If landowners are to consider wood production as a land management option in this area, multiple use management that allows for continued grazing of livestock may be needed.

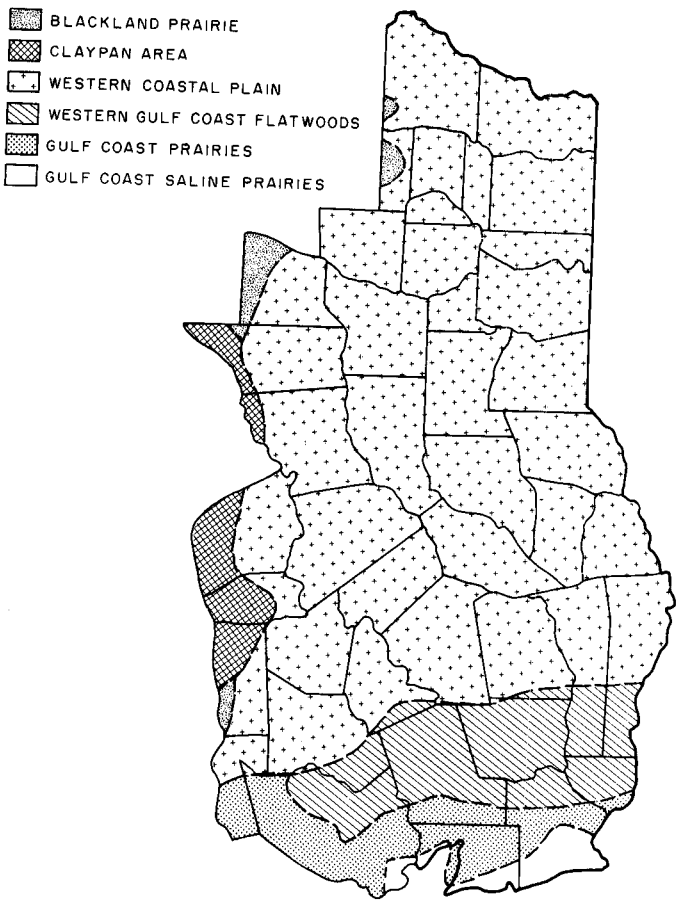


Figure 5.— *Major Land Resource Areas of East Texas (Greiner 1982).*

Table 2— *Area and growing-stock volume of timberland with evidence of livestock use, East Texas, 1986*[1]

Forest type	Area			Volume		
	Total	With livestock evidence		Total	With livestock evidence	
	Thousand acres		*Percent*	*Million cubic feet*		*Percent*
Longleaf-slash	279.9	41	15	331.6	59.7	18
Loblolly-shortleaf	3,936.6	672	17	6,104.1	981.9	16
Oak-pine	2,401.8	476	20	2,454.7	432.7	18
Oak-hickory	3,369.3	1,055	31	2,025.5	579.0	29
Bottomland hardwoods[2]	1,577.7	391	25	1,530.7	263.1	17
Total	11,565.3	2,635	23	12,446.7	2,316.4	19

[1]Rows and columns may not sum to totals due to rounding. Evidence includes livestock sighted (20 percent), dung (44 percent), tracks (15 percent), trails (4 percent), and other artifacts (17 percent).

[2]Includes oak-gum-cypress and elm-ash-cottonwood forest types.

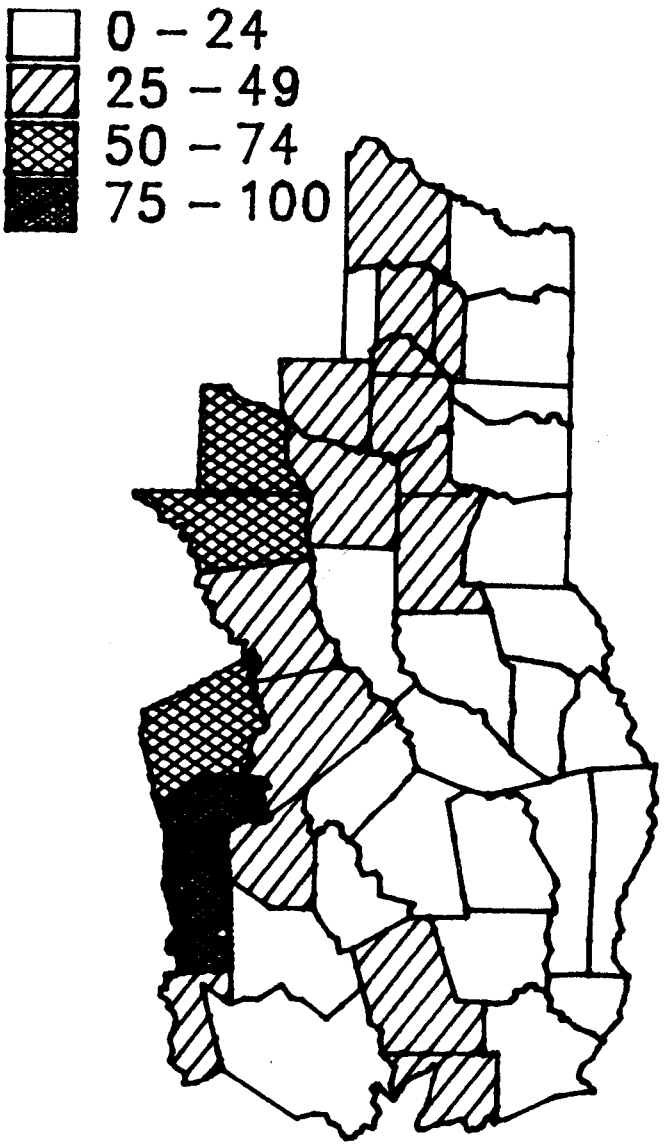


Figure 6.— *Percent timberland with evidence of livestock use by county, East Texas, 1986.*

WILDLIFE

Forest surveys provide analysis data on the habitat needs of forest-dwelling wildlife. A broad view of forest-dwelling wildlife can cover not only game species such as deer, wild turkey, quail, and squirrels but also songbirds, woodpeckers, reptiles, insects, and wildflowers. About 400 species of vertebrates (50 mammals, 250 birds, 100 amphibians and reptiles) inhabit a 10,000-acre tract of southeastern forest during a year—though less than 100 species on a given 10-acre forest tract at a specific time (Harris and others 1979).

Of the forest-dwelling wildlife, the red-cockaded woodpecker is one of the more extensively studied nongame species. This endangered bird prefers older, relatively pure pine stands with a limited hardwood understory. Few such stands remain because many pine stands on private timberland are harvested within 50 years, or hardwoods are allowed to encroach on otherwise pure pine stands. Minimum criteria for estimating suitable habitat are unknown with certainty; unique conditions may create suitable habitat in localized areas. A tree age of 60 years is suggested as the minimum average age required for nesting (Lennartz and others 1983b). If a pine sawtimber stand with a stand age averaging 51 years or over contains a few 60-year-old trees, then the potential red-cockaded woodpecker nesting habitat amounts to 443,900 acres. (The 95 percent confidence interval is plus or minus 101,700 acres. Appendix Table A1 lists general estimates based on 2/3 [67 percent] confidence).

A more restrictive assumption, that hardwood tree basal area must be less than or equal to 20 percent of the total live tree basal area (Lennartz and others 1983b), yields an estimate of 142,449 acres. (The 95 percent confidence interval is plus or minus 58,400 acres.) Depending on assumptions, public timberland contains between ¼ to ½ of the potential nesting habitat. Public acreage of southern pine stands designated as productive-reserved (54,900 acreas, not surveyed and not part of the timberland estimate) may qualify as additional acreage with suitable red-cockaded woodpecker nesting habitat.

Some reports have suggested that red-cockaded woodpecker colonies prefer longleaf pine stands (Lennartz and others 1983b, Seagle and others 1987). The first forest survey in the 1930's (Cruikshank and Eldredge 1939) recorded 930,000 acres of longleaf forest type. Extensive timber cutting coupled with control of recurrent fires accelerated the demise of this once abundant ecosystem (see History section, McWilliams and Lord 1988). For the 1986 survey, 279,900 acres are longleaf-slash forest type, but only 34,700 acres (12 percent) contain a plurality of longleaf pine trees. Most of the remaining 245,200 acres consist of stands with a plurality of slash pine trees.

To examine habitat needs for the many other species that occur in forests is a major task. Because many forest-dwelling wildlife depend upon areas other than timberland and on plant species other than trees, some of the attributes needed to assess wildlife habitat values are incomplete. While a number of studies have examined understory plant species on southern timberland areas (Pearson and others 1987), shrub, vine, and herbaceous species inventories concurrent with this extensive area timberland survey are not avail-

able. Additional tree species (large diameter trees, snags, mast-producers) may occur in "stringers" (wooded areas too narrow or small to be classified as timberland or managed for commercial products) along landowner boundaries, narrow rights-of-way, and as windbreaks or fencerows adjacent to cropland. Amount of forest edge and the diversity of adjacent land cover, which are important for several species (e.g., deer and wild turkey), also are not quantified directly.

Characteristics of timberland are presented by forest types to aid in general comparisons. Details on wildlife and fish species associated with a given forest type are provided elsewhere (Dickson and Maughan 1987, Felix and others 1986). A coarse measure of adjacent land characteristics is provided by examining forest attributes of sampled areas aggregated at the county and multi-county regional level of resolution. Almost invariably, forest-dwelling wildlife depend upon forested areas with certain features—particular landform or moisture conditions, stand structure, and tree species, diameter class, and condition. The following summaries describe several attributes of forests: selected tree species distributions, stand size, forest type, ownership, mast, large diameter trees and snags.

Species Distributions

The regional distribution pattern of individual tree species can suggest the extent and aggregation of selected ecosystems or wildlife habitats—specific soil, landform, or dispersal conditions that support a unique assemblage of plant and animal species. Plot coordinates are derived from digitizing the location of a few plots and simulating the location of remaining plots by the 3-mile sample grid. Each dot represents a sample of the trees on a one-acre plot of timberland with at least one individual of that species. Because the regional sample design is systematic, approximate distributions are representative at the multi-county and regional scale. (Note that each dot represents about 5,760 acres.)

Tree species that are infrequently planted and that occur naturally only in restricted areas can suggest landform and soil conditions within the region. Unless otherwise indicated, soil and landform characteristics typical of a species' natural occurrence (in parentheses) are from Agriculture Handbook Number 271 (Fowells 1965). Figure 7 displays six selected tree species distributions: blackjack oak (dry, sandy soils with low organic content [Harrar and Harrar 1962, page 226]), laurel oak (well-drained sandy soils with nearby water), white oak (wide variety of upland soils except extremely dry and poorly drained bottomlands), willow oak (bottomlands, alluvial soils, rarely upland sites), overcup oak (bottomlands, poorly-drained and clay soils), and baldcypress (soils where moisture is abundant and fairly permanent).

Figure 8 contains distribution maps for the four major southern pine species: loblolly, shortleaf, slash, and longleaf pine. Because these pines are historically planted or managed, their distributions reflect human influences as well as landform conditions. Pines naturally occur and are widely planted or managed on a variety of sites, commonly in upland areas. Loblolly and shortleaf pine are widely distributed, suggesting they naturally occur or are planted in bottomlands as well as upland environments. Slash and longleaf pine are less widely distributed and occur predominately on the Southeast Coastal Plain. Slash pine, a species introduced to Texas in 1926 (Texas Forest Service 1963), occurs on sites coincident with longleaf pine. Slash pine also occurs more frequently beyond the Southeast Coastal Plain than longleaf pine.

Spanish moss (*Tillandsia* sp.) is one of the few non-tree species easily identified on forest survey plots. Spanish moss is an important component of bottomland hardwood stands. It provides important nesting material for the parula warbler and is a useful nesting material for other bird species. Spanish moss is considered aesthetically pleasing, and is of minor economic importance for specialty products. The occurrence and abundance of Spanish moss are linked to the availability of minerals in the canopy of host trees (Schlesinger and Marks 1977). The distribution of Spanish moss in timberland areas in figure 9 depicts conditions that favor its growth (regional abundance of host trees with high foliar leaching [e.g., cypress and oaks], and trees with limited bark and lower branch sloughing [most hardwoods]). Dispersal conditions (prevailing wind direction of major storms, continuous and connected areas of hardwood forest type) and a favorable climate (warm and humid conditions) may limit the natural range of Spanish moss to inland areas along relatively narrow river drainages (e.g., cypress-tupelo bottomlands) and the southern half of the Gulf Coastal Plain.

Stand Size, Forest Type, and Ownership

Some wildlife species are restricted to young clearcuts, others to mature, unbroken forest cover, and still others to the juxtaposition of land cover types (forest edges) where cropland or young clearcuts meet mature stands. Forest type, i.e., pine, oak-pine, and hardwoods, also plays a role in describing optimal conditions for individual

species. Additional information on the status of animal species in southern forests is provided in other publications (Pearson and others 1987). Related issues relevant to management of East Texas timberland for timber and wildlife are discussed by Campo (1986) and Ortego (1984).

To get a general view of wildlife habitat and past trends, forest survey data are examined by forest type, stand size class, and ownership for 1975 and 1986. There has been a net decline in sawtimber stands in pine forest types and an increase in seedling and sapling stands (table 3). Shifts in stand dominance have favored loblolly pine over other pines in sapling and seedling stands.

In hardwood forest types, there has been a shift toward oak-pine and oak-hickory in sapling and seedling stands, and oak-hickory stands in poletimber and sawtimber stand size classes (table 4). Bottomland hardwoods have declined as well. Some of the forest type shifts result from temporary changes in stand dominance as pine stands

Figure 7.— *Timberland with selected tree species 1.0 inches d.b.h. and larger, East Texas, 1986.*

are harvested. Gains in oak-hickory forest type, particularly in sawtimber and poletimber acreage, are linked to losses in oak-pine and some shortleaf pine stands. These shifts suggest hardwoods are succeeding pines as these stands get older and that selective removal of dominant pines is occurring without further pine timber management.

Timberland acreage has changed little since the 1975 survey—less than a 1 percent decline. Timberland in public ownership, 763,000 acres, represents a decline of 9 percent, mainly due to designation of timberland to productive-reserved status. Public landholdings comprise 7 percent of the 1986 timberland. By stand-size class, 74 percent are sawtimber stands, 12 percent are poletimber stands, and 13 percent are sapling-seedling stands, virtually the same as in 1975.

Forest industries own 3,795,500 acres (33 percent), approximately the same proportion as in 1975. Sawtimber, poletimber, and sapling and seedling stands in 1986 represent 41, 18, and 39 percent respectively. By contrast, the 1975 proportions are 58 percent sawtimber stands, 20 percent poletimber stands, and 22 percent sapling and seedling stands. Nearly twice as many stands are in the sapling and seedling stand size class in 1986 as there were in 1975.

Most of the timberland, 7,006,900 acres (61 percent), continues in nonindustrial private landownership. By stand size class, 1986 acreage is 51 percent in sawtimber stands, 29 percent in poletimber stands, and 17 percent in sapling and seedling stands. This represents a small shift toward older stand size classes since the 1975 survey. (For 1975, percentages are 46, 30, and 23 percent respectively.)

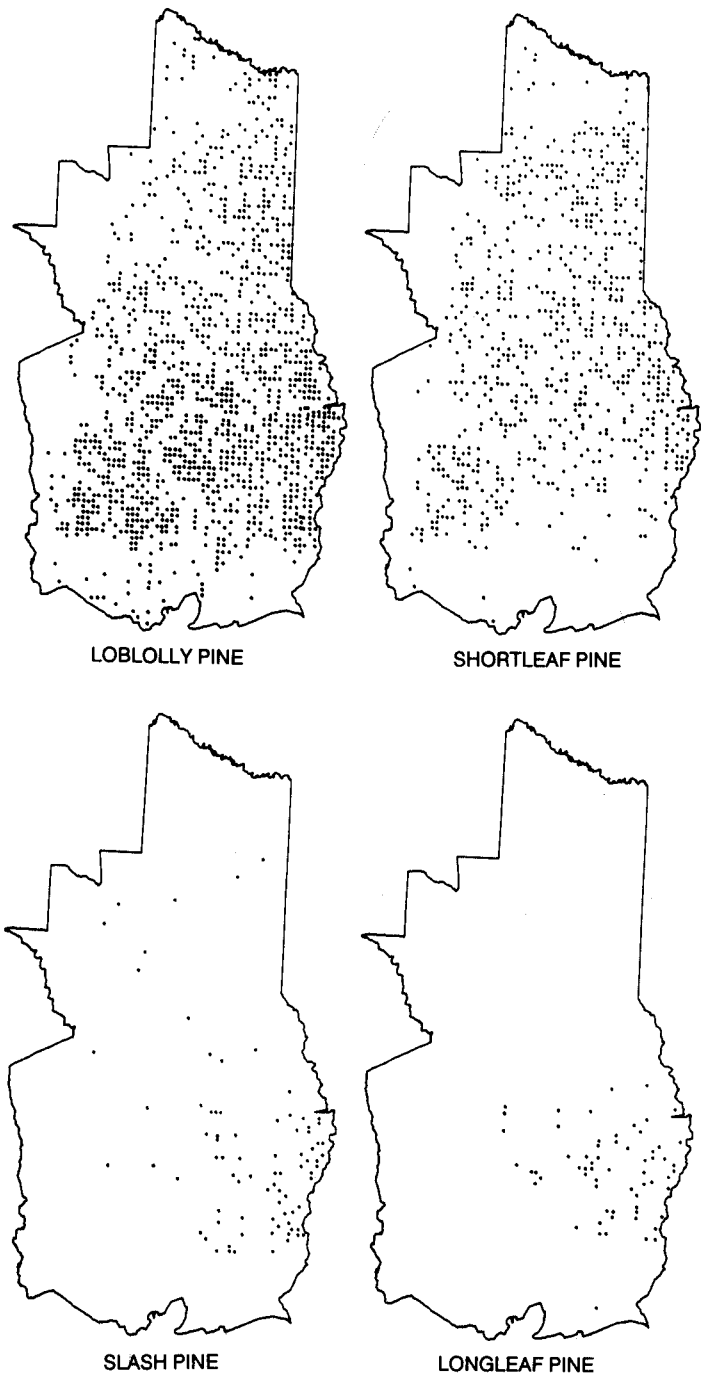


Figure 8.— *Timberland with major pine species 1.0 inches d.b.h. and larger, East Texas, 1986.*

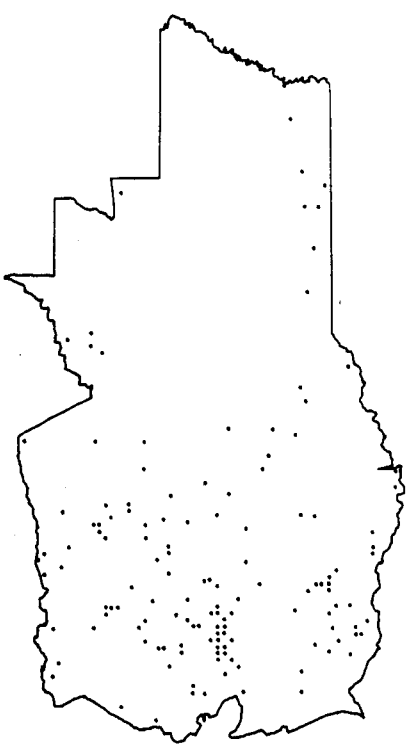


Figure 9.— *Timberland with Spanish moss, East Texas, 1986.*

Table 3—*Area of pine timberland by stand-size class and detailed forest type, 1986, and change since 1975, East Texas*[1]

Stand size class	Loblolly-shortleaf[2]				Longleaf-slash			
	Loblolly		Shortleaf		Slash		Longleaf	
	1986	Change	1986	Change	1986	Change	1986	Change
	Thousand acres							
Sawtimber	1,761.1	-141	667.3	-196	66.8	+32	29.2	-12
Poletimber	597.0	+10	79.2	-154	121.8	+14	5.5	-0
Sapling-seedling	761.7	+161	50.8	-85	56.7	-13	0.0	-12
Nonstocked	6.0	+6	0.0	-6	0.0	+0	0.0	-0
All classes	3,125.8	+36	797.3	-441	245.2	+33	34.7	-24

[1]Columns may not sum to totals due to rounding.
[2]Other detailed loblolly-shortleaf type: eastern redcedar, 13,600 acres, up 7,600 acres from 1975; all in sawtimber size class.

Table 4—*Area of hardwood timberland by stand-size class and forest type, 1986, and change since 1975, East Texas*[1]

Stand size class	Oak-pine		Oak-hickory		Oak-gum-cypress		Elm-ash-cottonwood	
	1986	Change	1986	Change	1986	Change	1986	Change
	Thousand acres							
Sawtimber	1,226.8	-152	1,030.1	+230	879.2	-101	41.0	+2
Poletimber	462.1	-200	1,113.3	+232	428.8	+8	5.6	-35
Sapling-seedling	695.5	+145	1,052.8	+125	155.3	-100	5.7	-12
Nonstocked	17.3	+12	173.1	+103	55.9	+33	6.2	-0
All classes	2,401.8	-195	3,369.3	+691	1,519.1	-160	58.5	-45

[1]Columns may not sum to totals due to rounding.

Mast

On timberland, hard mast or nuts (e.g., the fruit of oak, hickory, and beech) and soft mast (e.g., the soft or fleshy fruits of dogwood, blackgum, and cherries) are important food sources for many game and some nongame wildlife. Of these, oak and hickory nuts are most likely to be critical during the fall and winter months. For example, squirrel populations are positively correlated with acorn and hickory nut yields; populations generally lag 1 year behind nut supplies.

(Note that other food sources are essential to the survival of species that use mast as a major food supply, particularly in years of acorn crop failure. Mast from shrubs and vines, such as blackberries [*Rubus* sp.] and honeysuckle [*Lonicera* sp.], also are important.)

When available, acorns are generally the most common food sources for white-tailed deer, squirrel, and turkey during the fall and winter months, and are important to other game and many nongame wildlife species as well. Production of acorns and other nuts varies by tree species, diameter class, crown position, and weather conditions (Shaw 1971, Goodrum and others 1971). Stands with a mixture of sawtimber-sized (11.0+ inches d.b.h.) tree species produce more consistently, as yields vary from year to year among species, and most species do not produce nuts abundantly until of sawtimber size.

Oaks comprise the majority of nut-bearing tree species in East Texas (table 5). Large numbers of sawtimber-sized post oak, water oak, and southern red oak occur across East Texas; differences in species composition by survey region are minor (table 6). By county, per-acre basal area of sawtimber-sized, nut-bearing tree species is lowest in central counties and highest in northwestern counties and a few southeastern counties (fig. 10). Counties with high basal area are those where oak-hickory sawtimber stands are abundant. Most differences are by forest type (fig. 11). Bottomland hardwoods (oak-gum-cypress and elm-ash-cottonwood) contain over 13 sawtimber-sized trees of nut-bearing species per acre, compared with only

3 sawtimber-sized trees per acre for pine (loblolly-shortleaf and longleaf-slash) stands.

Blackgum, hawthorn, and dogwood comprise the majority of fleshy fruit-bearing tree species on timberland (table 7). Average basal area of important fleshy fruit-bearing tree species is lowest in central counties and highest in southeastern counties and a few northern counties (fig. 12). Counties with high average basal area are those with abundant bottomland hardwoods. As with hard mast species, basal area per acre and number of trees per acre of most fleshy fruit-bearing tree species are more abundant in bottomlands (12 square feet, 108 trees), than oak-pine (5 square feet, 88 trees), oak-hickory (5 square feet, 78 trees), and pine forest types (3 square feet, 64 trees).

Large Trees and Snags

Many large-bodied birds of prey (e.g., bald eagle, barred owl) and mammals (e.g., squirrels, raccoons) require large diameter trees for nesting and perching. Large diameter live trees also are important foraging areas for some warbler species and a number of other bird species. On timberland, abundant large diameter live trees are prevalent only in the oak-gum-cypress forest type (table 8).

Cavity-nesting birds and mammals use snags (standing dead and dying trees) for nesting and foraging. Potential snags vary by condition—rotten, salvable dead (sound trees of timber species with merchantable volume), and nonsalvable dead (unsound timber trees as well as all dead

Table 5—*Number of live trees of nut-bearing tree species on timberland by species and diameter class, East Texas, 1986*[1]

Species	All classes	Diameter class (inches at breast height) 1.0-4.9	5.0-10.9	11.0-14.9	15.0-20.9	21.0 & larger
	Thousand trees					
Oaks						
White oaks						
Post	351,810	243,236	84,726	15,481	7,019	1,348
White	93,930	69,111	17,890	3,777	2,659	493
Overcup	19,611	9,130	6,823	1,825	1,404	428
Swamp chestnut	8,896	6,528	1,296	334	394	344
Chinkapin	97	. . . .	65	32	. . . .	. . . .
Bur	56	. . . .	45	. . . .	11	. . . .
Other white	45	. . . .	45	. . . .	. . . .	. . . .
Total	474,445	328,005	110,890	21,449	11,487	2,613
Red oaks						
Water	223,579	168,203	37,361	9,827	6,079	2,110
Southern red	194,892	132,388	45,310	10,880	5,079	1,234
Willow	96,563	73,201	14,735	4,750	2,816	1,060
Blackjack[2]	70,646	54,218	13,507	1,967	893	62
Cherrybark	67,247	51,323	11,005	2,630	1,529	759
Laurel	50,788	42,429	5,378	1,713	985	283
Bluejack[2]	31,714	27,865	3,152	654	42	. . . .
Black	25,630	22,019	2,733	441	383	54
Shumard	15,624	14,333	716	258	171	146
Nuttall	812	. . . .	491	119	120	83
Live[2]	81	. . . .	. . . .	47	34	. . . .
Other red	42	. . . .	42	. . . .	. . . .	. . . .
Total	777,618	585,979	134,430	33,286	18,131	5,791
All oaks	1,252,063	913,984	245,320	54,735	29,618	8,404
Hickories						
Water	16,285	11,644	3,500	817	252	72
Pecan	2,220	1,145	768	193	73	41
Other	166,458	134,222	25,451	5,124	1,547	113
All hickories	184,963	147,011	29,719	6,134	1,872	226
Bluebeech[2]	165,145	150,354	14,462	329	. . . .	. . . .
Ironwood[2]	96,697	88,193	8,391	114	. . . .	. . . .
American beech	6,058	3,050	1,140	922	704	242
Allegheny chinkapin	3,147	3,021	126	. . . .	. . . .	. . . .
Chinkapin (other)[2]	2,405	2,202	203	. . . .	. . . .	. . . .
Black walnut	3,011	2,274	553	161	10	12
All species	1,713,489	1,310,089	299,914	62,395	32,204	8,884

[1]Rows and columns may not sum to totals due to rounding.
[2]Noncommercial species.

Table 6—*Number of live sawtimber trees of nut-bearing species by species and survey region, East Texas, 1986*

Species	Survey region		
	Statewide	Southeast	Northeast
	Trees per 1000 acres		
Oaks			
White oaks			
Post	2,062	2,035	2,082
White	599	708	519
Overcup	316	249	366
Swamp chestnut	93	217	2
Chinkapin	3	. . . .	5
Bur	1	. . . .	2
Total	3,074	3,209	2,976
Red oaks			
Water	1,558	2,293	1,018
Southern red	1,487	1,554	1,437
Willow	746	731	757
Cherrybark	425	588	306
Laurel	258	600	7
Blackjack[1]	253	129	344
Black	76	27	112
Bluejack[1]	60	11	96
Shumard	50	46	52
Nuttall	28	64	1
Live[1]	7	16	. . . .
Total	4,948	6,059	4,130
All oaks	8,022	9,268	7,106
Hickories			
Water	99	171	46
Pecan	27	32	22
Other	587	514	640
All hickories	713	717	708
American beech	162	364	13
Bluebeech[1]	28	32	26
Black walnut	16	10	20
Ironwood[1]	10	16	5
All species	8,951	10,407	7,878

[1]Noncommercial species.

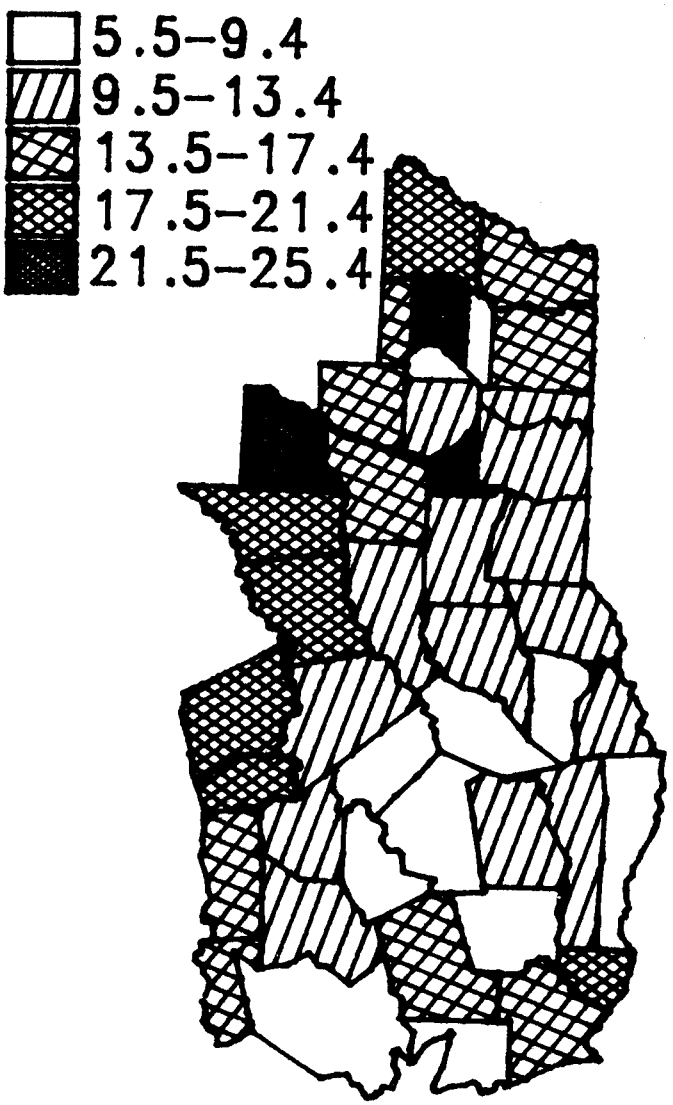


Figure 10.— *Basal area of sawtimber-sized nut-bearing tree species per acre of timberland by county, East Texas, 1986.*

trees of nonmerchantable trees). Optimum dead tree densities for cavity nesting bird species vary with what is considered adequate. Estimates range from 212 trees per 100 acres to 1,170 trees per 100 acres, with the majority of trees in small diameter classes (McComb and others 1986b). Another study suggests that larger diameter snags have an advantage over smaller snags, as larger snags, while not abundant, are favored by birds over the smaller trees (Morrison and others 1986).

Data on snags by diameter class, condition, forest type, and ownership provide indices of cavity-nesting wildlife habitat. Rotten trees are relatively rare in pine stands but are much more abundant in oak-gum-cypress stands (table 9). Dead trees (salvable dead plus standing nonsalvable dead) are present at an average density of 547 per 100 acres, although the majority are in the smaller diameter classes (table 10). The larger diameter dead trees are relatively rare; they are more frequent in hardwood stands (table 11). Salvable dead trees are not as common in bottomland hardwoods and longleaf-slash forest types as in loblolly-shortleaf, oak-pine, and oak-hickory forest types (fig. 13). Standing nonsalvable dead trees are not as frequent in longleaf-slash forest type as in other forest types. Bottomland hardwood stands contain the most standing nonsalvable dead trees in all diameter classes (figure 14).

Examination of tree numbers by ownership and forest type suggests forest industry timberland contains fewer potential snags, except in bottomland hardwood stands (table 11). The density of den trees (live cavity-bearing trees, most of which are classed as rotten trees) has generally been greater in hardwood stands and on public lands

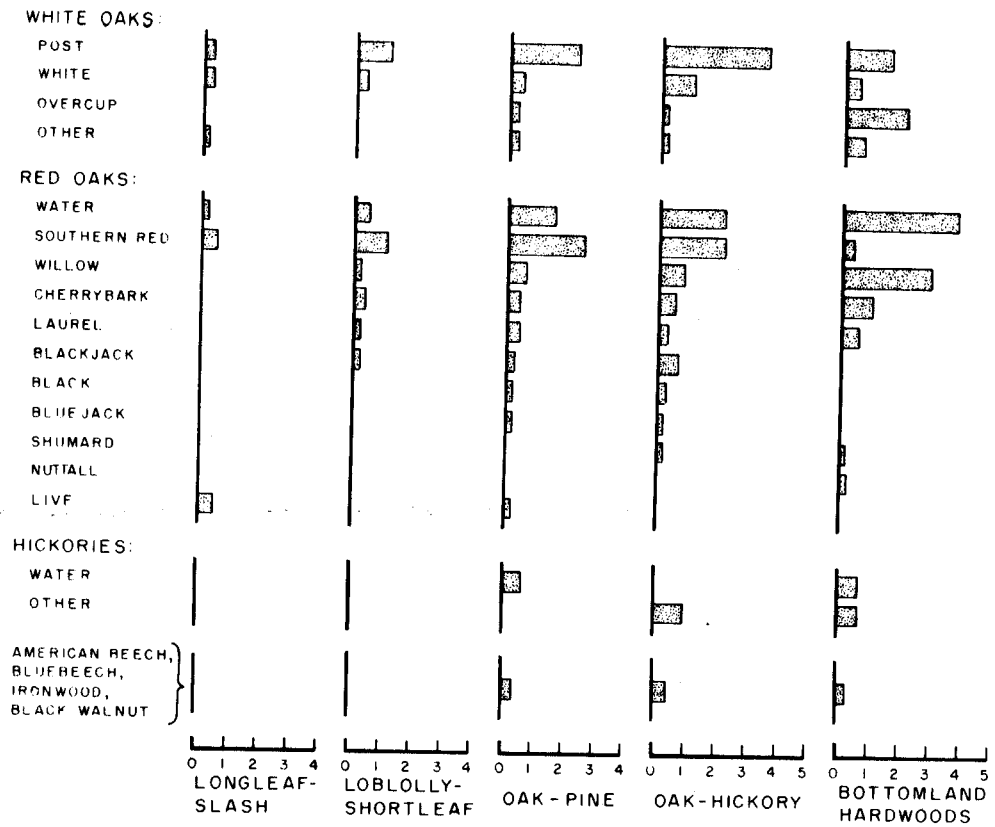


Figure 11.— *Number of live sawtimber trees of nut-bearing hardwood species per acre by species and forest type, East Texas, 1986.*

Table 7—*Number of live trees of fleshy fruit bearing species on timberland by species and diameter class, East Texas, 1986*[1]

Species	All classes	Diameter class (inches at breast height) 1.0-4.9	5.0-10.9	11.0-14.9	15.0-20.9	21.0 & larger
	Thousand trees					
Blackgum	237,374	204,031	26,652	4,306	1,878	508
Hawthorn	155,343	153,174	2,140	30	. . . .	. . . .
Dogwood	144,128	141,020	3,108	. . . .	. . . .	. . . .
Holly	87,452	79,944	6,645	265	64	. . . .
Sugarberry and hackberry	69,726	53,461	12,969	2,259	916	121
Persimmon	42,875	41,573	1,198	94	10	. . . .
Eastern and southern redcedar	40,755	34,023	5,833	662	211	26
Prunus sp.						
Black cherry	15,883	14,421	1,421	29	12	. . . .
Other	20,916	19,905	976	35	. . . .	. . . .
Mulberry	23,750	21,512	2,040	141	56	. . . .
Water tupelo	11,318	7,027	2,425	1,101	668	98
Total	849,522	770,091	65,406	8,922	3,816	752

[1]Rows and columns may not sum to totals due to rounding.

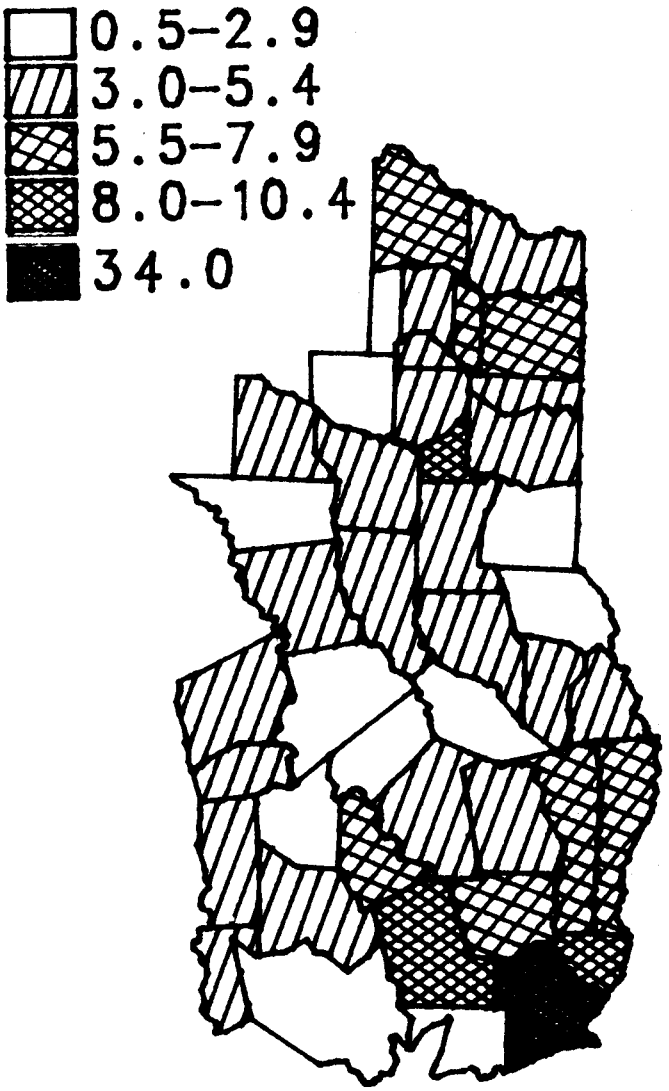


Figure 12.— *Basal area of fleshy fruit producing tree species per acre of timberland by county, East Texas, 1986.*

in Florida and South Carolina (McComb and others 1986a). Reduced standing dead tree densities have been noted for pine stands (Harlow and Guynn 1983; McComb and others 1986b, Rudis 1988), and for pine type forest industry lands in Florida (McComb and others 1986b) and Louisiana (Rudis 1988).

Patterns in large diameter trees and snags are due in part to differences in stand maturity by forest type and ownership. Many of the pine stands (loblolly-shortleaf and longleaf-slash) are relatively young (McWilliams and Lord 1988) and have not matured sufficiently to develop snags or large diameter trees, particularly when compared with older bottomland hardwood stands. Forest industry acreage is younger in pine, oak-pine, and oak-hickory stands, than comparable forest types in public or other private ownerships (McWilliams and Lord 1988). Differences in management priorities to retain multiple values on public and private timberland also can contribute to the relative abundance of snags and larger trees in pine stands.

RECREATION AND OTHER VALUE INTERACTIONS

The East Texas landscape contains the State's only extensively forested environment. Income from recreational uses of timberland comes directly from recreational activity leases (mainly for hunting, but also fishing, camping, and horseback riding), and indirectly from motels, campgrounds, sporting goods shops, restaurants, and the transportation industry. Leasing timberland for recreation promotes surrogate ownership that helps protect timberland from poaching, trash dumping, arson, and vandalism (Allen 1987). Monetary

Table 8—*Number of large diameter live trees on timberland by diameter class and forest type, East Texas, 1986*[1]

Forest type	Total	Diameter class (inches at breast height) 21.0-22.9	23.0-24.9	25.0-26.9	27.0-28.9	29.0 & larger
	Trees per 100 acres					
Longleaf-slash	17	16	. . .	. . .	. . .	2
Loblolly-shortleaf	142	78	34	17	7	6
Oak-pine	148	63	39	23	9	14
Oak-hickory	126	53	30	18	10	14
Oak-gum-cypress	345	137	87	48	26	47
Elm-ash-cottonwood	223	[2]	[2]	[2]	[2]	[2]
All types	256	117	63	35	17	24

[1]Rows may not sum to totals due to rounding.
[2]Insufficient sample size.

Table 9—*Number of rotten trees on timberland by diameter class and forest type, East Texas, 1986*[1]

Forest type	Total	Diameter class (inches at breast height)				
		5.0-8.9	9.0-12.9	13.0-16.9	17.0-20.9	21.0 & larger
	Trees per 100 acres					
Longleaf-slash	28	. . .	9	19	. . .	. . .
Loblolly-shortleaf	129	63	26	21	11	8
Oak-pine	259	70	65	64	33	27
Oak-hickory	313	122	69	57	32	33
Oak-gum-cypress	445	124	99	82	70	70
Elm-ash-cottonwood	277	[1]	[1]	[1]	[1]	[1]
All forest types	249	88	56	49	29	27

[1]Insufficient sample size.

Table 10—*Number of dead trees on timberland by diameter class and forest type, East Texas, 1986*[1]

Forest type	Total	Diameter class (inches at breast height)				
		5.0-8.9	9.0-12.9	13.0-16.9	17.0-20.9	21.0 & larger
	Trees per 100 acres					
Longleaf-slash	335	207	109	11	5	3
Loblolly-shortleaf	552	400	90	42	15	5
Oak-pine	492	315	101	51	17	8
Oak-hickory	552	331	130	54	22	15
Oak-gum-cypress	658	342	173	90	30	23
Elm-ash-cottonwood	327	[1]	[1]	[1]	[1]	[1]
All forest types	547	348	116	53	19	11

[1]Insufficient sample size.

Table 11—*Number of rotten, salvable dead, and standing nonsalvable dead trees 5.0 inches or more in diameter by forest type and ownership, East Texas, 1986*

Forest type and ownership	Total	Rotten	Salvable dead	Standing nonsalvable dead
	Trees per 100 acres			
Pine[1]				
Public	858	70	377	411
Forest industry	490	109	129	252
Nonindustrial private	750	145	225	380
All owners	660	122	205	333
Oak-pine and oak-hickory				
Public	941	278	107	556
Forest industry	634	262	135	237
Nonindustrial private	889	303	228	358
All owners	817	290	197	330
Bottomland hardwoods[2]				
Public	[3]	[3]	[3]	[3]
Forest industry	1,103	392	75	636
Nonindustrial private	1,091	465	75	551
All owners	1,086	439	81	566
All forest types				
Public	879	145	290	444
Forest industry	625	209	126	290
Nonindustrial private	880	282	204	394
All owners	796	249	184	363

[1]Includes longleaf-slash and loblolly-shortleaf forest types.
[2]Includes oak-gum-cypress and elm-ash-cottonwood forest types.
[3]Insufficient sample size.

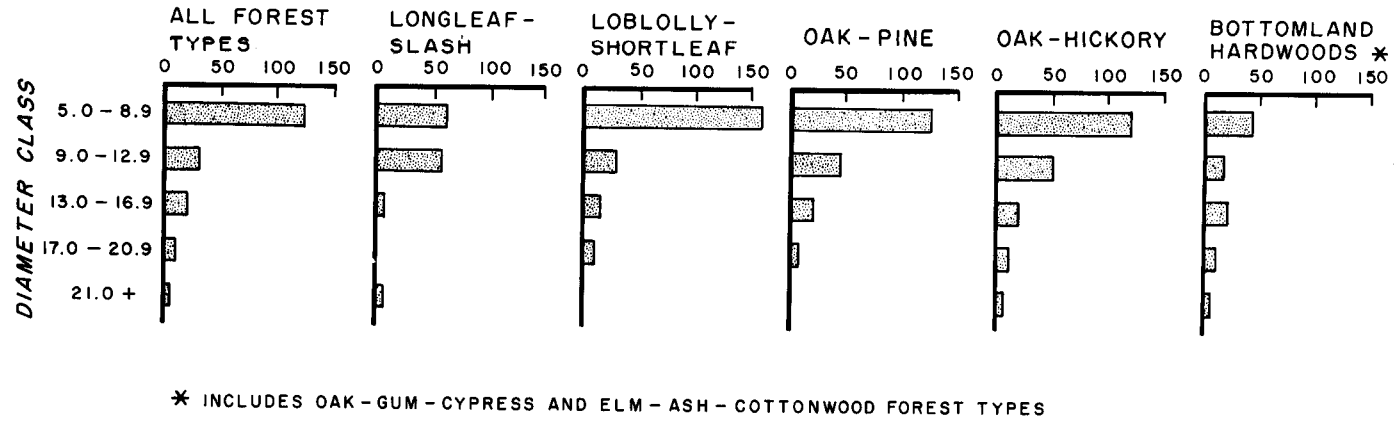


Figure 13.— *Number of salvable dead trees per 100 acres by diameter class and forest type, East Texas, 1986.*

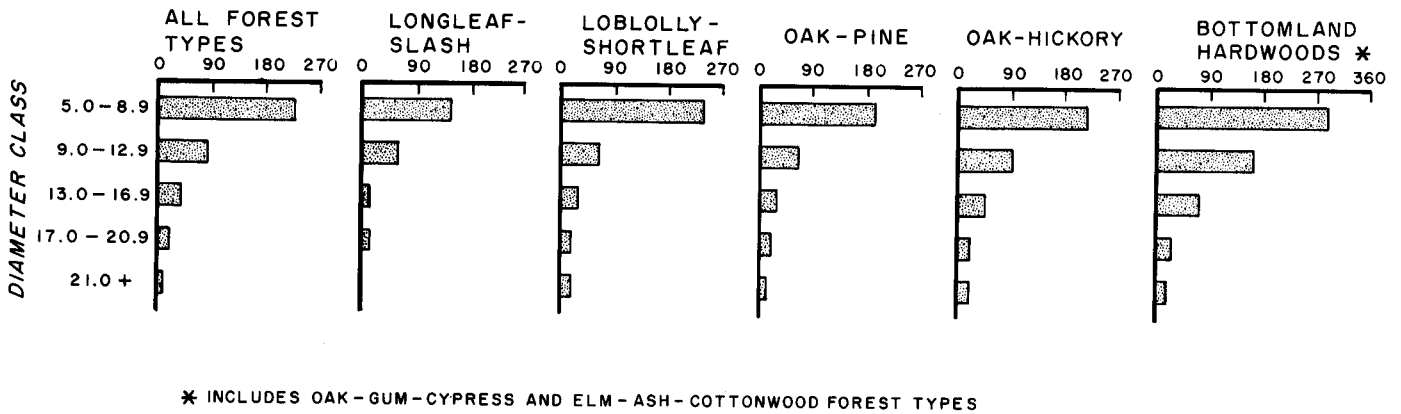


Figure 14.— *Number of standing nonsalvable dead trees per 100 acres by diameter class and forest type, East Texas, 1986.*

incentives for leasing are present as well, with hunting leases averaging $2.50 per acre Statewide, and some that are as high as $25 per acre (Gramann 1987). Other hunting expenditures that generate income to local economies (e.g., for lodging, equipment, etc.) are considerable as well (Adams and Thomas 1983). Tourism promotion, allowing public access to private timberland, and development of well-planned regional forest trails, waterways, and scenic areas are some of the ways communities enhance indirect income-generating recreational opportunities. Managing timberland for other forest values (e.g., game species, aesthetics) also has a public relations benefit, an important incentive to industrial timber producers and others with large landholdings.

Timberland with the greatest number of recreation users is likely to be near water and populated areas (as in Alabama [Rudis 1987]). One-third of the timberland in East Texas (3,800,000 acres) is within 1,600 feet of permanent water bodies; one-sixth of this amount (600,000 acres) is also within 1 mile of urban or built-up areas and within ¼ mile of roads.

In addition to water and populated acres, timberland areas with the most users for dispersed recreational activities are those with unique features, easy access, and close proximity to developed facilities. Several characteristics—such as remoteness (isolation from human intervention), location in relation to population centers, available facilities, aesthetics, and fire—influence recreation as well as the multiple values of timberland.

Remoteness

Remote timberland areas are relatively rare in the Midsouth states (Rudis 1986). Such areas traditionally are the lands with limited opportunities for development—usually poorly drained bottomlands and mountainous areas with steep slopes where road-building is costly, and areas where soils, land management, or economic conditions favor forest cover over cropland or urban or built-up land. When located near designated wilderness or natural forest vegetation areas, remote timberland areas act as buffers against conflicting land

uses. Remote timberland areas are important to recreation users and others interested in conserving areas isolated from civilization, and are valued by wildlife in need of seclusion.

Estimates of remote timberland areas in this report are based on forest size (area of contiguous forest land) and distance from roads (all-weather roads, or otherwise truck-operable roads) (table 12). Timberland that is a part of large tracts (2,500 acres or more) represents 22 percent of East Texas' timberland and 24 percent (2,956 million cubic feet) of the growing-stock volume. Timberland distant from roads (½ mile or more from roads) represents 1,200,000 acres (10 percent) and 1,334 million cubic feet of growing-stock volume (11 percent).

Remote timberland is widely scattered throughout the region. Most of the acreage part of 2,500 acre tracts or ½ mile or greater from roads is concentrated in the south central portion (fig. 15). Timberland distant from roads and part of large tracts is relatively rare—representing only 4 percent (500,000 acres). Of this amount, 37 percent occurs in bottomland hardwood forest types, while 48 percent occurs in upland hardwoods and 15 percent occurs in pine forest types (table 13).

(Nontimberland that is forested may contain acreage that is considered remote. This "productive-reserved forest land" amounts to 119,726 acres. Detailed measurements in this area are not conducted as part of the timberland survey).

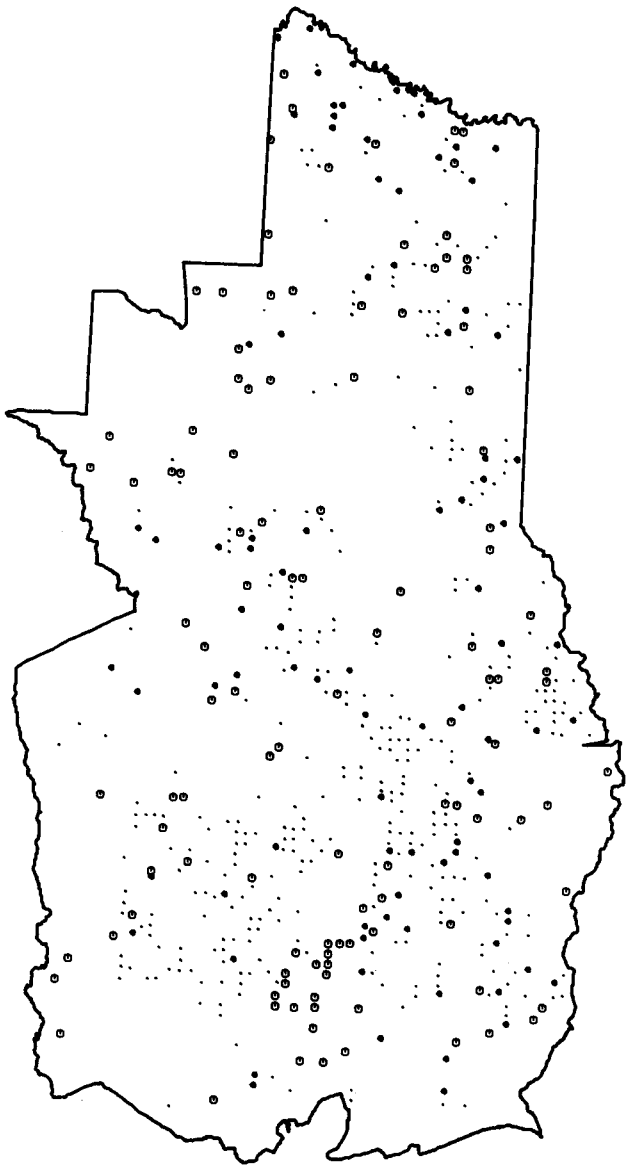


Figure 15.— *Remote timberland by forest tract size and distance from roads, East Texas, 1986.*

Access

Physical access to East Texas timberland is relatively good, as 86 percent of the timberland is within ¼ mile of roads, and many residents of the area are within a 1-day drive of a variety of timberland areas. Approximately 22 percent of the roads are paved, 56 percent are dirt or gravel, and 8 percent are right-of-ways or for 4-wheel drive

Table 12—*Area of timberland by size of tract and distance from roads, East Texas, 1986*[1]

Size of tract (acres)	Total	Distance from roads (miles)				
		0-<¼	¼-<½	½-<¾	¾-<1	1 or more
	Thousand acres					
1-10	132.8	100.2	32.6	. . .	. . .	. . .
11-50	538.1	473.6	39.6	18.7	6.3	. . .
51-100	848.3	694.5	129.1	12.2	6.2	6.3
101-500	3,303.1	2,569.1	559.8	118.8	24.3	31.1
501-2,500	4,202.8	2,822.4	923.3	348.9	59.3	48.9
2,501-5,000	1,596.4	823.9	424.5	213.6	61.4	73.0
More than 5,000	943.8	553.6	194.6	93.5	41.4	60.8
Total	11,565.3	8,037.2	2,303.4	805.7	198.9	220.1

[1]Rows and columns may not sum to totals due to rounding.

Table 13—*Area of timberland by size of tract, distance from roads, and forest type, East Texas, 1986*[1]

Size of tract	Total	Pine[2]	Upland hardwoods[3]	Bottomland hardwoods[4]
	Thousand acres			
2,500 acres or more				
½ mile or more from roads	543.7	84.1	259.2	200.4
less than ½ mile from roads	1,996.5	839.4	907.8	249.4
Less than 2,500 acres				
½ mile or more from roads	681.0	163.0	285.8	232.2
less than ½ mile from roads	8,344.1	3,130.1	4,318.3	895.7
Total	11,565.3	4,216.6	5,771.1	1,577.7

[1]Rows and columns may not sum to totals due to rounding.
[2]Includes longleaf-slash and loblolly-shortleaf pine forest types.
[3]Includes oak-pine and oak-hickory forest types.
[4]Includes oak-gum-cypress and elm-ash-cottonwood forest types.

vehicles only. Potential limitations on recreation access include "no trespassing" or "keep out" signs (13 percent of the timberland) and fences (61 percent of the timberland).

Access to timberland may be restricted by private landowners who control most of the timberland acreage (33 percent forest industries, 61 percent other private landowners, and 6 percent public agencies). Agreements to allow public access to private timberland and involvement by private landowners in supplying other forest values benefit the well-being of communities, and can provide financial returns, particularly where there are shortages.

Location

In addition to road distance, timberland's recreation value depends on its proximity to population centers. County population density is greatest in Harris and Gregg counties (fig. 16). Ten-year projections of county populations suggest most of the growth is expected in Gregg, Harris, and Montgomery counties, with surrounding counties receiving substantial increases in population density (fig. 17). Montgomery County has a projected annual population growth rate of 5 percent, one of the highest rates in the United States.

Examination of timberland by State planning districts allows one to consider the pool of potential recreation users and forest resources from surrounding counties. There are inequities in the distribution of timberland, but the variety of forest types are represented in each of the planning districts (fig. 18). Each of the State's planning districts have some timberland, though the majority is in Lufkin/Nacogdoches district. Most of the acreage in East Texas is in nonindustrial private ownership, except in Lufkin/Nacogdoches where forest industries control half of the acreage (table 14). Public timberland, 763,000 acres, is supplemented by productive-reserved forest land acreage in the districts of Houston (5,000 acres), Lufkin/-Nacogdoches (67,000 acres), and Beaumont/Port Arthur (48,000 acres).

Timberland per resident ranges from 0.49 acres in the Houston district to 15.58 acres in the Lufkin/Nacogdoches district. Visitors that use timberland for recreation frequently outnumber the resident population. According to information gathered by the Texas Parks and Wildlife Department (TPWD), Tyler and Texarkana district are particularly influenced by users from the Dallas-Ft. Worth metropolitan area (TPWD 1985). The rural character of the Lufkin/Nacogdoches district, coupled with its relatively abundant freshwater lakes, attracts many nonresidents, particularly from the Houston metropolitan area (TPWD 1985).

The expansion of major cities, such as Houston, Tyler, and Dallas-Ft. Worth, and an increase in cropland and pastureland reduces timberland area, increases the demand for nontimber and timber values to remaining forests. Urban expansion, coupled with development for water impoundments and roads, has diverted 500,000 acres out of timberland between 1975 and 1986. Clusters of diverted acres to urban and other uses (plus signs in figure 19) suggest growth of Tyler, Longview, and Houston as contributing to the decline in timberland. Conversion of timberland to nontimberland in the near future is likely for some of the acreage within one mile of urban areas (large dots and open circles in figure 19), particularly those also within 200 feet of a road (open circles in figure 19).

Nontimber uses influence timberland near water sources, urban areas, and agricultural areas. Timberland associated with water (fig. 3) has

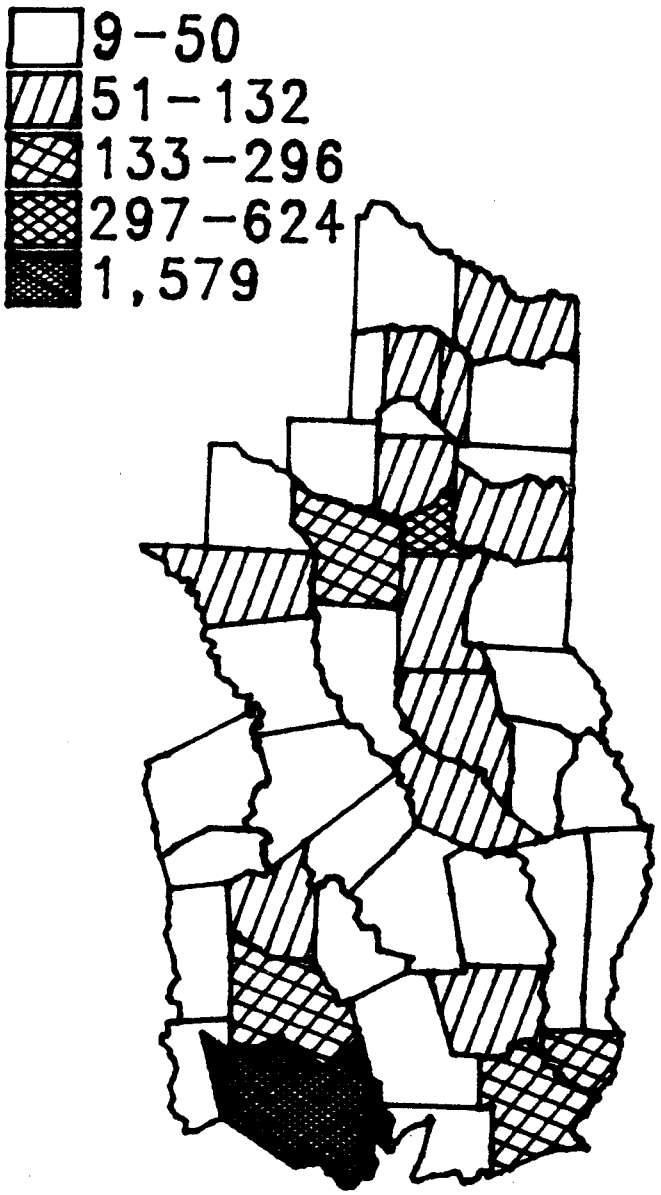


Figure 16.— *Population density per square mile by county, East Texas, 1985. (Projection from 1980 U.S. Census by Texas Department of Water Resources, 1981).*

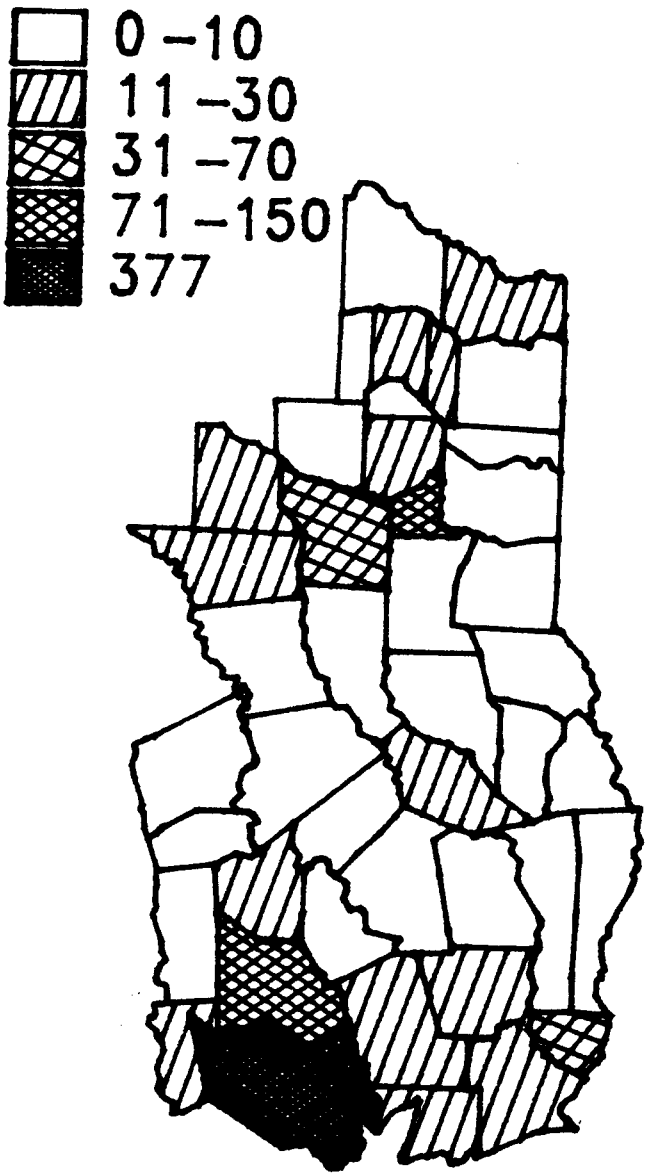


Figure 17.— *Increase in population density per square mile by county, East Texas, 1985-1995. (Projection from 1980 U.S. Census by Texas Department of Water Resources, 1981).*

Table 14—*Population, timberland area per person, and timberland area by ownership and State planning district for the East Texas survey region, 1986*[1]

State planning district	Population	Timberland area per resident	All owners	Public	Forest industry	Nonindustrial private
	Thousands	*Acres*	*Thousand acres*			
Houston	3,056	0.5	1,500.4	112.4	236.0	1,152.0
Tyler	641	4.6	2,944.3	29.7	375.0	2,539.4
Beaumont/Port Arthur	396	1.5	606.9	. . . .	380.6	226.3
Lufkin/Nacogdoches	311	15.6	4,840.4	548.7	2,602.6	1,689.1
Texarkana	177	6.7	1,192.3	72.0	179.4	940.9
Bryan/College Station	37	12.9	481.0	. . . .	22.0	459.0
Total	4,617	2.5	11,565.3	762.9	3,796.5	7,006.9

[1]Rows and columns may not sum to totals due to rounding.

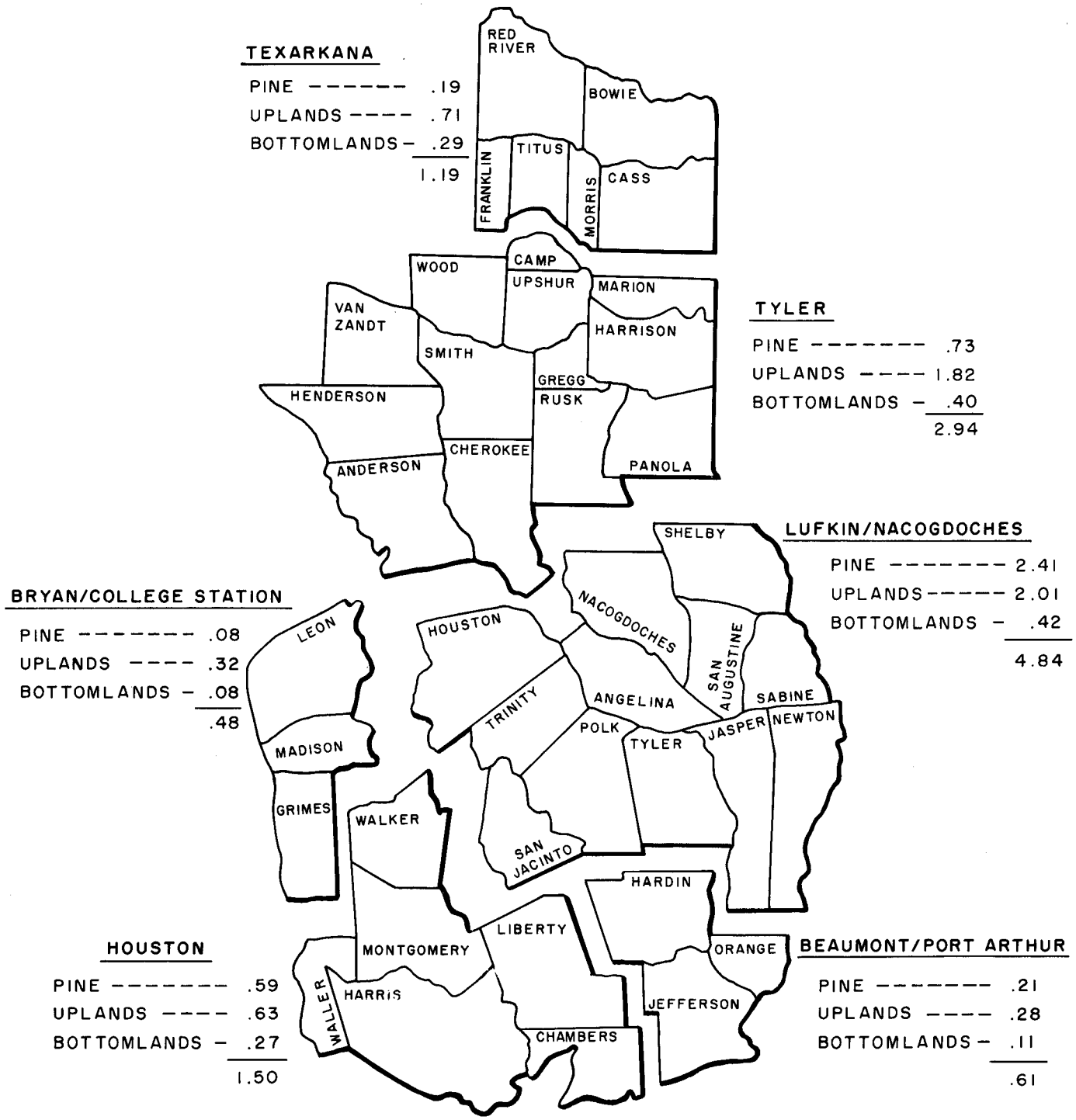
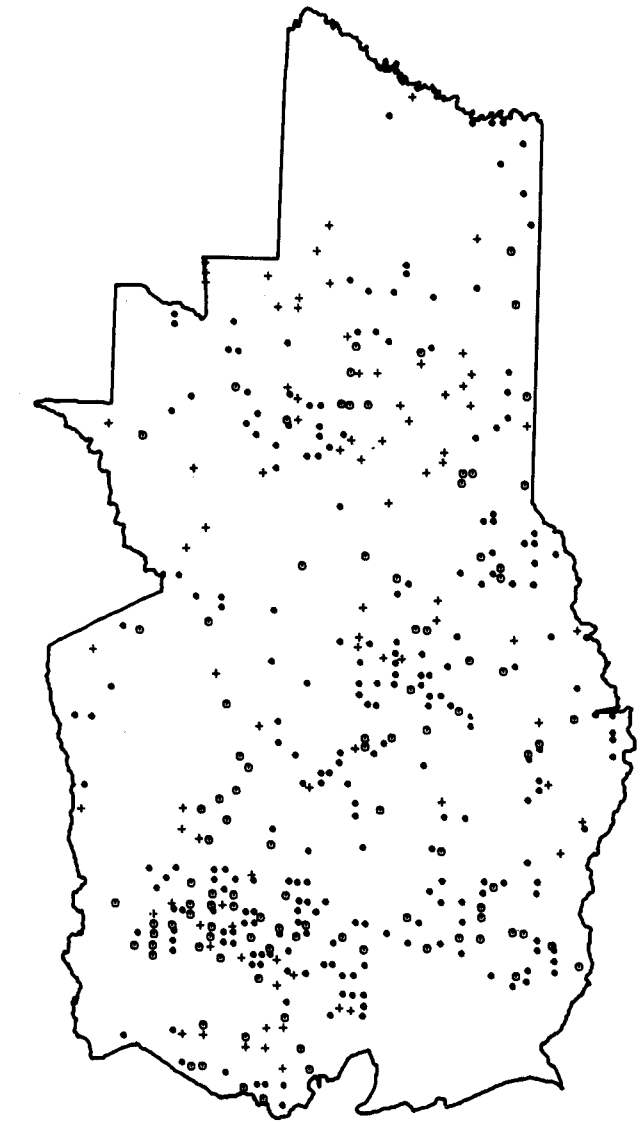
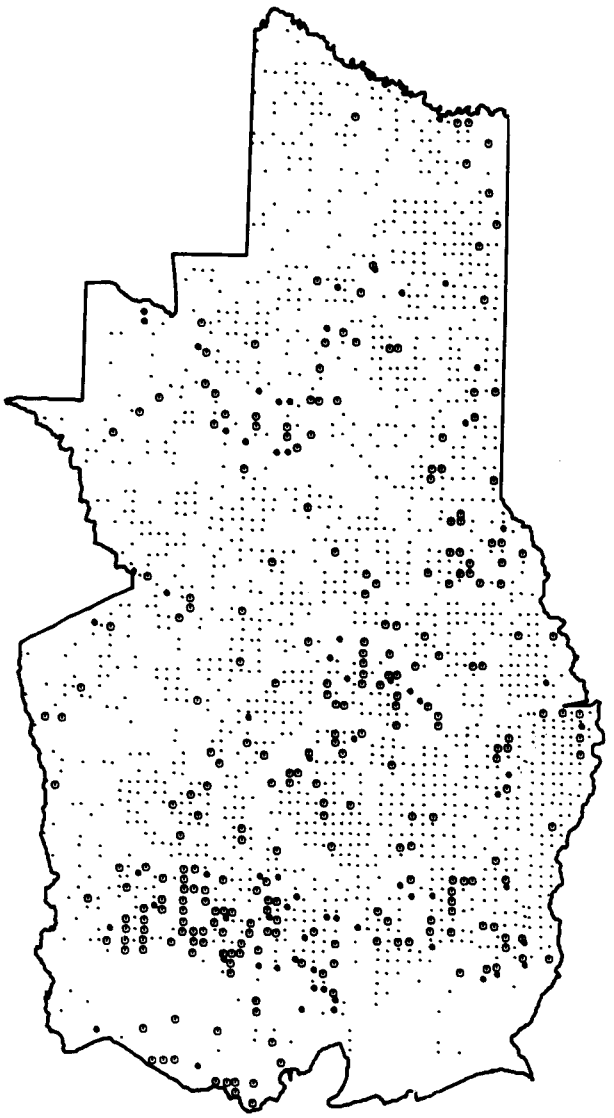


Figure 18.— *Timberland by planning districts and forest type, East Texas, 1986. Pine=longleaf-slash, loblolly-shortleaf; uplands=oak-pine, oak-hickory; bottomlands=oak-gum-cypress, elm-ash-cottonwood. Columns may not sum to totals due to rounding.*



+ Former timberland (1975) diverted to urban and other uses
- Timberland within 200 feet of a road and within 1 mile of urban or built-up land
- Timberland within 1 mile of urban or built-up land

Figure 19.—*Timberland or former timberland with potential for diversion to urban and other nonagricultural uses, East Texas, 1986.*



- Less than 1 mile urban or built-up land and within 1,200 feet of a road
- Less than 1 mile urban or built-up land and more than 1,200 feet of a road
- 1 mile or more from urban or built-up land

Figure 20.— *Timberland by proximity to urban and built-up land and roads, East Texas, 1986.*

already been discussed. Urban influences on timber management operations—a shift in fire control priorities toward forests near buildings, reduced opportunities for fire in harvest and management operations, increased visibility of timber production operations, real estate speculation, and recreational use—are generally greater when closer to urban areas and roads. The timberland-urban land interface (fig. 20) represents an area where serious fire suppression/protection problems can arise and where use of fire in timber management can confront public concerns for limiting pollution and conserving wildlife and aesthetics. Clusters illustrate the proximity of major cities to timberland areas (fig. 20). The 1,561,000 acres of timberland within 1,200 feet of roads and within one mile of urban or built-up land represent 13.5 percent of the acreage and 14.6 percent of the growing-stock volume (1,816 million cubic feet).

Agricultural influences on timberland—occasional multiple use, such as grazing by livestock, beekeeping, firewood and fencepost harvesting for personal use, and temporary diversions to cropland—are most likely to occur where land in agricultural use is dominant. In East Texas, timberland associated with agricultural land is found mainly in northern and western parts of the region (fig. 21). The 1,940,000 acres of timberland within 200 feet of agricultural land represents 16.7 per-

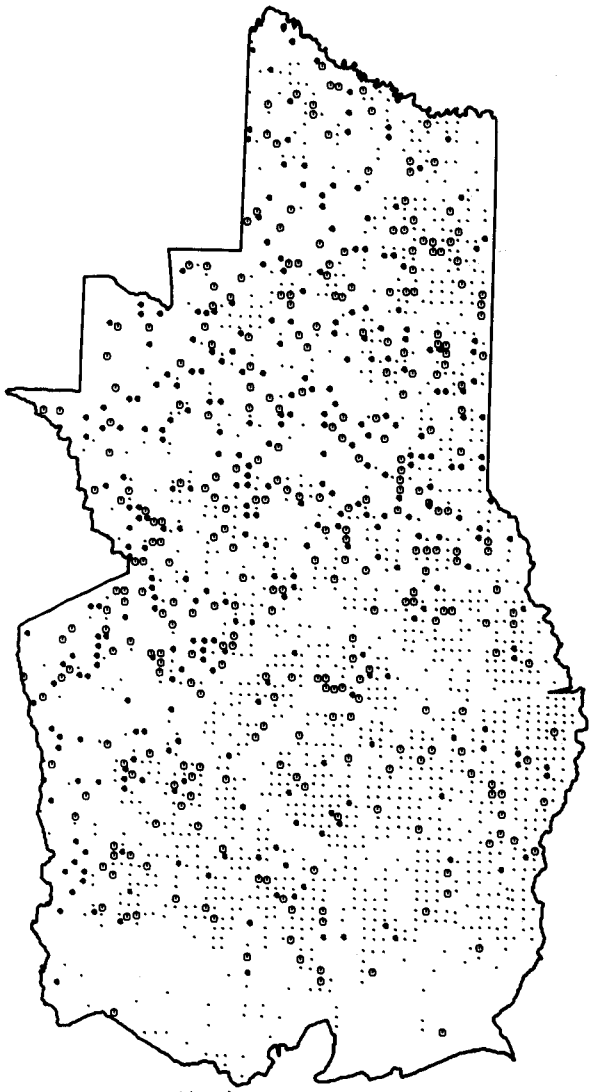


Figure 21.— *Timberland by proximity to agricultural areas, East Texas, 1986.*

cent of the region's timberland, and 11.6 percent (1,442 million cubic feet) of the growing-stock volume. Between 1975 and 1986, most of the timberland diverted to agriculture (367,000 acres) and most timberland recently reverted from agriculture (633,700 acres) came from the northern and western parts of the region. A net increase in tree planting, soil conservation programs, and an economic downturn in short-term crop or livestock production could increase timberland in these same areas.

Activities

In this report, recreation activities considered are those associated with dispersed forested areas. Direct use of timberland occurs with activities such as hunting, primitive camping, and hiking. Indirect use occurs with activities such as sightseeing, picnicking, freshwater fishing, and boating.

Areas associated with outdoor recreation activities influence and are influenced by timberland management, as forests provide the setting for many activities. Developed recreation acreage is concentrated near the urban areas, in Harris and Jefferson counties (fig. 22). Undeveloped acreage represent areas with recreation development potential or areas devoted to nature conservation, hunting, and other multiple uses (including timber management). Counties with appreciable undeveloped acreage occur in the south central portion of East Texas where the National Forest System is a major landholder (fig. 23). Sabine, Polk, Harris, Smith, and Henderson counties contain the highest concentration of campsites (fig. 24). Developed shoreline for water-related activities are abundant in only a few counties: Harris, Polk, and Sabine (fig. 25).

The Texas Parks and Wildlife Department indicates that overuse of recreation facilities has created problems in selected areas due to the unequal distribution of suitable areas relative to demand. Intense human activities near water bodies have resulted in soil erosion and reduced water quality, particularly on slopes adjacent to the more limited recreational lakes in the Northeast Survey Unit (TPWD 1985, p. 5-2). Limited public access to other rivers and lakes and crowding at existing access points excludes potential recreation users. Hunting pressure, intensified by a the lack of uniform procedures among landholders for the taking of game, has reduced hunter success rates in the Lufkin/Nacogdoches district (TPWD 1985, p. 14-2). Actions planned by the agency to reduce problems include promoting infrequently used areas to alleviate overuse in more well-known areas, seeking additional funds for maintenance and acquisition of recreation and conservation areas, and augmenting cooperative efforts among public agencies and the private sector to provide recreation opportunities (TPWD 1986).

Aesthetics

Tourism and recreation industries and individual communities are influenced by forest resources. Continuous management of forests to maximize wood production conserves timber values but has the potential for reducing aesthetics and other nontimber values. Dedication of timberland to conserve nontimber values, either by government action or through decisions by private landowners, ensures that such values are preserved in the short term but requires active management to maintain aesthetics as forest vegetation matures.

An alternative to exclusive land dedication is to

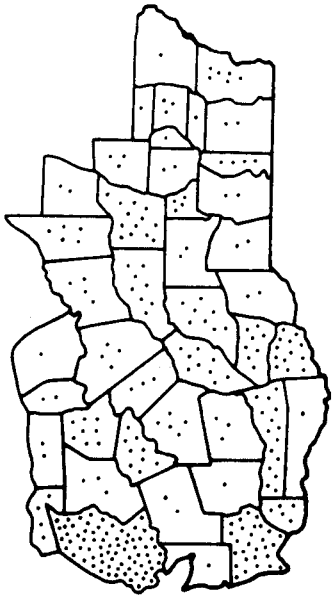


Figure 22.— *Acres of land developed for recreation by county, East Texas, 1985 (TPWD 1985). Each dot represents 100 acres.*

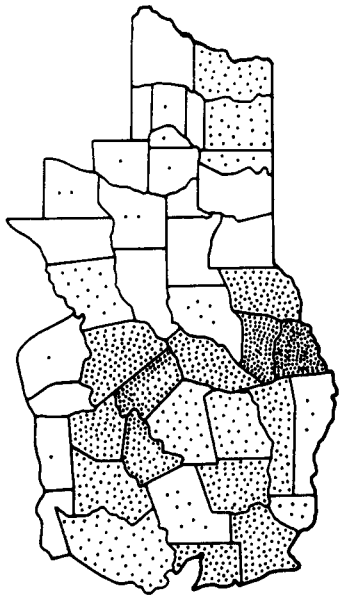


Figure 23.— *Acres of undeveloped land for recreation by county, East Texas, 1985 (TPWD 1985). Each dot represents 1,000 acres.*

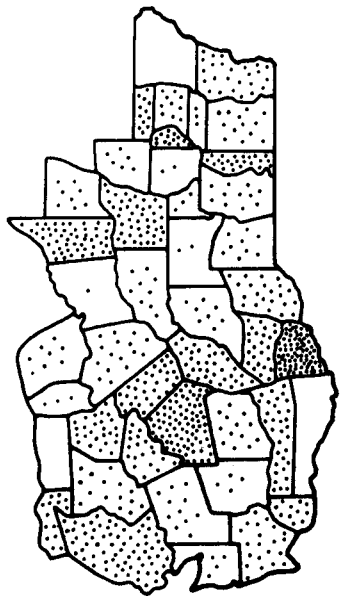


Figure 24.— *Number of campsites by county, East Texas, 1985 (TPWD 1985). Each dot represents 20 sites.*

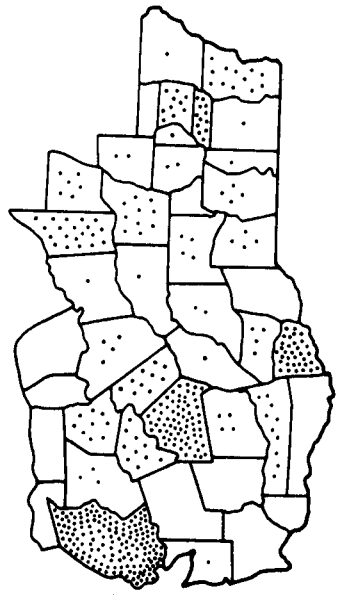


Figure 25.— *Yards of freshwater piers, marinas, and boat launch structures by county, East Texas, 1985 (TPWD 1985). Each dot represents 50 yards.*

retain the option for wood production while enhancing aesthetics and other nontimber values when harvesting timber and to consider wood production when managing forest resources for nontimber uses. Byproducts of timber management—temporary clearcut areas, regenerating sapling stands, and older even-aged stands of various age classes—provide visual variety in the landscape. Proper landscape design, particularly important along well-traveled roadways, near populated areas, in heavily-used recreation areas, and in sparsely forested agricultural areas, can mitigate timber and nontimber losses while enhancing aesthetic benefits. Guidelines to managing forests for timber as well as aesthetic benefits are available (Crowe 1973, Duffield 1970, Stern 1985).

More specifically, studies (Vodak and others 1985) have suggested that scenic quality is reduced in forested areas when slash or vegetative debris (discarded plant materials associated with wood harvests) is present. Forest recreation users dislike logging activity; those interested in opportunities for "primitive recreation" (i.e., being isolated from sights and sounds of man) are especially sensitive (Rudis 1987). Another study (Rudis and others, 1988) suggests that small amounts of vegetative debris may not be viewed negatively if the debris does not inhibit visual penetration into the forest scene. Harvesting and management activities associated with timber production have occurred on nearly half of East Texas timberland, 5,500,000 acres, since the 1975 survey. One might anticipate that vegetative debris is not uncommon in these areas. However, "abundant" vegetative debris (a relative judgment, not quantified) occurs on only 19 percent of harvested or managed acres (1,100,000 out of 5,500,000 acres). The remaining acreage with "not abundant" vegetative debris occurs on 43 percent (2,400,000 acres). Acreage with no vegetative debris occurs on 38 percent (2,100,000 acres).

For all of East Texas, vegetative debris occurs on 34 percent of the timberland (3,900,000 out of 11,565,300 acres), 88 percent of which occurs on acres with commercial timber harvesting or timber management activities. The remaining 12 percent is associated with noncommercial activities, such as cutting for firewood, posts, etc. Vegetative debris is well-distributed, although it is less frequently encountered in southern and western portions (fig. 26). Adjacent nontimber influences (cropland uses and livestock grazing in the west, urban and built-up land in the south) and reduced

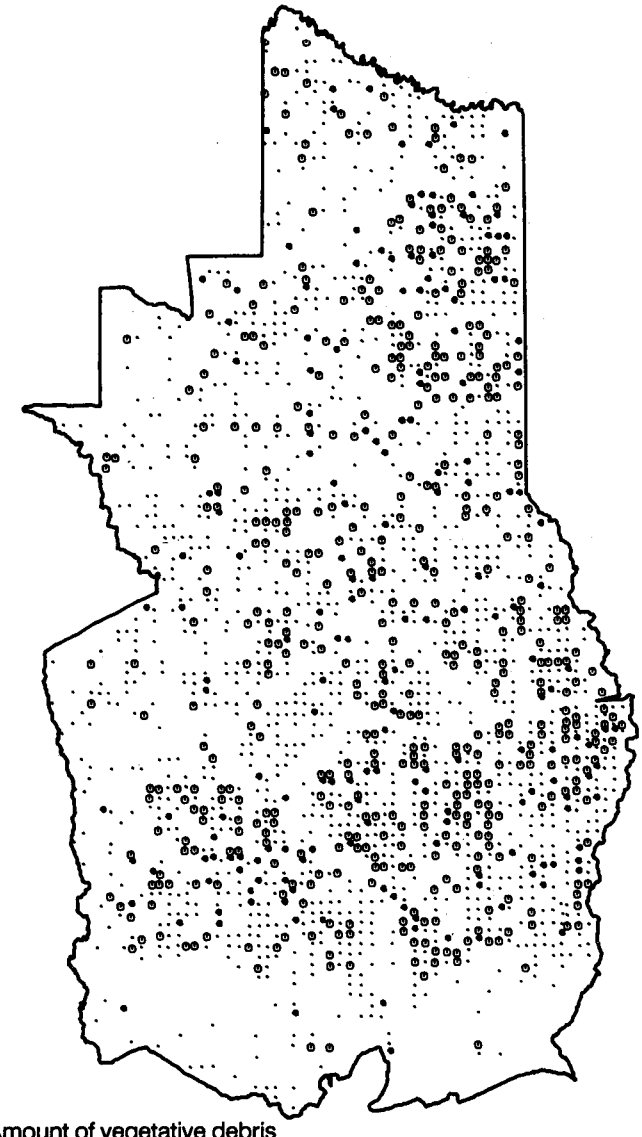


Figure 26.— *Timberland by amount of vegetative debris, East Texas, 1986.*

pine acreage (oak-hickory forest type in the west and bottomland hardwood forest types in the south) may affect timber harvesting and management practices in these areas.

Other discarded materials associated with human use can detract from the enjoyment of forests. Old bottles and rusted cans are especially disliked by forest users (Rudis 1987). Litter occurs on 34 percent of East Texas's timberland. Garbage dumping occurs on 5 percent of the acreage, beverage and food containers occur on an additional 23 percent, and other materials (miscellaneous bottles and cans, discarded machinery) adds another 6 percent. Much of the debris is found near roads, water sources, and areas with other evidence of human activities (e.g., hunting, farming, mineral exploration and extraction).

Fire

Sawtimber stands that have had low-intensity fires can be more scenic than those where understories are unmanaged and crowded with foliage. Prescribed fires aid timber management of southern pine stands by reducing competition from competing hardwoods, disposing of logging debris, and assisting in site preparation. In young or recently thinned stands, fire also aids growth of grasses and forbs useful to livestock and selected game species prior to canopy closure. Fire also is recognized as a natural process that helps maintain the health of southern pine ecosystems, particularly the longleaf pine climax forest type. In older pine stands, periodic fires help prevent hardwoods from encroaching on otherwise suitable red-cockaded woodpecker nesting habitat.

Estimates of the acreage on which evidence of fire—natural or man-caused—is noted for the East Texas survey. Acreage with evidence of fire since the prior survey amounts to 2,000,000 acres, or 18 percent of the timberland. On an annual basis, this is about 200,000 acres, mostly in the loblolly-shortleaf pine forest type (table 15). Evidence of fire is more frequent in nonstocked, sapling, and seedling stands due to the use of fire in site preparation (i.e., removing logging debris prior to planting, soil scarification prior to seeding). The longleaf-slash forest type, a fire-dependent type in many areas, is associated with fire more than other types in all stand size classes (table 16). Evidence of fire is common mainly in the south central portion of the region where longleaf, slash and other pine stands predominate (fig. 27).

In future surveys, trends in the presence of logging debris, discarded materials, and evidence of fire are likely to be important in describing changes in forest management activities to remove logging debris and litter, and to prevent or prescribe fires in forested areas.

OUTLOOK

Examination of projections involving timber resource supplies in the South and alternative timber management and public policy options is in its infancy regarding the other forest values (Joyce and others 1986). Results-to-date suggest wildlife and other forest values are less affected by changes in wood production than by changes in timberland acreage (Flather and others, in process). Reforestation programs designed for wood production will ultimately conserve a number of other forest resources, especially if these programs

Table 15—*Area and proportion of timberland with evidence of fire by forest type and time of fire, East Texas, 1986*

Forest type	Proportion with evidence of fire[2]	Since prior survey			
		Total	Within 2 years	Between 3 years and prior survey	None since prior survey
	Percent	*Thousand acres*			
Longleaf-slash	60	166.9	35.8	131.1	113.0
Loblolly-shortleaf	24	963.2	235.5	727.7	2,973.5
Oak-pine	20	486.8	134.6	352.2	1,915.0
Oak-hickory	11	386.2	154.2	232.0	2,983.1
Bottomland hardwoods[1]	1	23.6	11.4	12.2	1,554.0
All types	18	2,026.7	571.5	1,455.2	9,538.6

[1]Includes oak-gum-cypress and elm-ash-cottonwood forest types.
[2]Since prior survey.

Table 16—*Area and percent of timberland with evidence of fire since the prior survey by forest type and stand-size class, East Texas, 1986*[1]

Forest type	Stand-size class					
	Nonstocked, sapling, and seedling		Poletimber		Sawtimber	
	Thousand acres	*Percent*	*Thousand acres*	*Percent*	*Thousand acres*	*Percent*
Longleaf-slash	45.1	80	62.5	49	59.3	62
Loblolly-shortleaf	281.5	34	108.7	16	573.0	23
Oak-pine	296.8	42	36.4	8	152.4	12
Oak-hickory	282.5	23	43.0	4	61.8	6
Bottomland hardwoods[2]	23.6	11	. . .	. . .	. . .	. . .
All forest types	929.5	31	250.7	9	846.5	15

[1]Columns may not sum to totals due to rounding.
[2]Includes oak-gum-cypress and elm-ash-cottonwood forest types.

have other environmental objectives (e.g., planting some of the trees to promote wildlife, retain soil, and improve water quality). Integration of economically valued nontimber opportunities with timber management or more favorable economic conditions for hardwood sawtimber production also will favor selected nontimber resources.

Regionally, the south central portion (Polk and surrounding counties) of East Texas contains fewer mast hardwoods than elsewhere in the region. Forest industries have owned and continue to retain a significant portion of the timberland in this area. Some of these lands are made available to the public for hunting and other nontimber pursuits. Such areas likely support wildlife species that favor younger-aged stands. As these stands mature to sawtimber stand size class, wildlife species in need of older-aged stands will be favored.

The outlook for red-cockaded woodpecker nesting habitat is uncertain. An assessment based on the 1975 survey (Lennartz and others 1983b) is not comparable, as age class determination varied between surveys. Even if consideration is given to simplifying assumptions about stand age, statistical uncertainty for such a rare habitat is so large that significant trends in acreage cannot be detected. A large proportion of potential nesting habitat for red-cockaded woodpeckers is restricted to public forest acreage that will likely grow in importance for this endangered species.

Most information on the red-cockaded woodpecker has been limited to colonies on public land (Lennartz and others 1983a). Previously active colony populations on National Forests in Texas are declining (Richard Conner, personal communication, June 1987). However, comprehensive surveys of red-cockaded individuals forming new colonies on public land have not been done and the existence of new or expanding colonies on private land is not well known.

According to the Texas Parks and Wildlife Department (1985), demand for recreation facilities is likely to increase most in the Tyler and Lufkin/Nacogdoches district. Nearby suburban

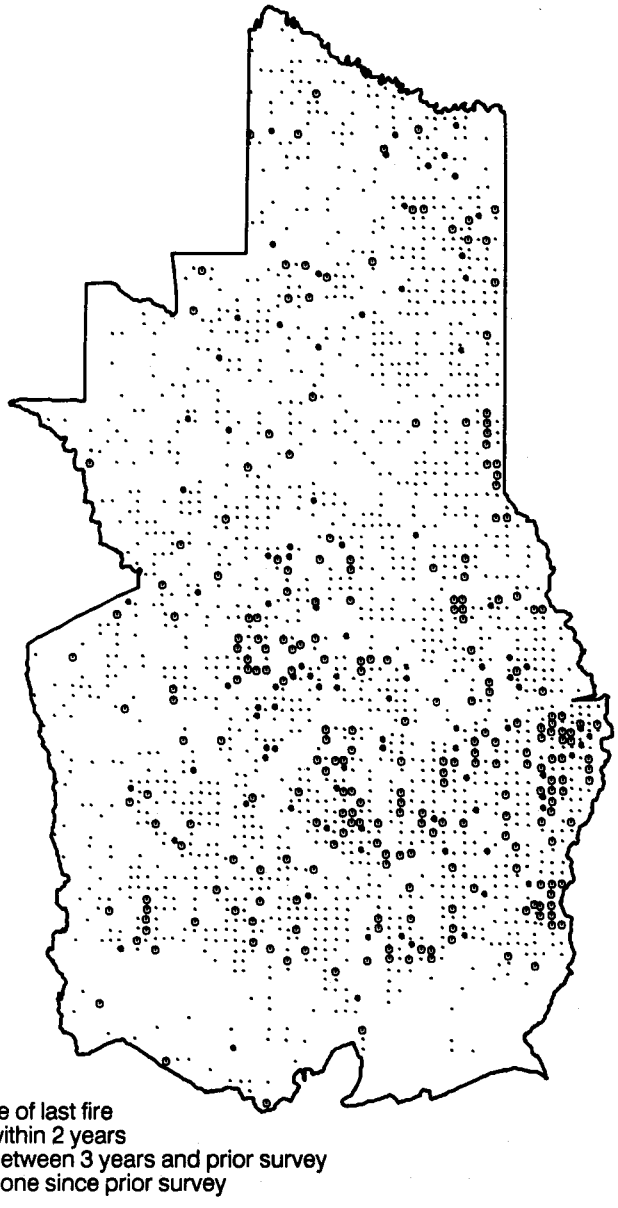


Figure 27.— *Timberland by time of last fire, East Texas, 1986.*

and urban populations outside East Texas have been expanding rapidly as well, increasing the nonresident demand for nonforest land uses, such as vacation homes and developed forest recreation facilities. An increase in road development on remaining timberland, and a reduction in remote timberland areas are anticipated with an increasing population, which suggests declines in primitive recreation opportunities (Cordell and Hendee 1982). Adequate planning for multiple uses is needed in those areas subject to urban influences if multiple value of timberland is to be retained.

The outlook for increasing East Texas' nontimber values is uncertain. There has been an increase in productive-reserved forest lands since the 1975 survey. (The current acreage, 119,726 acres, is represented by the Big Thicket National Preserve [84,550 acres] and the designated wilderness areas of the National Forests [35,176 acres]). With the addition of the Big Thicket, productive-reserved forest land has more than doubled since the last survey. While such a rate of increase is unlikely in the future, one should expect some additional emphasis on nontimber values with the growth of the region's population. Despite the limited extent of public timberland (7 percent of the acreage), public timberland is likely to provide more of the multiple values in the future.

In order to maintain or augment the bulk of nontimber values of timberland, efforts may need to concentrate on the largest class of timberland owners—the nonindustrial private sector. Studies have suggested that nonindustrial private landowners motivated to sell timber are primarily interested in the income-generating potential of timberland (Hickman 1984). Those not motivated to sell timber may need to be convinced that certain timber production alternatives can promote other values important to them (Young and Reichenbach 1987), such as nontimber commodity values (livestock production, recreation leases) and noncommodity values (aesthetics, opportunities for viewing wildlife, personal recreation by landowners and friends).

Near urban areas, development of markets for small-scale specialty products, such as longleaf pine straw mulch (Gormley 1987), nongrowing stock firewood for domestic use, and Spanish moss, may help supplement private landowner income while retaining nontimber as well as timber value options. Where markets for lease hunting exist, the economics of accomodating game species (such as reserving mast hardwoods along streams) can be more profitable than timberland management focused on timber alone (McKee 1987). However, short-term economic incentives for developing multiple resource opportunities through hunting and grazing leases, or recreation user fees, may be relatively limited (Fedkiw 1986).

Any extensive effort to increase the other forest values on timberland requires individuals, groups, and programs that can recognize both the short-term income-generating opportunities as well as the long-term multiple value opportunities of timberland in East Texas.

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Appendix

Survey Methods

Forest resource statistics were secured by a systematic sampling method involving forest-nonforest classification on aerial photographs and on-the-ground measurement of trees at selected locations. The locations selected were at intersections of a grid of lines spaced 3 miles apart.

Initial estimates of forest area were obtained by interpreting 95,640 photopoints using dot counts and the most recent aerial photography available. The dot counts provided an estimate of the proportion of forest to nonforest that was used along with U.S. Census land area data to develop county-level forest area statistics. The photointerpretation estimate was then adjusted by ground checks of all locations on the 3-mile grid, as well as intensification plots located between plots sampled.

Measurements included the collection of additional data on site productivity, stand origin, stand age, size of forest tract, distance from road, slope, aspect, management, evidence of use, proximity to nonforest land uses and other attributes. Ownership information was obtained for each plot from county tax assessors' records and contact with owners in the field. Personnel from the Agricultural Stabilization and Conservation Service and Soil Conservation Service, and other contacts were consulted when classifying absentee owners as farmers, individuals, corporations, or leasors.

Tree statistics were estimated from measurements taken at each forested location. Samples consist of 10 permanent horizontal points at each forested location. At each point, trees 5.0-inches d.b.h. or greater are tallied using a 37.5 factor prism, thus each tree represents 3.75 square feet of basal area per acre. Trees less than 5.0-inches d.b.h. are tallied on a 1/275 acre circular fixed plot on the first 3 points. Pine seedlings are tallied on a 1/1000 acre plot established at each of the 10 points. Growing-stock volume of trees was obtained using deterministic measurements, as described in Resource Bulletin SO-136 (McWilliams and Lord 1988).

Reliability of the Data

Reliability of FIA estimates may be affected by two sources of error. The first source, termed estimating error, arises from mistakes in measurement, judgement, recording, or compiling, and from limitations of the equipment. Estimating error is minimized by FIA through comprehensive training, good supervision, quality control programs, and emphasis on careful work.

A second source of error, called sampling error, is the statistical error associated with FIA's sample-based estimation procedures. Sampling errors are commonly referred to as percentages and are based on 1 standard deviation. That is, the chances are 2 out of 3 that if the results of a complete enumeration were known, the sample-based estimates would have been within the limits indicated. The FIA sample scheme has the objective of providing forest area and volume estimates of 1 percent per million acres and 5 percent per billion cubic feet, respectively, for the Pineywoods of Texas.

Sampling errors increase as estimates are broken down below the State-level, say by forest type and stand size. The relationship between sampling error and the degree of disagregation is depicted in table A1.

Table A1.—Sampling error to which estimates are liable, two chances out of three, East Texas, 1986

Sampling error	Timberland area	Growing-stock volume
Percent	*Thousand acres*	*Million cubic feet*
0.3	11,565.3	. . . .
1.0	1,040.9	. . . .
2.0	260.2	11,233.2
3.0	115.6	4,992.5
4.0	65.1	2,808.3
5.0	41.6	1,797.3
10.0	10.4	449.3
15.0	4.6	199.7
20.0	2.6	112.3
25.0	1.7	71.9

DEFINITION OF TERMS

Agricultural Land—Agricultural land is land used primarily for the production of crops or livestock. Included in proximity (nontimber) estimates are areas 10 acres or more in size such as cropland and pasture, nurseries, vineyards, orchards, confined feeding areas, and horse farms.

Basal Area—The area in square feet of the cross section at breast height of a single tree or of all the trees in a stand, usually expressed in square feet per acre.

D.b.h. (diameter at breast height)—Tree diameter in inches, outside bark, usually measured at 4½ feet above ground.

Diameter Classes—The 2-inch diameter classes extend from 1.0 inch below to 0.9 inches above the stated midpoint. Thus, the 12-inch class includes trees 11.0 inches through 12.9 inches d.b.h.

Dimension Classes of Trees

Sawtimber Trees—Trees 9.0 inches and larger in d.b.h. for softwoods, and 11.0 inches and larger for hardwoods.

Poletimber Trees—Trees 5.0 to 8.9 inches in d.b.h. for softwoods and 5.0 to 10.9 inches d.b.h. for hardwoods.

Saplings—Trees 1.0 inch to 4.9 inches in d.b.h.

Seedlings—Trees that are less than 1.0 inch in d.b.h.

Rough, Rotten, and Salvable Dead Trees—See "tree classes."

Forest Land Classes

Forest Land—Land at least 16.7 percent stocked by forest trees of any size, or formerly having such tree cover, and not currently developed for nonforest uses. Minimum area considered for classification is 1 acre. Forest land is divided into commercial categories: timberland, deferred timberland; and noncommercial categories: productive-reserved forest land, unproductive forest land.

Timberland—Forest land that is producing, or is capable of producing, crops of industrial wood and not withdrawn from timber utilization. Timberland is synonymous with "commercial forest land" in prior reports.

Deferred Timberland—National forest land that meets productivity standards for timberland but is under study for possible inclusion in the wilderness system.

Productive-Reserved Forest Land—Productive public forest land withdrawn from timber utilization through statute of administrative regulations.

Unproductive Forest Land—Forest land incapable of yielding crops of industrial wood because of adverse site conditions.

Forest Types

Longleaf-Slash Pine—Forests in which longleaf or slash pine, singly or in combination, comprise a plurality of the stocking. Common associates include oak, hickory, and gum.

Loblolly-Shortleaf Pine—Forests in which loblolly, shortleaf, Virginia, spruce pine and eastern redcedar, singly or in combination, comprise a plurality of the stocking. Common associates include oak, hickory, and gum.

Oak-Pine—Forests in which hardwoods (usually upland oaks) comprise a plurality of the stocking, but in which softwoods, except cypress, comprise 25-49 percent of the stocking. Common associates include gum, hickory, and yellow-poplar.

Oak-Hickory—Forests in which upland oaks or hickory, singly or in combination, comprise a plurality of the stocking except where pines comprise 25-49 percent, in which case the stand would be classified oak-pine. Common associates include yellow-poplar, elm, maple, and black walnut.

Oak-Gum-Cypress—Bottomland forests in which tupelo, blackgum, sweetgum, oaks, or cypress, singly or in combination, comprise a plurality of the stocking except where pines comprise 25-49 percent, in which case the stand would be classified oak-pine. Common associates include cottonwood, willow, ash, elm, hackberry, and maple.

Elm-Ash-Cottonwood—Forests in which elm, ash, or cottonwood, singly or in combination, comprise a plurality of the stocking. Common associates include willow, sycamore, beech, and maple.

FIA—Forest Inventory and Analysis unit of the U.S. Department of Agriculture, Forest Service, Southern Forest Experiment Station.

Mortality—Number or sound-wood volume of live trees dying from natural causes during a specified period.

Permanent Water Sources—Bodies of water or water courses present throughout the year. Included in proximity (nontimber) estimates are bodies of water ⅛ acre in size or larger, or water courses 40 feet or more in width.

Plantations—Timberland classified as longleaf-slash or loblolly-shortleaf forest types with evidence of planting or direct seeding.

Site Classes—A classification of forest land in terms of potential capacity to grow crops of industrial wood.

Stand-Size Classes

Sawtimber Stands—Stands at least 16.7 percent stocked with growing-stock trees, half or more of this stocking in sawtimber or poletimber trees, and with sawtimber stocking at least equal to poletimber stocking.

Poletimber Stands—Stands at least 16.7 percent stocked with growing-stock trees, half or more of this stocking in sawtimber or poletimber trees, and with poletimber stocking exceeding that of sawtimber stocking.

Sapling-Seedling Stands—Stands at least 16.7 percent stocked with growing-stock trees, more than half of this stocking in saplings or seedlings.

Nonstocked Stands—Stands less than 16.7 percent stocked with growing-stock trees.

Stocking

Stocking is a measure of the extent to which the growth potential of the site is utilized by trees or preempted by vegetative cover. Stocking is determined by comparing the stand density in terms of number of trees or basal area with a specified standard. Therefore, full stocking is 100 percent of the stocking standard.

The tabulation below shows the density standard in terms of trees per acre by size class, required for full stocking.

D.b.h. (inches)	Number of trees	D.b.h. (inches)	Number of trees
Seedlings	600	16	72
2	560	18	60
4	460	20	51
6	340	22	42
8	240	24	36
10	155	26	31
12	115	28	27
14	90	30	24

Tree Classes

Commercial Species—Tree species currently or prospectively suitable for industrial wood products. Excluded are noncommercial species (see Species List).

Noncommercial Species—Tree species of typical small size, poor form, or inferior quality that normally do not develop into trees suitable for industrial wood products (see List of Species).

Growing-Stock Trees—Live trees of commercial species classified as sawtimber, poletimber, sapling, and seedling. Trees must have a 12-foot butt log now or prospectively to be classed as growing stock.

Rough Trees—Live trees of commercial species that are unmerchantable for saw logs currently or potentially because of roughness or poor form in the butt log. Also included are all live trees of noncommercial species.

Rotten Trees—Live trees of commercial species that are unmerchantable for saw logs currently or potentially because of rot deduction in the butt log.

Cull Trees—Rough or rotten trees.

Hardwoods—Dicotyledonous trees, usually broad-leaved and deciduous.

Softwoods—Coniferous trees, usually evergreen having needle or scalelike leaves.

Live Trees—All trees that are alive. Included are all size classes and all tree classes.

Salvable Dead Trees—Standing or down dead trees that were formerly growing stock and are considered merchantable.

Urban or Built-Up Land—Urban or built-up land is land comprised of areas of intensive human use with much of the land covered by man-made structures. Included in proximity (nontimber) estimates are areas 10 acres or more in size, such as towns, villages, strip developments along highways, power and communication facilities, industrial complexes, and institutions.

Volume

Volume of Cull—The volume of sound wood in the bole of rough and rotten trees.

Volume of Growing Stock—Volume of sound wood in the bole of sawtimber and poletimber trees from a 1-foot stump to a minimum 4.0-inch top outside bark or to the point where the central stem breaks into limbs. Rough, rotten, and noncommercial trees are excluded.

Volume of Sawtimber—Net volume of the saw-log portion of live sawtimber trees in cubic feet or board feet of the International rule (¼-inch kerf). Net volume equals gross volume less deductions

for rot, sweep, and other defects that affect use for lumber to the point where the central stem breaks into limbs. Rough, rotten, and noncommercial trees are excluded.

Volume of Timber—The volume of sound wood in the bole of growing stock, rough, rotten, and salvable dead trees 5.0 inches and larger in d.b.h. from stump to a minimum 4.0-inch top outside bark, or to the point where the central stem breaks into limbs.

LIST OF SPECIES

Table A2 ranks all live trees (1.0 inches d.b.h. and larger) by relative importance and presents data on occurrence, relative importance, frequency, density, and basal area. The timber report (McWilliams and Lord 1988) ranks species by survey unit and volume for all live trees and provides maps of the county volume distribution of selected species.

Scientific and common names of tree species that were recorded on plots sampled in East Texas:[1]

Genus and Species	Common Name
Softwoods	
Juniperus silicicola	southern redcedar
J. virginiana	eastern redcedar
Pinus echinata	shortleaf pine
P. elliottii	slash pine
P. palustris	longleaf pine
P. taeda	loblolly pine
P. virginiana	Virginia pine
Taxodium distichum var. *distichum*	baldcypress
Hardwoods	
Acer barbatum	Florida maple
A. negundo	boxelder
A. rubrum var. *rubrum*	red maple
A. saccharinum	silver maple
A. saccharum	sugar maple
Aesculus glabra	Ohio buckeye
A. sp. [2]	buckeye
Betula nigra	river birch
Bumelia sp.[2]	bumelia
Carpinus caroliniana[2]	bluebeech
Carya sp.[2]	hickory
C. aquatica	water hickory
C. illinoensis	pecan
Castanea sp.[2]	chinkapin
C. pumila	Allegheny chinkapin
Catalpa sp.	catalpa
Celtis laevigata	sugarberry
C. occidentalis	hackberry
Cercis canadensis[2]	eastern redbud
Cornus florida	flowering dogwood
Crataegus sp.[2]	hawthorn
Diospyros virginiana	common persimmon
Fagus grandifolia	American beech
Fraxinus americana	white ash
F. pennsylvanica	green ash
F. profunda	pumpkin ash
Gleditsia aquatica	water locust
G. triacanthos	honey locust
Ilex opaca	American holly
Juglans nigra	black walnut
Liquidambar styraciflua	sweetgum
Maclura pomifera	Osage-orange
Magnolia acuminata	cucumbertree
M. grandiflora	southern magnolia
M. virginiana	sweetbay
Melia azedarach[2]	chinaberry
Morus alba[2]	white mulberry
M. rubra	red mulberry
Nyssa aquatica	water tupelo
N. sylvatica var. *sylvatica*	blackgum
N. sylvatica var. *biflora*	swamp tupelo
Ostrya virginiana [2]	ironwood
Oxydendrum arboreum[2]	sourwood
Persea borbonia	redbay
Planera aquatica[2]	water-elm
Platanus occidentalis	American sycamore
Populus sp.	cottonwood
Prosopis sp.	mesquite
Prunus sp.[2]	cherries, plums
P. serotina	black cherry
Quercus alba	white oak
Q. bicolor	swamp white oak
Q. coccinea	scarlet oak
Q. falcata var. *falcata*	southern red oak
Q. falcata var. *pagodifolia*	cherrybark oak
Q. incana[2]	bluejack oak
Q. laurifolia	laurel oak
Q. lyrata	overcup oak
Q. marilandica[2]	blackjack oak
Q. macrocarpa	bur oak
Q. michauxii	swamp chestnut oak
Q. muehlenbergii	chinkapin oak
Q. nigra	water oak
Q. nuttallii	Nuttall oak
Q. phellos	willow oak
Q. prinus	chestnut oak
Q. shumardii	Shumard oak
Q. stellata var. *stellata*	post oak
Q. velutina	black oak
Q. virginiana[2]	live oak
Salix sp.	willow
Sassafras albidum	sassafras

Tilia americana	American basswood
Ulmus alata	winged elm
U. americana	American elm
U. crassifolia	cedar elm
U. pumila	Siberian elm
U. rubra	slippery elm
U. serotina	September elm
Vaccinium arboreum[2]	sparkleberry

[1]Names according to: Little, Elbert L., Jr. Checklist of United States Trees (Native and Naturalized). 1978. U.S. Department of Agriculture, Agr. Handbook No. 541, 375 p.
[2]Noncommercial species.

Table A2.— *Occurrence, average importance, and relative frequency, density, and basal area of all live trees 1.0 inches diameter at breast height or greater by species on timberland, East Texas, 1986*

Species	Occurrence[1]	Average Importance[2]	Relative		
			Frequency[3]	Density[4]	Basal area[5]
	Percent				
Loblolly pine	65.3	19.8	10.2	20.6	28.7
Sweetgum	63.3	11.5	9.9	14.2	10.5
Shortleaf pine	38.5	7.9	6.0	6.3	11.3
Post oak	39.4	6.2	6.1	5.4	7.2
Water oak	36.0	4.6	5.6	3.4	4.9
Southern red oak	39.5	4.6	6.1	3.0	4.7
Winged elm	33.3	4.6	5.2	6.1	2.4
Blackgum	28.8	3.5	4.5	3.6	2.5
Hickory (a)	24.7	2.9	3.8	2.6	2.2
White oak	17.6	2.0	2.7	1.4	2.0
Willow oak	14.1	2.0	2.2	1.5	2.2
Red maple	15.6	1.8	2.4	2.0	1.1
Bluebeech	9.1	1.6	1.4	2.5	.9
Cherrybark oak	15.1	1.6	2.3	1.0	1.5
Flowering dogwood	12.7	1.6	2.0	2.2	.5
Hawthorn	11.8	1.6	1.8	2.4	.4
Green ash	9.6	1.4	1.5	1.6	1.1
Slash pine	4.4	1.4	.7	1.7	1.7
Blackjack oak	10.8	1.3	1.7	1.1	1.0
Sugarberry and hackberry	10.3	1.2	1.6	1.1	1.1
Ironwood	7.2	1.0	1.1	1.5	.5
American holly	7.9	1.0	1.2	1.3	.5
White ash	9.5	1.0	1.5	.9	.6
Sassafras	7.9	.9	1.2	1.2	.3
American elm	8.2	.9	1.3	.7	.6
Laurel oak	6.4	.8	1.0	.8	.8
Sparkleberry	5.8	.7	.9	1.0	.2
Overcup oak	5.4	.7	.8	.3	.9
Eastern and southern redcedar	5.0	.6	.8	.6	.5
Common persimmon	5.4	.6	.8	.7	.2
Cedar elm	3.7	.5	.6	.4	.6
Black oak	4.7	.5	.7	.4	.3
Sweetbay	2.8	.5	.4	.6	.3
Longleaf pine	3.6	.5	.6	.3	.6
Slippery elm	4.1	.5	.6	.5	.2
Bluejack oak	2.7	.4	.4	.5	.3
Water hickory	3.4	.4	.5	.3	.4
Red mulberry	3.9	.4	.6	.4	.2
Baldcypress	2.1	.3	.3	.2	.5
Redbay	2.5	.3	.4	.5	.1

Table A2.— *Occurrence, average importance, and relative frequency, density, and basal area of all live trees 1.0 inches diameter at breast height or greater by species on timberland, East Texas, 1986 Continued*

Species	Occurrence[1]	Average Importance[2]	Relative Frequency[3]	Relative Density[4]	Relative Basal area[5]
			Percent		
Swamp chestnut oak	2.8	.3	.4	.1	.3
American beech	2.7	.3	.4	.1	.4
River birch	2.0	.3	.3	.2	.3
Black cherry	3.0	.3	.5	.2	.1
Plum and cherries except black cherry	2.0	.2	.3	.3	.1
Southern magnolia	2.5	.2	.4	.2	.2
Shumard oak	1.7	.2	.3	.2	.2
Water tupelo	.8	.2	.1	.2	.4
Eastern redbud	1.8	.2	.3	.3	.1
Honey locust	2.5	.2	.4	.1	.1
Water-elm	1.2	.2	.2	.2	.2
American sycamore	2.1	.2	.3	.1	.2
Willow	1.9	.2	.3	.1	.1
Osage-orange	1.0	.1	.2	.1	.1
Bumelia	1.3	.1	.2	.1	(b)
Florida maple	1.0	.1	.2	.1	.1
Pecan	1.1	.1	.2	(b)	.1
Black walnut	1.1	.1	.2	(b)	.1
Boxelder	.7	.1	.1	.1	(b)
American basswood	.7	.1	.1	.1	.1
Cottonwood	.4	.1	.1	(b)	.1
Nuttall oak	.7	.1	.1	(b)	.1
Water locust	.7	.1	.1	(b)	(b)
Chinkapin	.6	.1	.1	.1	(b)
Other species	(c)	(c)	(c)	.1	.1
Miscellaneous[6] with stems > =5 inches d.b.h.	2.0	.2	.3	.1	.1
Total	642.0	100.0	100.0	100.0	100.0

Columns may not sum to totals due to rounding.

[1]Out of the estimated 11,565,300 acres (1,910 timberland plots weighted by the acres each plot represents).

[2]Sum of relative frequency + relative density + relative basal area and divided by 3.

[3]Occurrence times 100.0 and divided by 642.0.

[4]Out of the estimated 6,523 million live trees in East Texas, 1986.

[5]Out of the estimated 880 million square feet in East Texas, 1986.

[6]Includes tree-like shrubs (e.g. *Zanthoxylum* sp. [prickly-ash, toothache tree], *Ligustrum* sp. [privet], *Symplocos tinctoria* [sweetleaf], *Cyrilla* sp.), exotic and native tree species very rarely encountered in Midsouth forests (e.g. *Pyrus* sp. [pear], *Sapium* sp. [tallowtree]), and other stems of noncommercial hardwoods not recorded by species.

(a) Except pecan and water hickory.

(b) Less than 0.05 percent.

(c) Relative importance is less than 0.05 percent for other species in species list but not listed above. Occurrence per species is less than 0.35 percent.

Rudis, Victor A. Nontimber values of East Texas timberland. Resour. Bull. SO-139. New Orleans, LA: U.S. Department of Agriculture, Forest Service, Southern Forest Experiment Station; 1988. 34 p.

Principal findings of the 1986 survey of timberland in East Texas are presented and discussed in terms of nontimber values: water and soils, range, wildlife, recreation, and other value interactions.

Additional keywords: multiresource inventory, dead trees, snags, red-cockaded woodpecker habitat, tree species composition

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