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ORIGINAL ARTICLE

Land changes and their driving forces in the Southeastern United States

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Abstract The ecoregions of the Middle Atlantic Coastal Plain, Southeastern Plains, Piedmont, and Blue Ridge provide a continuum of land cover from the Atlantic Ocean to the highest mountains in the East. From 1973 to 2000, each ecoregion had a unique mosaic of land covers and land cover changes. The forests of the Blue Ridge Mountains provided amenity lands. The Piedmont forested area declined, while the developed area increased. The Southeastern Plains became a commercial forest region, and most agricultural lands that changed became forested. Forests in the Middle Atlantic Coastal Plain declined, and development related to recreation and retirement increased. The most important drivers of land conversion were associated with commercial forestry, competition between forest and agriculture, and economic and population growth. These and other drivers were modified by each ecoregion's unique suitability and land use legacies with the result that the same drivers often produced different land changes in different ecoregions.

Keywords Land cover · Driving forces · Land change · US South

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Introduction

Human activities have become the dominant force shaping the surface of the earth (Vitousek et al. 1997; National Research Council 2001), increasingly overriding natural changes (Ojima et al. 1994) by altering the topography (Hooke 2000), modifying the quality and quantity of surface water and groundwater (Rogers 1994), reducing biodiversity (Leemans 1999), and changing biogeochemical systems (National Research Council 2001). Land use changes, often resulting in changes to land cover, are significant because land cover provides many ecosystem goods and services, including the production of food and fiber, clean air and water, energy resources, and natural ecosystems that provide for both biodiversity and recreation (Gitay et al. 2001). Recent land cover changes have been both large and rapid (National Research Council 2001), threatening to reduce the number and quality of ecosystem goods and services, including species extinction, soil loss, (Stern et al. 1992), and weather and climate changes (Pielke et al. 1999).

The driving forces of land cover change (Turner et al. 1994) originate from the social, economic, and political processes embedded in human societies, and result in changes in the demand for, and supply of, land and land related resources (Kates et al. 1990). Driving forces may include changes in population or consumption that result in different land resource demands, changes in technology, government policies, or economic conditions. A better understanding of the driving forces of land cover change and how they interact is needed to improve land use theory (National Research Council 2001). This understanding will provide an assessment of which drivers are most likely to result in significant land changes and which drivers may be relatively unimportant. The assessment of driving forces should focus on land change, go beyond economic analysis, and include geographic variation in the impact of the drivers. The development of better predictive models will come from a better understanding of the driving forces (Loveland et al. 2003).

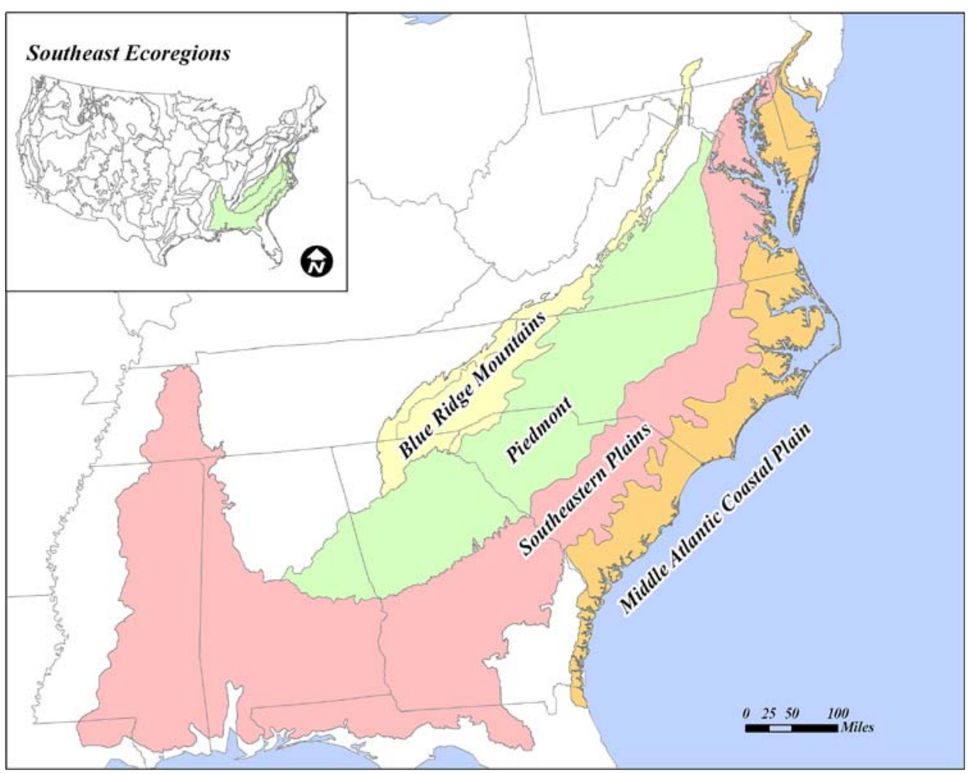
Land use changes are local; however, the time and expense of determining land change in all places becomes prohibitive, while aggregating land changes to the national level may mask significant regional trends and variations (Hart 1984; Heimlich and Anderson 1987). Additionally, local land cover change has a cumulative environmental effect and is a component of global systems (Meyer and Turner 1992). US Environmental Protection Agency (EPA) Level III ecoregions provide an intermediate scale that is manageable and is still able to capture significant regional differences. These ecoregions have been shown to provide a geographical context for land use and land cover that corresponds well with the geographical and temporal changes in land (Gallant et al. 2004). Land cover conversions have been found to be similar within ecoregions and different among them (Griffith et al. 2003; Ramsey et al. 1995).

The Southeast

This paper focuses on land changes and associated driving forces in four southeastern ecoregions of the United States from 1973 to 2000. The ecoregions, the Blue Ridge, Piedmont, Southeastern Plains, and Middle Atlantic Coastal Plain (Fig. 1), provide a continuum of land cover from the Atlantic Ocean to the highest peaks in the East. The paper's objective is to determine the driving forces associated with the major land cover changes that have occurred in four southeastern ecoregions between 1973 and 2000.

The data are from the US Geological Survey (USGS) Land Cover Trends Project, which is developing an assessment of land cover and land use changes that occurred within the 84 Level III (EPA) ecoregions of the conterminous United States between 1973 and 2000 (Loveland et al. 2002; Omernik 1987, 1995; Environmental Protection Agency 1999a). The project uses probability sampling of Landsat remotely sensed satellite imagery and manual interpretation of land cover classes at a modified Anderson level for each US ecoregion with a 60 m minimum mapping unit (Loveland and Acevedo 2006). The imagery was interpreted for the following target dates: 1973, 1980, 1986, 1992, and 2000. The project then estimated the rates of change for each time interval (Stehman et al. 2003). For this paper, we used local, regional, and thematic literature and a convergence of evidence approach to determine the driving forces of the major land changes. Local studies can embrace complexity and synthesis and hence contribute insights that regional and national may not be able to accomplish (Turner and Meyer 1991).

Fig. 1 Southeastern ecoregions



Meanwhile, national thematic studies are useful to put ecoregion scale drivers within a national context and show that many drivers originate outside the region as the result of national or global, political or socio-economic events.

Forest is the dominant land cover in all four ecoregions ranging from 80% of the Blue Ridge to 36% of the Middle Atlantic Coastal Plain in 1973 (Table 1). Natural forests consist of pine or hardwoods depending on the location and the time since the last forest disturbance, while commercial forests are generally monoculture pine interspersed with clear cuts where recent forest harvest has taken place. The second most common land cover in the Blue Ridge, Piedmont, and Southeastern Plains and the third most common in the Middle Atlantic Coastal Plain, is agriculture. Islands of highly productive, specialized farming are scattered throughout the Southeast along with other less productive cropland and pastureland. Urbanization consists of small towns and residential housing along rural highways in each ecoregion, while small and medium sized cities are common along the Atlantic coast, in the Southeastern Plains, and in the Piedmont, with Atlanta the largest city located completely within the study area.

Table 1 Estimated percent of predominant land covers of Southeast ecoregions

	1973 (%)	1980 (%)	1986 (%)	1992 (%)	2000 (%)
Blue Ridge Mountains					
Water	0.5	0.5	0.5	0.5	0.5
Developed	6.1	6.3	6.5	6.7	7.2
Mechanically disturbed	0.0	0.2	0.1	0.2	0.2
Mined lands	0.0	0.1	0.1	0.1	0.1
Forest	79.5	79.1	79.0	78.6	78.3
Grass/shrubs	0.1	0.1	0.1	0.1	0.1
Agriculture	13.7	13.7	13.7	13.6	13.7
	100.0	100.0	100.0	100.0	100.0
Piedmont					
Water	2.2	2.2	2.2	2.2	2.4
Developed	11.9	12.7	13.2	14.5	16.4
Mechanically disturbed	0.9	1.1	1.9	2.5	2.0
Mined lands	0.1	0.1	0.1	0.2	0.3
Forest	59.9	59.0	57.9	56.4	55.1
Agriculture	24.4	24.2	23.9	23.3	23.1
Wetlands	0.8	0.8	0.8	0.8	0.7
	100.0	100.0	100.0	100.0	100.0
Southeastern Plains					
Water	1.0	1.0	1.1	1.0	1.1
Developed	9.0	9.2	9.4	9.7	10.3
Mechanically disturbed	2.1	2.3	2.9	4.2	4.9
Mined lands	0.0	0.1	0.1	0.1	0.1
Forest	53.1	52.2	51.7	51.9	51.8
Grass/shrubs	0.0	0.0	0.1	0.1	0.0
Agriculture	24.3	24.7	24.2	22.2	21.5
Wetlands	10.5	10.6	10.6	10.6	10.3
	100.0	100.0	100.0	100.0	100.0
Middle Atlantic Coastal Plains					
Water	6.7	6.7	6.7	6.7	6.7
Developed	6.5	7.0	7.7	8.4	9.0
Mechanically disturbed	2.3	3.1	3.4	4.0	4.2
Mined lands	0.0	0.1	0.1	0.1	0.2
Barren	0.1	0.1	0.1	0.1	0.1
Forest	35.5	33.9	33.2	31.9	32.1
Grass/shrubs	0.3	0.3	0.5	0.6	0.5
Agriculture	22.7	22.9	22.9	22.8	22.7
Wetlands	26.0	26.0	25.4	25.4	24.6
	100.0	100.0	100.0	100.0	100.0

All data not cited from other sources are from the US Geological Survey Land Cover Trends Project (Loveland and Acevedo 2006)

The Blue Ridge ecoregion

Introduction and land cover changes

The forested and moist Blue Ridge ecoregion (Fig. 1) has one of the highest levels of biodiversity in the eastern United States (Environmental Protection Agency 1999b) and one of the most diverse forests in the world (Southern Appalachian Man and the Biosphere 1996). The most significant area of biodiversity is Great Smoky Mountains National Park in the southern Blue Ridge, an International Biosphere Reserve (Bousquet 2000; Della Sala et al. 2001).

Historically, the ecoregion was an area of forests and small farms. Before 1900, the forest was privately owned and occupied the steeper lands and higher elevations. During the late nineteenth and early twentieth centuries, much of the forest was cut by commercial timber companies (Brown 2000; Bolgiano 1998). The Weeks Act (1911) and the Clarke-McNary Act (1924) provided for federal government purchase of hardscrabble farms and cutover and forested lands and was the driving force that created the national parks and forests of the Blue Ridge ecoregion (Shands and Healy 1977). Today, almost one-third of the ecoregion is under public ownership, including two national parks, seven national forests, 29 wilderness areas, and the Blue Ridge Parkway (Nash 1999).

Forest makes up nearly four-fifths of the ecoregion (Table 1). The forested proportion slowly declined, while agricultural land, the second most common land cover, remained stable. Developed land, which included cities, rural housing, and infrastructure, increased at an annual rate of 0.35% until the 1990s when it increased to 0.54 average annual percent change. Between 1973 and 2000, only 2% of the ecoregion changed land cover (Table 2),

Table 2 Percent of ecoregion with land cover conversions

	Number of land cover changes from 1973 to 2000				Total change (%)
	One time (%)	Two times (%)	Three times (%)	Four times (%)	
Blue Ridge Mountains	1.5	0.5	0.0	0.0	2.0
Piedmont	8.8	5.2	0.4	0.1	14.5
Southeastern Plains	10.8	8.8	0.7	0.1	20.4
Middle Atlantic Coastal Plain	8.2	8.7	1.0	0.1	18.0

Table 3 Estimated annual change rates for Southeastern ecoregions land covers

Ecoregion	1973–1980 (%)	1980–1986 (%)	1986–1992 (%)	1992–2000 (%)
Blue Ridge Mountains	0.1	0.1	0.1	0.1
Piedmont	0.5	0.6	1.1	0.9
Southeastern Plains	0.7	1.0	1.5	1.3
Middle Atlantic Coastal Plain	0.8	1.1	1.3	1.1

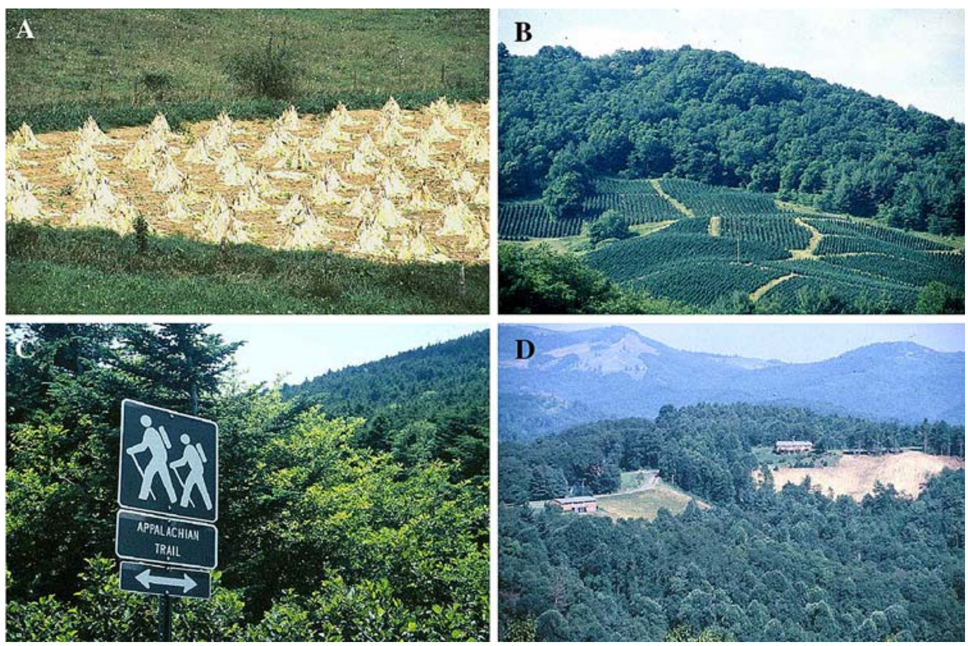


Fig. 2 Blue Ridge. **a** Drying tobacco. More than 10,000 farmers raised burley tobacco in the ecoregions (North Carolina Department of Agriculture and Consumer Services 2000). Photo taken in Grayson County, VA, Summer, 2000. **b** Christmas tree field. About 2,000 farmers grew Christmas trees in the ecoregion, making the state second only to Oregon for Christmas tree production. Photo taken in Watauga County, near Boone, NC, Summer, 2000. **c** Appalachian Tail. Photo taken in Watauga County, near Boone, NC, Summer, 2000. **d** Searching for sites with sights: ridge line view lots. Photo taken from Blue Ridge Parkway in Avery County, NC, Summer, 2001

and the annual change rate never exceeded 0.2% (Table 3). Three land covers accounted for about 99% of the ecoregion.

Farms occupy flatter areas in valleys at lower elevations where farmers produce specialty products such as tobacco (Brown 2000; Fig. 2a), grapes for wine, apples, cabbages, green beans, tomatoes, strawberries, and Christmas trees (Gade et al. 2002; North Carolina Department of Agriculture and Consumer Services 2000) (Fig. 2b). There were also substantial areas of hay and pasture. New development nibbled away at the ecoregion's farmland (Algeo 1997) but was balanced by a slow conversion of forest to agriculture with the result that the Blue Ridge farmland total area did not change.

Driving forces

National forests in the ecoregion tend to be on steeper land, which is more difficult and expensive to harvest, and these forests are managed for many benefits in addition to producing trees for market (Wear and Flamm 1993). Consequently, Blue Ridge national forests are harvested less frequently than private forestland (Southern Appalachian Man and the Biosphere 1996).

Forests account for over 98% of the land cover on federal lands, but only 72% of nonfederal lands (Della Sala et al. 2001). Public land has likely provided a moderating force that slowed overall land conversion rates (Della Sala et al. 2001). North Carolina, for example, has 11 wilderness areas, and the Conservation Trust for North Carolina works to preserve the rural landscape and natural scenery visible from the Blue Ridge Parkway (Gade et al. 2002).

The overall Blue Ridge landscape is a mixture of large continuous blocks of forest with small parcels of alternate land uses mixed throughout. The area and spatial distribution of nonforested land is largely driven by ownership and topography. More than half of the congressionally designated area of Blue Ridge national forests remains in privately owned infill parcels (Gade et al. 2002), which result in a high degree of forest fragmentation. Boundaries between public and private forested land may attract some second home developers.

Many of the recent land cover changes are related to the ecoregion's transition to its relatively new role as an amenity-rich, in-migration, and second home development area by the 1960s (Borchert 1972). Several Blue Ridge counties have high proportions of seasonal housing including Watuga and Avery counties, 22 and 29%, respectively of each county's housing stock (US Census Bureau 2000). These North Carolina counties have a cluster of amenities including several ski slopes, Appalachian State University, and Grandfather Mountain (an International Biosphere Reserve), as well as the Blue Ridge Parkway and Appalachian Trail (Fig. 2c). The change in the ecoregion's economic base from agriculture and forestry resulted in land changes focused on housing, ski resorts, golf courses, and the infrastructure needed to support both new residents and second homes. Many of the new residents were migrants attracted by the ecoregion's climate, scenic vistas, abundance of public land, access to recreation, and picturesque small farms (Fig. 2a, b) (Wear and Bolstad 1998; Andrews 1981; McGranahan 1999). From 1970 to 2000, Blue Ridge population increased 63% compared with a national increase of 38% (Table 4).

The driving forces associated with increased development occurred at multiple scales, from national to local. Nationally, second home development is related to discretionary income, available leisure time, a desire to own property and enjoy an outdoor lifestyle, adequate transportation, and the availability of property for purchase (Richard L. Ragatz Associates 1974). Regionally, during the 1990s, the focus of southeastern seasonal home development shifted from coastal areas, especially Florida, to mountainous areas, such as the Blue Ridge (Wyatt 2002). Seasonal migrants sought scenic beauty, a cool summer climate, recreational opportunities, and the cachet of mountain living (Algeo 1997). Younger retirees and the footloose income provided by Social Security, investments, and company pensions that accompany retirement, plus the increased number of footloose jobs associated with the information economy, all support amenity related development (Vance 1990) and new seasonal and full-time residents. Locally, within the Blue Ridge ecoregion, development occurred in amenity clusters, such as Glassy Mountain, South Carolina (Ragatz 1970; Nash 1999). Local driving forces resulted in two distinct land use change patterns on the landscape: compact development on private lands near service and residential centers, and dispersed settlement in more remote areas. Additions to existing centers typically were compact development on relatively flat areas often found in conjunction with agriculture, since building on flat, already cleared land requires fewer economic resources. Dispersed developments were more likely established in forested sites, away from other urban or agricultural areas. The spatial focus during the search for house sites in these areas is constrained by whether the land is publicly or privately owned. Additionally, many homeowners prefer sites that are at or near the border with public land (Nash 1999), particularly the Blue Ridge Parkway, because of the views and public land management, which is likely to favor amenities and other noneconomic factors (Gade et al. 2002).

Developed area changes in the Blue Ridge ecoregion were modest but were funneled into the ecoregion's desirable and accessible locations, constrained throughout

Table 4 Population (thousands) of Southeastern ecoregions

	1970	1980	1990	2000	Change (%)
Blue Ridge Mountains	813	971	1,078	1,327	63
Piedmont	7,631	9,177	10,990	13,854	82
Southeastern Plains	11,220	12,254	12,976	14,378	28
Middle Atlantic Coastal Plain	2,885	3,318	3.869	4,361	51
US[a]	202,230	225,176	247,045	279,583	38

Census of population

[a] Conterminous US

by the ecoregion's rugged topography and limited road network. Primary homeowners tend to favor sites on or near major roads, while secondary homes are more often located in less accessible sites in remote areas such as ridge lines (Fig. 2d) (Cho et al. 2003; Turner et al. 2003). When high-speed highways are constructed, they may be a precursor to development (Nash 1999). The Asheville Basin, which provides the largest area of both flat and accessible land in the ecoregion, accounted for 17% of the ecoregion's population in 2000 (US Census Bureau 2001). Local topography also puts a limit on available building sites, because construction is more difficult and expensive on steep land and may be regulated for environmental sensitivities. Development tends to be focused into creek and river valleys where more accessible flat land is available (Wear and Bolstad 1998).

Many Blue Ridge seasonal migrants are retirees who spend the winter in warmer areas, especially Florida. However, Blue Ridge recreational entrepreneurs have worked to change the ecoregion into a four-season destination. Second home and resort developments have been built in areas with high elevations, cold winters, long slopes, and significant snowfall. At least 20 ski areas were built by the late 1980s (Clay et al. 1989), four of them clustered in the second home area in Watuga and Avery counties (Nash 1999). Because snowfall and cold winter temperatures are not always dependable enough for a full skiing season (Clay et al. 1989), snowmaking technology is important for Blue Ridge ski areas. The construction of successful ski slopes enhanced the recreational value of surrounding communities and promoted additional local development (Bousquet 2000). Golf course development is another significant recreational land use that results in new land covers and is often a catalyst to subsequent residential and retail growth (Napton and Laingen 2008). Between 1970 and 2000, the number of golf courses increased 107% from 55 to 114, a rate of increase that was nearly twice the ecoregion population increase (Table 4; Golf Magazine 2001).

The Piedmont ecoregion

Introduction and land cover changes

The Piedmont is a transitional region between the mountainous Appalachian ecoregions and the Southeastern Plains (Fig. 1). The topography is generally rolling, and the presettlement forests were typically oak–hickory and mixed oak–pine with pine on drier sites (Johnson and Sharpe 1976). After European and American settlement, the Piedmont became a farming region, but by the late twentieth century much of the ecoregion had reverted to forest (Johnson and Sharpe 1976). Atlanta is the largest city, but there are numerous small and medium sized cities, and the ecoregion has an uncommonly high rural population density.

Nearly 15% of the Piedmont was estimated to have changed land cover (Table 2); with 5.7% changing more than once. There was considerable temporal variation in the estimated annual rates of change, with the fast conversion years more than twice the rate of slow years (Table 3).

Estimates for the proportion of the ecoregion devoted to agriculture (cropland plus pasture and other agricultural covers) shows continual decline from 24.4 to 23.1% after 1973 (Table 1), but farming prospered in some areas because of local pockets of good soil or local agricultural specialization, such as confined poultry and hogs (Hart 1980; Kovacik and Winberry 1987). Forest accounted for more than half of the ecoregion's area throughout the study period. The forested proportion of the Piedmont peaked before the study period and has been declining since the 1960s (Knight 1973), and throughout the study period (Table 1). Land Cover Trends estimates for mechanically disturbed land, which includes tree harvesting, as well as land disturbed for development and other human activities, increased from 1973 (Table 1), peaked in 1992 at 2.5% and then declined.

The estimated water area of the ecoregion remained steady before 1992 and then increased by 0.2% (Table 1), an areal increase of nearly 10%. The water area increased because new dams were constructed to increase public water supplies and to provide water for irrigation and recreation (Fig. 3d) (Henderson and Walsh 1995). Piedmont geology is composed of the metamorphosed roots of ancient mountains, which generally precludes groundwater availability. Fortunately, the ecoregion has adequate precipitation and abundant sites for reservoirs.

Driving forces

The Piedmont was the nation's primary agricultural region before the Midwest was settled (Lewis 1988). The proportion of the ecoregion in cropland increased through 1910 (US Census of Agriculture various years; and National Agricultural Statistics Service 1997), but by the late 1920s, Piedmont cropland area began to decline rapidly (Van Lear et al. 2004), though it remained an important farming region through the first half of the twentieth century. In 1949, 70% of the ecoregion was farmland, which includes cropland, pasture, and hay fields, but by 1974 that proportion had fallen to one-third (US Census of Agriculture).

Tobacco had been a significant Piedmont crop that provided a high return and demanded a large rural labor force. Piedmont tobacco farms, however, were generally

Fig. 3 Piedmont. **a** Rolling Piedmont pasture. Photo taken in Forsyth County, NC, Summer, 2000. **b** New Atlanta suburb subdivision. Photo taken approximately 8 km southwest of Kennesaw, GA, Summer, 2000. **c** Rural hobby farm. Photo taken approximately 5 km south, southwest of Mooresville, NC, Summer, 2000. **d** Lake Norman is a new public water supply reservoir 23 km northeast of Charlotte, NC. Photo taken, Summer, 2000

too small to profitably adapt to other crops, and as the ecoregion population grew and jobs became plentiful, these farms were largely replaced by dairy, beef, and hobby farms (Fig. 3c) (Hart and Chestang 1996), which resulted in cropland being replaced by pasture.

Cotton farming had been a mainstay of the economy, but before 1930, corn was often grown on more hectares (Van Lear et al. 2004). Erosion, however, had altered the distribution, structure, and moisture holding capacity of the soil, and the boll weevil increased the costs of cotton farming (Trimble 1974; Manners 1979). Additionally, the Piedmont's rolling topography was unsuited to the mechanical cotton picker, and Piedmont farmers and gin operators were slow to adapt to mechanization and new technology (Healy 1985; Lord 1996; Kovacik and Winberry 1987). For these reasons, Piedmont farmers were unable to compete with low cost producers in Texas, Arizona, and California, and cropland devoted to cotton declined from 567,000 ha in 1949 to fewer than 6,000 ha in 1987—a 99% decline. During the 1990s, in response to the boll weevil eradication program and changes to the global market, cotton acreage increased slightly to 17,000 ha (US Census of Agriculture 1949, 1987; US Department of Agriculture 1997; Fournier and Mark Risse 1996).

Changes to agricultural land in the late twentieth century continued the conversion to forests that had started early in the twentieth century and accelerated after World War II. Piedmont farmers lost many of their competitive advantages, and the profitability of farming relative to forestry generally declined (Wear 2002). The hilly Piedmont fields were often eroded and typically were too small to be easily adapted to mechanized agriculture (Hart 1978), and small Piedmont farms did not produce enough income to support the expenses associated with experimentation or diversification (Hart and Chestang 1996; Hart 1980). Additionally, national surpluses of crops and cropland kept prices low (Moulton and Dicks 1987). Piedmont farmers adapted to these conditions by leaving farming, acquiring off-farm jobs, and converting cropland to hay fields and pastures (Fig. 3a). These changes are reflected in the reduced land area that Piedmont farmers devoted to crops. In 1949, 24% of the Piedmont was used to grow crops (US Census of Agriculture 1949). From 1949 to 1969, cropland in the Piedmont declined from 3.9 to 1.5 million ha or more than 60%. After 1969, an additional 24% (365,000 ha) of Piedmont cropland was converted to a different land use leaving only 7% of the ecoregion in cropland in 1997 (US Census of Agriculture 1949, 1969; US Department of Agriculture 1997).

As cropland and farmland decreased, forest returned as the ecoregion's dominant land cover. The typical sequence of change began with coniferous trees and moved to hardwood, except where commercial harvest maintained a pine cover (Henderson and Walsh 1995). Commercial harvest may be limited by human settlement patterns. When population density in an area reaches 388 km^{-2} (150 per square mile), the likelihood of continued commercial harvest approaches zero (Van Lear et al. 2004). The area along the Interstate 85 corridor has already reached a population density that is incompatible with commercial forestry.

Development pressures were responsible for most of the decline in forest area. As part of the Sun Belt, Piedmont population growth exceeded the national average each decade after 1960. From 1970 to 2000, the ecoregion's

Table 5 Southeastern Plains ecoregion: the four largest land cover conversions all involved forest

1973–1980		1980–1986		1986–1992		1992–2000	
Area (ha)	Conversion	Area (ha)	Conversion	Area (ha)	Conversion	Area (ha)	Conversion
Forest to mechanically disturbed	660,200	Forest to mechanically disturbed	823,000	Forest to mechanically disturbed	1,264,900	Forest to mechanically disturbed	1,402,600
Mechanically disturbed to forest	586,400	Mechanically disturbed to forest	654,000	Mechanically disturbed to forest	865,900	Mechanically disturbed to forest	1,192,400
Forest to agriculture	212,500	Agriculture to forest	224,900	Agriculture to forest	551,000	Agriculture to forest	361,600
Agriculture to forest	62,500	Forest to agriculture	134,700	Forest to developed	57,800	Forest to developed	140,100

population increased 82% (Table 4). The increase in population helped drive the estimated change in developed area from 11.9 to 16.4% (Table 1). This population growth also increased the average population density of the ecoregion from 308 km^{-2} (119 per square mile) to 539 km^{-2} (216 per square mile).

Population growth was centered upon four metropolitan clusters along the Interstate 85 corridor: Atlanta, Georgia; Greenville and Spartanburg, South Carolina; Charlotte, North Carolina; and the North Carolina urban crescent of Raleigh, Durham, Greensboro, and Winston-Salem (US Census Bureau 1970, 2000). Atlanta's growth (Fig. 3b) was fueled by its roles as a corporate center, air hub, and distribution center, while Charlotte became the commercial banking and financial capital of the South (Hartshorn 1997). The Research Triangle area of Raleigh, Durham, and Chapel Hill grew because of higher education, research and development, and the emerging industries associated with the high-tech sectors of the economy (Hartshorn 1997). Additionally, industrialization drove growth throughout the Carolina Piedmont (Hartshorn 1997), and rural manufacturing supported population increases in many of the interstices of the major growth nodes (Hart and Morgan 1995). Much of this growth was fueled by the expansion of footloose capital, service companies, and high-tech firms that wanted to expand in the Sun Belt (Hartshorn 1997). Additional industrial growth resulted from foreign investments as the global economy became more interconnected (Lord 2001).

Southeastern Plains ecoregion

Introduction and land cover changes

The Southeastern Plains ecoregion is a relatively flat transition area between the even flatter coastal ecoregions and the Piedmont (Fig. 1). These irregular plains are a mosaic of forest, pasture, and cropland (Environmental Protection Agency 1999b). The ecoregion has a long growing season, and the soils are typically sandy, with silts and clays. Forests of oak, hickory, and pine dominate the land cover of the ecoregion.

Land cover changed dramatically during the study period, with 20.4% of the ecoregion being converted to a different land cover; however, much of the conversion was cyclical and did not result in large net changes (Table 2). The annual rate of land conversion peaked during the late 1980s and early 1990s (Table 3).

Forest cover accounted for more than half (53%) of the ecoregion in 1973, and by 2000, declined slightly but still accounted for nearly 52% of the ecoregion (Table 1). The cycle of forest cutting and subsequent regrowth dominated change in all time periods with forest to mechanically disturbed conversions accounting for the largest land cover change, and mechanically disturbed to forest conversions accounting for the second largest land changes in each time period (Table 5). Additional changes to forests accounted for the third and fourth largest land conversions in each of the four periods.

Table 6 Estimated Southeastern Plains ecoregion forest land cover dynamics: 1973–2000

Forest to other land covers	Top 3 conversions (ha)	Land covers converted to forest	Top three conversions (ha)		Net forest loss (ha)
Mechanically disturbed	4,150,545	Mechanically disturbed	3,298,660	Forest to all covers	4,991,580
Agriculture	446,310	Agriculture	1,199,990	All to forest	4,579,680
Developed	304,030	Grass/shrub	36,800		
From forest	4,990,885	To forest	4,535,450	Net forest loss	411,900

Table 7 Southeastern Plains ecoregion farmland and cropland loss

	1949	1969	1997
Land in farms (thousands ha)			
United States	468,822	428,774	372,301
Southeastern Plains	23,229	16,169	10,703
Percent in Southeastern Plains	5.0%	3.8%	2.9%
Land in crops (thousands ha)			
United States	193,389	185,652	172,190
Southeastern Plains	9,782	7,502	5,679
Percent in Southeastern Plains	5.1%	4.0%	3.3%

Source: US Census of Agriculture 1949, 1969; US Department of Agriculture 1997

Table 8 Estimated agriculture to forest land cover conversions in the Southeastern Plains ecoregion

Time period	Net agriculture to forest conversion (ha)	Annual net agriculture to forest conversion (ha)
1973–1980	−150,058	−21,453
1980–1986	90,230	15,050
1986–1992	511,723	85,354
1992–2000	301,785	37,752
	753,680	

The small (412,000 ha) net decline in estimated forested land cover masked the substantial movement of land covers to and from forest (Table 1). The net forest decline represented only 4.3% of the 9.5 million ha that changed to or from forests during the three decades following 1970 (Table 6). A substantial 1.2 million ha of agricultural land was converted to forest, while only 0.4 million ha of forest was converted to agriculture (Table 6). Forest to agriculture conversions were dominant only during 1973–1980 when crop prices were high (Batie and Healy 1980; Schertz 1979a), while agriculture to forest conversions dominated the latter three periods (Table 5). During the 1980s and 1990s, the estimated annual net conversion of agricultural land to forests ranged from 15,000 to 85,000 ha (Tables 7, 8).

Forest loss was dominated by conversion to mechanically disturbed cover (4.1 million ha), and other forest changes included conversion to developed (304,000 ha), which is largely a one-way transition, and conversion to agriculture (446,000 ha). The mechanically disturbed cover was also the primary land cover that was converted to forests (3.3 million ha). The forest-mechanically disturbed conversions generally represented lands that are in the commercial forest growth–harvest–replant cycle (Fig. 4b–d).

The Southeastern Plains ecoregion made the transition from being an agricultural region to a forest region after World War II. During these decades, the cropland area decreased with the remaining cropland concentrated in areas with better soils and flatter land, while land with steep slopes, poor soils, and small fields was converted to forest (Hart 1978; Healy 1985). During the study period, most of the land lost by agriculture was converted to forest, which had a net gain from agriculture of more than 750,000 ha between 1973 and 2000 (Tables 6, 8).

The developed portion of the Southeastern Plains increased during the study period (Table 1). Much of the population growth occurred along highways and secondary roads in rural areas and was associated with 1970s rural industrialization that occurred when tobacco was being

Fig. 4 Southeastern Plains. **a** Irrigated melons in Georgia. Photo taken approximately 12 km west of Eastman, GA, Summer, 2000. **b** Harvested wheat with soybeans doubled-cropped. Background shows recently harvested forest. Photo taken approximately 27 km southeast of Dublin, GA, Summer, 2000. **c** Young pine trees. Photo taken in Jefferson County, GA, Summer, 2000. **d** Pine plantation. Photo taken approximately 21 km southeast of downtown Columbia, SC, Summer, 2000

mechanized, which allowed former farm workers to stay and work in local factories rather than migrate (Bascom and Gordon 1999; Hart and Morgan 1995).

Driving forces

Two types of forest change dominated the Southeastern Plains ecoregion after 1973. The forest harvest and regrowth cycle (mechanical disturbance) dominated land cover changes but led to little net change, while the forest–agriculture interaction reflected the declining competitiveness of the ecoregion for agriculture. After World War II and throughout the study period, agriculture in the Southeastern Plains diversified and intensified (Hart and Chestang 1996; Winsberg 1997; Howard 2002). In addition to corn, cotton, and tobacco, farmers added or increased their production of peanuts, pecans, soybeans, wheat, poultry, and hogs, as well as fruit and vegetables. While agriculture as a whole diversified, individual farmers often specialized, and islands of specialized farming appeared. Many of these specialized farms were in areas that were more suitable for reasons of soil quality, level terrain that promoted the adoption of new technologies, including mechanization and irrigation, or access to markets (Fig. 4a) (Hart 1978).

For a brief time, during the 1970s, forests were converted to agriculture because of high crop prices that resulted when the Soviet Union purchased cereals on the global market (Table 5) (Schertz 1979b). Between 1971 and 1974, prices received by farmers increased 70%, and some grain prices doubled or tripled. Increased profitability led some farmers to convert some of their forested land to cropland (Table 5). During the late 1970s, there were several national government responses to inflation that resulted in an upward valuation of the dollar and a decline in the ability of US farmers to export their increasingly expensive products (Atkin 1995). One result was a decreased demand for US farm products and lower prices, which in the Southeastern Plains meant that forestry again became a more profitable use for many fields than agriculture. These fields were converted back to forests either through neglect and natural seeding or through active afforestation by the owner.

The 1985 farm bill implemented the Conservation Reserve Program (CRP) that encouraged farmers to plant trees on highly erodible cropland (Alig and Wear 1992). By 1992, the CRP was responsible for the conversion of 1 million ha of cropland to forest (Fig. 4c, d) (Kurtz et al. 1996). The Southeastern Plains were responsible for 794,000 of those ha (US Census of Agriculture 1992), which accounted for 8% of the land in farms in the ecoregion (US Census of Agriculture 1992; US Department of Agriculture 1997). The major driving force was declining agricultural profits relative to forestry in the ecoregion (Wear 2002; Moulton and Dicks 1987). Wood prices increased while national agricultural surpluses led to protracted low prices, forcing marginal lands out of agricultural use. The conversion of marginal agricultural land, typically to forest, resulted in profitable farming being concentrated in areas that were most suitable for farming or areas that had creative, efficient farmers (Hart and Chestang 1996; Howard 2002). Farmers adapted to their loss of competitive advantage by converting land to forest or by selling land to forestry companies or other landowners who favored forest over other land covers (Howard 2002). Some farmers took jobs at local manufacturing plants and continued to farm part time (Bascom and Gordon 1999), while others continued to farm by focusing their resources on the best land or by working with other farmers, government agencies, and agribusinesses to develop better technologies and management that provided higher profits for specialized products (Howard 2002; Hart 2003).

Middle Atlantic Coastal Plain ecoregion

Introduction and land cover changes

The Middle Atlantic Coastal Plain, stretching along the Atlantic Ocean from the shores of Delaware Bay to Florida (Fig. 1), is flat with a high proportion of wet areas from swamps to coastal marshes (Environmental Protection Agency 1999b). Forests are generally pine, with hardwoods located near streams. The proportion of the ecoregion that is cropland is typically higher in the northern third of the ecoregion, which is associated with a higher proportion of well-drained soils.

Forest, wetlands, and agriculture accounted for most of the land covers (Table 1). Developed and mechanically disturbed areas increased in importance after 1973. More than half of the 18% of the ecoregion that changed land cover had two or more conversions (Table 2). Forest is the most common land cover in the ecoregion, and the two most common land conversions were associated with the commercial forest cycle. Commercial wood harvesting, largely centered on loblolly pine production, extends from the southern tip of the ecoregion in extreme northeastern Florida through the southern half of Maryland’s Eastern Shore (Auch 2000; DiLisio 1983). The forested proportion of the ecoregion slowly declined during the study period (Table 1).

The mechanically disturbed portions of the ecoregion increased by 78% after 1973. These parcels are most closely associated with recently harvested forest, although a smaller percentage may be associated with new development.

Agriculture in the ecoregion was nearly stable during the study period. During the 1960s and 1970s, wetland drainage projects, primarily in eastern North Carolina, converted pocosins (Carolina Bays) and other forested wetlands to cropland that presumably balanced less productive lands leaving agriculture during those years (Healy 1985; Hart 1978, 2001). By the late 1970s, farmland drainage slowed and in 1985 the Food Security Act implemented the Swampbuster program, which prohibited farmers from receiving federal agricultural program benefits if they drained wetlands.

Wetlands accounted for a quarter of the land cover in the ecoregion (Fig. 5a). Many of these wetlands are forested. After 1973, the estimated wetland area of the ecoregion declined, with most of the drainage taking place during the early 1980s and mid to late 1990s (Table 1). Most (87%) of the estimated wetland conversion went to a transitional cover (mechanically disturbed). A majority of this conversion was probably the harvesting of bottomland hardwood forests. Outright wetland conversion totaled only 22,000 ha, with development the largest destination (13,365 ha), followed by forest (5,552 ha) and agriculture (3,471 ha).

Driving forces

The driving forces associated with the commercial forest cycle were similar to those in the Piedmont and Southeastern Plains ecoregions, though it is likely that a higher proportion of commercial forestry in the ecoregion was associated with wetlands. Historically, the wetland area of this ecoregion was larger, but wetland drainage and conversion modified significant areas between 1940 and 1973 (Healy 1985). Pocosins, as well as other wetland areas, were drained in blocks of dozens to thousands of hectares in response to higher farmland and soybean prices (Fig. 5b) (Healy 1985; Hartmann and Goldstein 1994). Additionally, wetlands were converted to tree plantations in response to federal incentives (Hartmann and Goldstein 1994), while other wetlands were converted to transportation, peat mines, and residential uses (Healy 1985; Hartmann and Goldstein 1994; Hartshorn 1997). Drainage slowed during the early 1970s as the nation embraced a new set of environmental values and laws that valued wetlands in their natural state (Prince 1997; Vileisis 1997) with the result that wetland drainage became increasingly regulated, mitigated, or prohibited (Prince 1997).

Part of the ecoregion's population growth and associated increase in developed area is related to growth in industrial branch plants (Bascom and Gordon 1999). These plants were located in rural areas, near cities, and in small towns. Rural industrialization flourished during the 1970s, because transportation and communication technologies reduced the costs of driving while many cities and towns offered tax breaks and infrastructure to new industries (Bascom 2000). During the 1980s, rural industrial growth slowed in response to national economic restructuring and globalization of the economy. This slower growth resulted in many low paying jobs moving overseas, while foreign investments in the region were more likely to be directed toward cities (Bascom 2000). Few new rural industrial plants were opened during the 1990s, and by the decade's end, there was some loss (Halbfinger 2002). Other developed land was located in and near a number of military

Fig. 5 Middle Atlantic Coastal Plain. **a** Coastal wetland. Photo taken in Camden County, GA, Fall, 2000. **b** Wetlands that have been drained and converted to farmland. Photo taken approximately 24 km east, northeast of Washington, NC, Fall, 2000. **c**. Coastal house elevated to withstand storm surges. Photo taken approximately 3 km southeast of Washington, NC, Fall, 2000. **d** Daniel Island Park golf course in metropolitan Charleston, South Carolina. Photo taken approximately 10 km north, northeast of downtown Charleston, SC, Fall, 2000

Table 9 Driving forces and their relative impacts on land cover

Driving forces	Land cover impacts	Blue Ridge	Piedmont	Southeastern Plains	Middle Atlantic
Forces of change					
Demand for commercial forest products	Forest cutting and replanting	×	×	××	×
Loss of agricultural advantages	Farmland converted to forest		×××	×××	
Soil bank and conservation reserve program	Farmland converted to forest			××	
Infrastructure investments	Legacies from prior investments	×	××		××
Infrastructure investments	Direct conversion to developed	×	×	×	×
Infrastructure investments	Indirect support of conversion to developed	×	×××	×	××
Population/economic growth	Urbanization: developed land covers increase	×	××	×	××
Rural industrial growth	Developed increase		××	×	×
Retirement/recreation/amenities	Forest to developed	×			××
Global economy	Conversion to developed slowed			×	×
Global economy	Developed increase		××	×	
Global economy	Forest cutting and replanting			××	××
Forces of stability					
Public land ownership		×××			
Environmental stewardship		×××			×

Major driving forces impacts varied by ecoregion and reflect the range of physical and human suitabilities of each ecoregion and the competition between and among the ecoregions and connections with the wider world

×××, large impact; ××, moderate impact; ×, modest impact

installations along the coast including the Kings Bay submarine base in southeastern Georgia that was constructed during the study period (US Navy 2006).

Transportation improvements facilitated the development of several areas. Several coastal counties gained better highway and air access after World War II (Clay et al. 1989), and during the 1950s and 1960s, nearly all of the population gain occurred in oceanfront counties and associated barrier islands. After 1970, the population increases were more widespread within the region and much of the rural population increase occurred at locations that provided easy access to the region's highway network (Bascom and Gordon 1999).

Tourism and retirement developments in coastal communities and other areas that had access to the water and to the new transportation infrastructure increased the area of developed land (Table 1; Fig. 5c) (Kovacik and Winberry 1987; Clay et al. 1989). After 1950, tourists sought good climate and access to the ocean (Kovacik and Winberry 1987). Retirement-oriented growth in the ecoregion began during the 1980s (Clay et al. 1989). Golf courses are a particularly land intensive amenity land use that are often associated with retirement areas. After 1970, the number of golf courses increased by 209%, from 152 to 470 (Fig. 5d), while the ecoregion's population increased 51% compared with the

national average of 38% (Golf Magazine 2001; US Census Bureau various years). In Beaufort County, South Carolina, 40 miles north of Savannah, Georgia, and less than 10 miles from Hilton Head Island, an investment group purchased 8,100 ha from International Paper (Riddle 2001) and built 5,000 homes and three golf courses. The Landings, another new residential golf community located on Skidaway Island in Savannah, Georgia, is the largest private golf facility in the nation (Laingen 2003) with six 18-hole golf courses and a large residential community located on 721 ha.

Southeastern regional driving forces

Multiple driving forces resulted in the land cover changes in the Southeastern ecoregions. Most of these were related to commercial forestry, competition between forest and agriculture, economic and population growth, and changes in transportation and technology. They were modified by the legacy of past land decisions which in turn were the product of earlier driving forces interacting with the pattern of suitabilities of each ecoregion (Bain and Brush 2008). Some driving forces were stronger and resulted in larger land conversions than weaker drivers (Table 9). The most significant changes occurred when there was a convergence of driving forces. A convergence promoted farmland conversion to forest in the Southeastern Plains when the demand for commercial forest products increased at a time when the ecoregion's farmers were becoming less competitive, and when two federal programs subsidized the conversion of cropland to forest land. There also were drivers that worked to stabilize or limit particular types of land conversion or conversion in particular locations (Table 9). In the Southeastern United States, the two strongest stabilizing forces were public land ownership that was primarily associated with national forests and national parks in the Blue Ridge ecoregion, and national environmental stewardship concerns about wetland destruction that began to limit wetland drainage during the 1970s.

The Piedmont and Southeastern Plains historically had been farming regions and together made up the heart of the Cotton Belt. Large parts of these ecoregions were unable to reward farmers with the higher yields that were required to be economically viable after World War II (Hart 1978). The demand for cropland declined, while the demand for other types of rural land use increased. The decreased demand for Piedmont and Southeastern Plains cropland occurred for many reasons, though declining suitability factors linked to past farming practices and national economic and technological changes in agriculture were perhaps the most important. As farmers lost their competitive advantage in agriculture, the predominant land cover returned to forest (Table 9) both through natural afforestation and tree planting by private landowners and commercial forestry companies.

Commercial forestry, which had played an important role in Southern economies since the nineteenth century, expanded and much of the rural land cover became managed forest in the forest–harvest–replant cycle. The combination of high demand for commercial forest products, especially pulp, and the suitability of the Southeast for growing trees, resulted in forested land cover change in each of the four ecoregions (Prestemon and Abt 2002) (Table 9). Impacts were most significant in the Southeastern Plains where the gentle topography, long growing season, and abundant precipitation permitted plantation forestry and mechanical harvesting technologies. Many landowners had a difficult time adjusting to the new economic conditions because it required switching from farming to forestry during a time when each was substituting labor with technology (Hart 2003; Schertz 1979; Cubbage and Carter 1994; Fickle 2001). The federal government helped ease the transition by providing assistance to farmers to convert marginal cropland to forest through the Soil Bank Program of the 1950s and 1960s and the CRP of the 1980s and 1990s (Table 9) (Anderson 1973; Alig and Wear 1992). The move to commercial forestry continued through the study period as the demand for wood and wood products increased, and the economic return for growing trees exceeded the return for growing crops in much of the ecoregion (Wear 2002).

Both farming and forestry are more economically viable when they are located on the most suitable land. As economic conditions changed, landowners of each industry adjusted land uses to the new conditions, by embracing labor-reducing technologies and increasing the scale of operation. The conversion from labor intensive to technologically intensive operations changed which lands were most suitable; both farming and forestry technologies favored large, flat areas (Wear and Flamm 1993; Sedjo 1991). Land covers in the Southeast generally moved toward the more profitable "highest and best" uses as predicted by land theory (Barlowe 1986), and when land was equally suitable for farming and forestry, farming was typically the most profitable. The land cover result was islands of cropland on flat land that had the best soil surrounded by a sea of forest located on hills or on land that had less productive soil (Hart 1978). But in areas with population growth, driving forces that promoted commercial forestry were not as strong (profitable) as the forces that led to an increase in developed land covers. The result was a decline in forest area in each ecoregion. Forest declines would have been more pronounced if farmland had not been converted to forest in the Southeastern Plains and Piedmont.

Many Americans became familiar with the amenities of the Southern climate during World War II while undergoing military training (Anderson 1973). About the time that World War II veterans began to consider retirement locations, Kevin Phillips coined the term "Sun Belt" (Lang and Rengert 2001). The Sun Belt concept provided the South with a new, twofold image: one of economic opportunity (Hartshorn 1997), the other as a land rich in amenities desirable for recreation and retirement. Both the search for amenities and economic opportunity resulted in population growth that contributed to the conversion of forest and farmland to developed land covers.

Legacies of prior land changes and infrastructure investments supported many Southeastern land changes after 1973. Federal projects, such as the 1930s Tennessee Valley Authority projects, which provided inexpensive electric power, and World War II military expansion, provided an infrastructure that triggered industrial migration to the Southeast (Table 9) (Meinig 2004; Raup 1980; Suarez-Villa 2002). Later, federal investments in the Interstate Highway System helped enable a wider economic boom (Moon 1994). These highways provided the Southeast with direct access to Megalopolis, Florida, and other regions. The population of the counties served by interstate highways was 17 million (60% of the South's population) in 1950 and increased to 45 million (80% of the South's population) by 1994 (Mitchelson et al. 1997). Additionally, the Atlanta airport is the busiest airport in the nation (US Census Bureau 2002). The migration of new residents to more accessible locations nearly always resulted in increases in developed land covers.

Population growth in three of the four southeastern ecoregions increased substantially faster than the national average (Table 4) and fit the profile of Sun Belt population growth. Most Southeastern development occurred in five types of locations: in and near cities, along interstate highways, along hard-surfaced rural roads, along the coast, and in mountain valleys (Hartshorn 1997; Hart 1985; Nash 1999). The urban and highway locations provided access to businesses and job opportunities, while the coastal and mountain areas provided access to recreation and retirement opportunities. The Piedmont had the largest growth rate at 82% and was clearly one of the economic engines of the Southeast (Table 9) (Hartshorn 1997). Population growth of 51% in the Middle Atlantic Coastal ecoregion was substantially faster than the national average. Migrants were attracted to the ecoregion's coastal recreation and retirement communities, while away from the coast, jobs were more dependent upon rural industrialization, which was spatially localized as well as temporally erratic (Bascom and Gordon 1999). The Southeastern Plains lagged behind the national growth rate with a 28% population increase. This large ecoregion was less urban and had fewer transportation advantages than the Piedmont and fewer amenities than the Middle Atlantic Coastal Plain and Blue Ridge. Also, the Southeastern Plains did not have a long-established rural industrial base as the Piedmont had, nor did it have the urban economic expansion that drove Piedmont growth (Halbfinger 2002). As a result, the increase in developed area was relatively modest (Table 1). Rural industrialization was significant in portions of the ecoregion (Bascom and Gordon 1999), but as with the Middle Atlantic Coastal Plain, the impacts were spotty and many of these blue collar industries were unable to compete in a globalizing economy (Table 9).

Retirement and recreation demands were major drivers of population and land cover change to developed covers in the Blue Ridge and the Middle Atlantic Coastal Plain (Table 9), but in each ecoregion, the land cover impacts were moderate and localized. Post World War II transportation improvements provided the foundation for coastal recreation and retirement that increased substantially after 1980 when younger, healthier retirees increasingly sought warmer areas for vacations and recreation oriented living areas (Clay et al. 1989). In the Blue Ridge, the transition away from a landscape of commercial farms and massive forest harvesting had occurred by the 1930s (Bolgiano 1998; Shands and Healy 1977). Federal land purchases followed deforestation and the realization that many Blue Ridge farms were too small to be economically competitive. When these lands became reforested they proved to be less suitable for modern, large-scale commercial forestry than the surrounding, flatter lands of other ecoregions because the steep slopes were more expensive to harvest (Wear and Flamm 1993). The contemporary amenity economy depends upon the forested land cover legacy from the early twentieth century, and the national forests are a substantial part of that legacy. The stewardship involved with managing these forests for environmental and amenity reasons may have provided some land cover stability (Table 9), because most development was excluded, and multiple use management guidelines required national forest managers to take into account biodiversity enhancement and other nonpecuniary goals (Wear and Flamm 1993). Recreation and retirement development were continuations of historic processes to use the scenic resources of the ecoregion (Clay et al. 1989; Borchert 1972). The Blue Ridge, with only an 18% increase in developed land cover, had a 63% increase in population that had to be accommodated on the ecoregion's limited, private, flat to gently sloping land. Amenity driven land conversion was concentrated in development hubs that combined attractive sites, clusters of recreation and personal services, and generally convenient access to more distant places (Nash 1999).

Globalization forces contributed to some land changes in the Middle Atlantic Coastal Plain, Southeastern Plains, and Piedmont. Higher wage and skill industries in the Piedmont were often successful competing globally, and some of the ecoregion's growth and increased developed area occurred because of foreign investment (Lord 2001; Kennedy 1998), such as a new BMW plant in Spartanburg County, South Carolina (Lord 2001; Kennedy 1998). Southeastern forests also are internationally important. During the 1980s, the United States exported nearly one-fifth of its wood products (Hagenstein 1990). Global wood demands resulted in increased forest planting and harvesting and the associated changes in land cover. Other impacts of globalization on land cover were ambiguous. Many low wage industries in the Southeastern Plains and the Middle Atlantic Coastal Plains were unable to compete globally and these businesses ceased to grow, declined, or closed (Bascom 2000; Halbfinger 2002). The land cover impacts that result from deindustrialization are difficult to measure and abandoned industrial infrastructure is unlikely to be restored to natural land covers.

Southeastern land cover changes occurred as a result of individuals, businesses, and governments adapting to new economic and social conditions. The new situations motivated land owners to maintain or change their land use. A new or modified land use often results in a different land cover, and some land uses, such as commercial forestry, necessitate regular changes in cover. Long term ecosystem consequences of monoculture commercial forests are still being debated. Land cover changes in the Southeastern United States have been substantial since 1950. The USGS Land Cover Trends Project provided reliable estimates of land cover change for Southeastern ecoregions after 1973 (Loveland and Acevedo 2006). National and global driving forces that reflected basic social, economic, and political changes led to changed accessibility and suitability of land parcels in the Southeast. Many Southeastern landowners adapted to these changes by altering land cover and use, but each ecoregion, had a different mosaic of suitabilities and legacies from earlier land changes that influenced which changes would be 'best.' Consequently land cover change in each ecoregion was different.

The interplay of driving forces and changing land covers in Southeastern ecoregions can be used to better understand degraded or improved ecosystem goods and services, changed weather and climate, and increased costs to maintain human quality of life. A better understanding of the causes of land change can lead to land management that recognizes the environmental consequences of land use and land cover changes. Better land management is particularly important now that it is recognized that humans have become the dominant force shaping the surface of the earth.

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