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Article

Changes in Woodland Use from Longleaf Pine to Loblolly Pine

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Abstract: There is growing evidence suggesting that the United States' roots are not in a state of "pristine" nature but rather in a "human-modified landscape" over which Native people have since long exerted vast control and use. The longleaf pine is a typical woodland use largely shaped by fires, lightning and by Native Americans. The frequent fires, which were used to reduce fuels and protect themselves from wildfires, enhance wildlife habitats and for hunting, protect themselves from predators and enemy tribes, led to the establishment of the fire dependent and fire tolerant longleaf pine across the southern landscape. In the last 3 centuries however, the range of longleaf ecosystem has been gradually replaced first by agriculture and then by loblolly pine farming. The joint effects of agricultural expansion, intense logging of the longleaf in the late 1800s, expanded fire control since the early 20th century, and subsequent bare-root planting beginning in the 1930s, has permitted loblolly pine to become dominantly established in the south. Longleaf and loblolly pines represent two distinct woodland uses and represent separate human values. This study investigated the change from longleaf pine use to loblolly pine farming in Southern US from perspectives of human values of land and natural resources.

Keywords: woodland use; Native American; industrialization; family forests; forest industry

1. Introduction

Land use/cover and forest resources have been extensively documented in the U.S., but the interaction between humans and nature has not been investigated adequately. Individuals have analyzed forest change from the perspective of their respective disciplines. Ecologists have examined the vegetation dynamics [1]; economists have examined forest change as a response to a change in the relative prices of forest products across land use history [2]; sociologists have paid attention to the impacts from culture and lifestyle. It is increasingly agreed upon that culture structures landscapes and landscapes include culture [3]. In fact all of the above mentioned factors jointly determine changes in forest/natural resources. For example, land degradation might make continuing farming uneconomical or growth of certain trees more difficult thus making way for other species to be established. Culture could also be important as immigration may bring totally different cultures and lifestyles, e.g., the Highlanders from Scotland have different cultural preferences when compared to the African Culture which brought yams, okra, collards, benne, and hunting, fishing and gathering lifestyle. The coupling dynamics of culture, economy and ecology needs to be examined jointly and from a long term perspective.

Examining the coupled human/nature system is difficult as it often requires the aggregation of different forests with different ecological and economic implications (e.g., managed forests *vs.* natural forests, timber production forests *vs.* amenity oriented urban forests, longleaf pine forest *vs.* shortleaf pine forest). Trees might be grown for different reasons. For example, Zhang *et al.* [4] in their study in Hainan island of China found that a rise in timber prices would result in more logging on natural forests to make remote forest resources more accessible, but also promote tree plantation. Murphy *et al.* [5] provide an account of how social factors have affected forests' ecological structure and function in the US and conclude that it will be a key in determining forests future. Rising timber prices may deplete the rainforest, but promote forest plantations (especially eucalyptus and some southern pines) which would shift other land use into forests, but it is known that rainforests and plantations have different ecological implications. The establishment of longleaf and loblolly reflect two kinds of woodland use that have different ecological, economical and cultural implication even though both are pine.

An excellent study by Raup [6] examined the land use and forest resource change in New England for a range of 300 years, using the historical change of one farm. Cronon [7] linked ecological change to culture and discussed how Native Americans interacted with the environment differently than the European colonists—each group manipulated the environment according to their own set of values and various technological resources available to them. Several studies have been conducted in the Southern U.S. on the dominance and subsequent decline of longleaf pine [8-11]. However, the replacement of the once dominant longleaf pine by the currently dominant loblolly pine species has not been addressed in these studies from coupled human/nature, or human value perspective. In the relationship

of human values to ecosystem and land, humans are both drivers and adaptors to changing environments. Therefore human values are dynamic, and different stakeholders have different values. For example, Siemens [12] discussed the human adaption to tropical wetland in agricultural development in Latin America. Goeber *et al.* [13] examined different values of woodlands to the people in Zimbabwe.

The US South has experienced large scale losses of its forest to agricultural expansion and logging prior to the 1920s but since then most of the land has been recovered back into forests in the wake of forest product industrial development, tremendous technological advancement in agricultural practices, and due to ecological reasons. Among the biggest change in forest resources is transition from longleaf pine (*Pinus palustris*) ecosystem to loblolly pine (*Pinus taeda L.*). Longleaf pine stands once covered an estimated 37 million hectares: 30 million hectares of longleaf dominant stands and 7 million hectares of longleaf in mixed-species stands [9]. However, today only about 1.2 million hectares of this ecosystem remain [10]. Nationally, loblolly pine area is currently approximately equal to longleaf two centuries ago.

While land remains the same, people change, and so do human values of time and resources. Value is dependent on change in demand. Pine wood used to be little economic value. Only after its extensive use along with the technological advancement by humans has it become extremely valuable today. Raup [6] has argued that land is only a stage and that people are players; people are more important than land and trees for driving the land use and land cover change. With the exception of longleaf ecosystem, both upland and bottomland hardwood forests of the southeastern United States were manipulated by Native Americans for thousands of years prior to the arrival of Europeans [14]. In this study, we discuss economy, ecology and culture to explain the change from being primarily longleaf to loblolly pine dominated ecosystem. Both ecosystems represent unique coupled human/nature systems that have different human values.

2. Longleaf Ecosystems: Fire, Native American and Culture

American Indians had been manipulating the environment, primarily with fire for a minimum of 12,000 years [14]. Fire, Native People, and the natural landscape seeks a middle ground between those conflicting paradigms, offering a critical, research-based assessment of the role of Native Americans in modifying the landscapes of pre-European America [15]. Fire also played an important role in the myths, beliefs and rituals of Native Americans [16]. Ceremonial fires were considered sacred by the Native Americans since they represented the Sun and the Upper World [14]. For thousands of years Native Americans employed a pattern of land use that influenced the southern landscape.

The longleaf pine/wiregrass ecosystem once covered approximately about 40 million hectares in the Southeastern U.S., extending from southern Virginia to central Florida and then west over to Texas [17]. The longleaf ecosystem was the in part result of the coupled ecological and Native Indian systems through evolutional process that included Savannah River Culture, Woodland Culture and Mississippian Culture.

During the Late Archaic Period (5,000 to 2,800 years BP), the climate and vegetation were similar to their modern equivalents. Population markedly increased and settlements stabilized, leading to the

emergence of Late Archaic culture which is also known as Savannah River Culture [14]. What is most important about this culture is the increased utilization of floodplains, for purposes such as mussel gathering and fishing, as well as hunting and gathering, and expanding cultivation. Fire was applied to clear the floodplain vegetation and for the cultivation of important plants, such as squash, gourds, sunflowers, sumpweed, and chenopodium [18].

A continuous development in stone and bone tools, leather working, textile manufacture, tool production, cultivation, and shelter construction lead to Woodland culture period (2800 to 1300 BP). The major technological advancement during this period was the widespread use of pottery. Bow and arrow were used in hunting and gathering. The increasing use of agriculture changed the nomadic nature of many of the tribes who settled into permanently occupied villages. The Woodland Culture emerged from clearing patches of land for agriculture, which allowed them to settle for longer periods in an area. Fire came into regular use as a tool to maintain openings, clear underbrush, enhance game forage, and a variety of other purposes. Native Americans used fire for many purposes. They controlled the composition and pattern of vegetation by frequently burning the southern landscape. They burned to manage wildlife habitat, ease travel, expose acorns and chestnuts, improve visibility, encourage fruiting, prepare their fields for planting, and to facilitate hunting and defense [19,20]. Frequent low intensity burning by Native Americans created a southern landscape of prairies, fields, savannas, woodlands, and dense forests.

The trade between peaceful tribes and lager civilizations in Mesoamerica gradually resulted in the replacement of the Woodland culture by the Mississippi culture (1,300 to 400 years BP). They cultivated tropical maize, flint corn, and beans along the Mississippi River and in the Gulf States and led to the beginning of the Mississippi Culture [14]. Agriculture became more intensive. Agricultural fields were cleared first by girdling trees and then by burning. Even when soil fertility declined from repeated cultivation and lands lay fallow, they were still burned annually to maintain their open condition for future cultivation [18,21]. According to Doolittle [22], the indigenous fields in the Eastern Woodlands tended to be larger, numerous, contiguous, and cleared of roots and stumps and usually on floodplains.

Therefore longleaf ecosystem to some degree was the result of agriculture, hunting and Native Indian lifestyle and economy. The longleaf pine is a hardy species, relatively wind firm and resistant to many insects and also tolerant to fire (it actually requires fire for its survival). This species can grow and survive well on poor, sandy soils, but it can also grow as well as other pines on sites with better soils. Economically such extensive land management activities warrant the low population density. Fire was the most effective tool for the Native Americans, who first settled primarily along floodplains and were largely dependent on fishing. Subsequently they spread out into larger areas and became increasingly dependent on hunting and then finally on cultivation. The extensive use of fire was supported by evidence for native burning from witness writings of the early Europeans [16,17,23,24]. Culturally Native Americans developed intimate understanding of the land, forests, plants, and animals through a long history [14]. The agricultural practices of the Indians, including their widespread burning of the land, kept the natural vegetation under control—particularly the trees—and also provided an excellent habitat for game [25].

3. Disappearing Longleaf Ecosystem: Plantations and Lumbering

When the white man moved in and dispossessed the Native Indian, land management practices changed dramatically. Although Native Americans frequently modified the forest for agriculture, large-scale exploitation of Southern forestlands for timber and agriculture began with the immigration of European settlers to this area in the early 1800s. One of the major differences in the use of fire to clear forestland for agriculture between the Native American and their successors, the Europeans, was the use of temporary cultivation by the Indians relative to the permanent-field agriculture practices of the Europeans [16]. Longleaf pine, which once covered more than 60% of the uplands and 40% of the entire region, has declined by more than 98% [26,27].

Apart from the United States Government and its laws that affected the Native Americans and the longleaf ecosystem [28], factors that contributed to the drastic decline of longleaf ecosystem include clearing for agriculture and development, aggressive logging at the turn of the last century, fire suppression efforts, and conversion to other pine types for faster growth and profits. Clearing land for agriculture and lumbering by the people from Europe and slaves from Africa, and fire exclusion policy could be the top three most important factors.

3.1. Agriculture

Cotton cultivation flourished in the South as did fur trade, and more and more white settlers started pouring in from the neighboring areas especially Georgia, Tennessee, Alabama and Mississippi. The plantation system was organized for maximizing market production required fertile soil on level or rolling land, cheap labor, social and economic management, and staple, routinely cultivated crops (tobacco, sugar, rice, indigo, cotton *etc.*). Blacks were brought to work as forced labor in what was primarily an agrarian society, firstly as slaves, and later becoming sharecroppers or tenants after Civil war. By 1900, 30.7 million acres or about 27% of the upland longleaf pine was listed as “improved” farmland, a category that included pasture, roads and building as well as cropland [9,29].

Agriculture, either cotton plantation, pasture or other crops, had fundamentally changed the land use and resulted in soil erosion and loss of nutrients that inhibits productive farming, and leave farmland without effective management.

3.2. Lumbering

Timber was of minor importance through the early Colonial Period to the mid-1730s. Even though water power (first introduced as early as 1611 in Virginia), and emergence of water-powered sawmills in Louisiana around 1714 opened up the first real possibility of commercial lumber production, commercial logging remained a constant but minor industry from 1730 to around 1850, and was mostly located along streams [9]. Railroads began to be rapidly expanded in the South beginning in 1850. The railroads not only consumed vast quantities of wood for ties, cars, fuel, bridges, and trestles, but also made long distance transportation possible and economical, motivating the forest industry to own timberland. Industrial forest ownership was very much related to demand driven by railroads and the vast stand of centuries-old longleaf pine. For example, the first railroad in Alabama under construction started in 1832 and by 1890 3,422 miles were covered [30]. Each mile of track

required over 2,500 crossties that had to be replaced every five to seven years [31]. Longleaf pine had particularly high value for naval applications before the advent of steel vessels, and continues to hold on to some particular market niches (e.g., poles and piers).

Much of the timber produced in the South before the Civil War was milled into lumber for only local use. After the war, reconstruction of damaged and destroyed buildings and infrastructure increased the demand for lumber and the number of sawmills multiplied. Depleted forests in the Northeast also created markets for southern timber. The rich, vast stands of centuries-old longleaf pine drew the nation's lumber industry to the Southeast. As the nation grew and flourished, so did the railroads, stretching across the country's vast plains and mountains and up and down its coasts. By the 1880s, sawmills were the dominant industry in the South [31]. Narrow gauge tram lines, improvements in steam-powered sawmill machinery, and other technological advances hastened the liquidation of the Southern standing timber.

3.3. Fire Exclusion Policy

Agriculture (including pastures) kept trees from growing; timbering, however, involved only extracting the wood and left the land to re-grow trees. The fire exclusion policy was a long process since the early of 20th century [32]. The increased liability and more restrictive burning conditions led to more fire suppression and hastened the demise of fire-adapted longleaf forests. Longleaf cannot regenerate because it cannot compete with other species without the support of fires that kill other species. Therefore it was largely replaced by short leaf pine and southern mixed hardwood [27,33].

Today, longleaf ecosystems are considered among the most threatened in North America. A recent study found only 5,095 hectares of remaining old-growth longleaf pine acreage, and these forests were divided among 15 stands [34]. McDaniel *et al.* [35] reported that the persistence of longleaf forests is related to some common characteristics found among families owning remaining longleaf forests, such as similar origins as homesteaders, strong knowledge of forests and the forest industry, a pragmatic conservation ethic, and long-term approaches to land management. Cultural legacy plays an important role for the remaining longleaf pine forests.

Different management objectives, besides timber, are important to maintain the longleaf pines. During the early 20th century, affluent landowners recognized the value of longleaf pine forests as habitat for bobwhite quail *(Colinus virginianus)* and white-tailed deer *(Odocoileus virginianus)* and acquired large tracts for private hunting reserves. Many large areas of longleaf pine exist today only because of the opportunities they provide for hunting and timber harvest [36]. Present day remaining longleaf are managed mostly by non-industrial private forest landowners. They serve as preferred habitat for many game species like white-tailed deer, turkey, bob-white quail and rabbit such that they are in high demand by hunters [17].

4. The Loblolly Pine Farming

If structure of the longleaf pine ecosystem was shaped by frequent uses of fire as Native American culture, the emerging loblolly pine was largely the driven by growth and development of modern pulp and paper industry for paper products.

A few decades of intense pine harvesting after the late 1800s destroyed 90% of the original 48.6 million hectares of longleaf pine systems and left 25% of the entire region without natural reproduction or seed trees. Artificial regeneration, by either planting or direct seeding, was the only means to get this land back into pine production [37]. A few small loblolly pine plantations can be traced back to as early as 1873. By 1931 there were 29,565 ha of southern pine plantations, many of which were loblolly pine [38].

During the early part of the 20th century, large areas of the loblolly pine, primarily in the Piedmont, but also on well-drained Coastal Plain soils, were developed on degraded farmlands. Most of these lands had been cropped for extensive periods without the benefit of chemical amendments or water and erosion control [39], and were "worn out"—highly eroded and depleted of nutrients. This land was no longer profitable for agricultural use but ideal for Loblolly pine growth and plantation.

"With the advent of agriculture, cleared land was often worth more than forested land, and by the early 1900s, much of the original forest had been cleared of forest" [40]. By the late 1920s the old-growth forests were virtually gone, and millions of hectares were cleared or degraded. Beginning in the 1920s, there was a large migration of African Americans out of the South to northern manufacturing centers. During the Great Depression of the 1930s, the Civilian Conservation Corps (CCC) planted over 200,000 ha into pines during a 7-year period. These early nursery operations and out plantings proved that loblolly pine could be artificially regenerated on a large scale and that it would grow rapidly on many diverse sites.

After the Second World War, the pulp and paper industry grew rapidly in the South, taking advantage of the under-utilized native pines and low-grade hardwoods. But the raw materials were very limited without plantations. Favorable markets for softwood products and state and federal incentive programs, as well as industry's commitment to short rotation, high fiber yield forestry, and tree improvement programs, resulted in an exponential increase in loblolly pine seedling production during the mid- to late-1900s [38]. The forest industry purchased large tracts of forestland to intensively manage for wood fiber and satisfy future raw material demand. During this same period, agricultural areas were abandoned and fire control was improved, resulting in many old fields reverting back to loblolly instead of longleaf for ecological and economic reasons. Longleaf pine cannot compete with loblolly pine with respect to natural regeneration without the help of fires, and loblolly also provided more favorable economic returns.

Together with growing demand for materials by pulp and paper industry, a significant amount of areas of farmland were converted to plantations first by Agricultural Conservation Program (ACP) shortly before and immediately following World War II , and later under the Soil Bank Program. The Soil Bank was a federal program designed to agricultural commodities. Farmland could be diverted from agricultural production for 10 years, and landowners were paid to not produce specific commodities. Landowners could enroll all or portions of their productive land in the Soil Bank and intensify agricultural management on the remained cropland. The Agricultural Conservation Program (ACP) funds for tree planting and timber stand improvement dwindled in the 1960s because of increasing competition for available funds and the reluctance of county-level ACP administrators. Perceiving needs for a better funding base, forestry interest groups successfully lobbied Congress for a separate cost-share program for forestry practices [41]. The federal cost-share rate is

commonly 50 percent and has ranged up to 65 percent. Non-industrial private forest landowners who own less than 1,000 acres are eligible for the cost-share funds.

Extensive planting and natural regeneration of cutover forest land and abandoned farmland between the 1930s and 1990s has made loblolly the leading timber species in the South. It now predominates on 13.4 million ha (45 percent) of the commercial forest land in the southern United States, and directly or indirectly provides 110,000 jobs and $30 billion to the economy of the region [38,42,43].

The longleaf ecosystem provided many benefits to Native American, who had a strong intimate relationship with the land, forests and plants. Loblolly pine, on the other hand, is more a resource for profit and business. Loblolly pine, more like cotton and other agricultural cash crops than the longleaf pine, is perceived as a commodity. Ecologically, loblolly pine is often called a "false forests", especially by environmentalists.

Associated with such a trend is the private timberland consolidation. Unlike longleaf ecosystem, people see loblolly pine as source of profit and cash. Society is also becoming more separated from nature. Alienation from nature is perhaps the most fundamental difference between the longleaf and loblolly pine.

5. Conclusions and Perspectives

Changes in forest resource are strongly related to ecology, economy and culture, or human values. The economic disadvantage in longleaf pine yield has led to its replacement by agriculture and loblolly pine farming. However, longleaf pine has an advantage in some of the niche markets such as in poles and piers compared to loblolly pine. Also, its wind resistant properties compared to loblolly pine which is most susceptible to strong winds among the southern pine species, would render longleaf pine economically advantageous in the hurricane prone southern landscapes. The dominance of longleaf in the early colonial and settlement era followed by its replacement with agriculture (cotton) and finally by loblolly pine (mainly plantations) in the recent past follows a distinct economic rationale. Table 1 summarizes the ecology, economy and culture of the two pines.

The change is often not unidirectional. Recent developments provide hope that these negative trends may be reversed and longleaf pine ecosystems that once dominated southern landscape may be restored. Conversion of longleaf pine to other tree species has slowed, as numerous federal and state agencies have begun regenerating longleaf pine on their lands following harvest, and they have rehabilitated degraded longleaf pine forests with fire and other appropriate techniques [44,45]. Interest in longleaf pine reforestation and afforestation has increased on private lands because of incentives provided by the federal government; from 1998 to 2000, longleaf pine was planted on 68,240 ha across the region. The southern forestry community has also gained an improved understanding of longleaf pine ecosystems and has come to appreciate the natural heritage that could be lost. It is also less susceptible to pest, for example southern pine beetle, and provides greater long term returns with less risk. No single entity dominates landownership in longleaf pine ecosystems but numerous groups share a sense of urgency, and partnerships have developed [36]. However, an enormous and continuing investment by timber companies in improved genetic strains of loblolly and the difficulties in using prescribed fire due to increased liability and more restrictive burning conditions would make the

position of longleaf disadvantageous in the commercial landscape even as it regains some lost ground on NIPF and public lands.

Table 1. Comparisons between Longleaf Pine and Loblolly pine.

Dimension	Longleaf Pine system	Loblolly Pine system
Ecological values	Results from frequent fire, Relative slow growth with more biodiversity	Mostly planted on abandoned farmland, Fast growth with less biodiversity
Economic values	Subsistence economy and relatively low population density and less settled small tribes;	It is empowered by modern industry for profit and fiber materials;
		Market economy; capital intensive investment
	Non-fiber production objective, but ecosystem as habits for hunting and soil nutrition restoration;	Private-ownership and timberland is more consolidated and largely owned for business purpose
	Common resource ownership;	
Cultural values	Indian American culture, largely dependent on hunting and gathering;	Market economy culture; human relation is based on trade and economic exchange
	Intimate relation with nature, strong conservation ethic, strong family origins and homesteading	Pine is viewed a part of an economic system; no difference from other resources that can generate economic values.

As the ecology, economy and culture are changing, we believe that we are moving towards the amenity rich hardwood dominance in the next decade or so. This is supported by an increase in income and an increased demand for recreational and other ecosystem services provided by forests. The perceptible increase in the number of small forest owners especially in and around cities is an indicator of this phenomenon. Evidence has already shown that a majority of hardwood forest land (upland and bottomland) is in the hands of nonindustrial private forest (NIPF) ownership [47], although a substantial portion of the hardwood rich Blue Ridge and Allegheny Highlands is in national forests and parks. The motivation for forest management for most nonindustrial forest landowners appears to be income, although most of these owners do not rank commercial forest production as the number one reason for holding land [47]. Likely the growing family-owned hardwood ecosystem would match the post-industrial society that is emerging in the U.S. The coupled human/nature system is changing along with the evolving society and nature.

References

1. Foster, D.R. Land-use history (1730–1990) and vegetation dynamics in central New England, USA. *J. Ecol.* **1992**, *80*, 753-772.
2. Clawson, M. Competitive land use in American forestry and agriculture. *J. Forest Hist.* **1981**, *25*, 222-227.

3. Nassauer, J.I. Culture and changing landscape structure. *Landscape Ecol.* **1995**, *10*, 229-237.
4. Zhang, Y.; Uusivuori, J.; Kuuluvainen, J. Econometric analysis of the causes of land use change in Hainan, China. *Can. J. Forest Res.* **2000**, *30*, 1913-1921.
5. Murphy, A.; Abrams, J.; Daniel, T.; Yazzie, V. Living among frequent-fire forests: Human history and cultural perspectives. *Ecol. Soc.* **2007**, *12*, 17; Available online: http://www.ecologyandsociety.org/vol12/iss2/art17/ (accessed on 20 November 2009).
6. Raup, H. The view from John Sanderson's farm: A perspective for the use of the land. *Forest Hist.* **1966**, *10*, 2-11.
7. Cronon, W. *Changes in the Land: Indians, Colonists, and the Ecology of New England*; Hill and Wang: New York, NY, USA, 2003.
8. Croker, T.C. *Longleaf Pine: A History of Man and a Forest*; Forestry Report R8-FR 7; USDA Forest Service: Atlanta, GA, USA, 1987.
9. Frost, C.C. Four centuries of changing landscape patterns in the longleaf pine ecosystem. In *Proceedings of 18th Tall Timbers Fire Ecology Conference, the Longleaf Pine Ecosystem: Ecology, Restoration and Management*; Tall Timbers: Tallahassee, FL, USA, 1993.
10. Outcalt, K.W.; Sheffield. R.M. *The Longleaf Pine Forest: Trends and Current Condition*; USDA Forest Service Southern Research Station: Washington, DC, USA, 1996.
11. White, P.S.; Wilds, S.P.; Thunhorst, G.A. Southeast. In *Status and Trends of the Nation's Biological Resources*; Mac, M.J., Opler, P.A., Puckett Haecker, C.E., Doran, P.D., Eds.; USGS: Reston, VA, USA, 1998; pp. 255-314.
12. Siemens, A.H. Modeling the tropical wetland landscape and adaptations. *Agric. Human Values* **2004**, *21*, 243-254.
13. Goebel, A.; Campbell, B.; Mukamuri, B.; Veeman, M. People, values, and woodlands: A field report of emergent themes in interdisciplinary research in Zimbabwe. *Agric. Human Values* **2000**, *17*, 385-396.
14. Carroll, W.D.; Kapeluck, P.R.; Harper, R.A.; Van Lear, D.H. Background Paper: Historical Overview of the Southern Forest Landscape and Associated Resources. In *Southern Forest Resource Assessment*; Wear, D.N., Greis, J.G., Eds.; Southern Research Station: Asheville, NC, USA, 2002; Chapter 24.
15. Vale, T.R. *Fire, Native Peoples, and the Natural Landscape*; Vale, T.R., Ed.; Island Press: Washington, DC, USA, 2002.
16. Fowler, C.; Konopik, E. The history of fire in the southern United States. *Human Ecol. Rev.* **2007**, *14*, 165-176.
17. Landers, J.L.; Van David, L.H.; Boyer. W.D. The longleaf pine forest of the southeast: Requiem or renaissance? *J. Forestry* **1995**, *93*, 39-43.
18. Hudson, C. *The South-Eastern Indian*; The University of Tennessee Press: Knoxville, TN, USA, 1976
19. Pyne, S.J.; Andrews, P.L.; Laven, R.D. *Introduction to Wildland Fire*, 2nd ed.; John Wiley: New York, NY, USA, 1996; p. 769.

20. Bonnichsen, R.; Stanford, J.D.; Fastook, L. Environmental Change and Developmental History of Human Adaptive Patterns: The Paleoindian Case. In *North America and Adjacent Oceans during the Last Glaciation: The Geology of North America*; Ruddiman, W.F., Wright, H.E., Jr., Eds.; Geological Society of America: Boulder, CO, USA, 1987; Volume K-3, pp. 403-424.
21. Doolittle, W.E. Agriculture in North America on the eve of contact: A reassessment. *Ann. Assoc. Amer. Geogr.* **1992**, *82*, 386-401.
22. Doolittle, W.E. Permanent *vs.* shifting cultivation in the Eastern Woodlands of Northern America prior to Europe contact. *Agric. Human Values* **2004**, *21*, 181-189.
23. Byrd, W. *A Journey to the Land of Eden*; Macy-Massius: New York, NY, USA, 1928; p. 367.
24. Cowdrey, A.E. *This Land This South, and Environmental History*; University of Kentucky Press: Louisville, KY, USA, 1983; p. 236.
25. *Forest Resource Report*; Alabama Forestry Commission: Montgomery, AL, USA, 2004.
26. Noss, R.F. Longleaf pine and wiregrass: Keystone components of an endangered ecosystem. *Nat. Area. J.* **1989**, *9*, 211-213.
27. Ware, S.; Frost, C.C.; Doerr, P. Southern mixed hardwood forest: The former longleaf pine forest. In *Biodiversity of the Southeastern United States: Lowland Terrestrial Communities*; Martin, W.H., Boyce, S.G., Echternacht, A.C., Eds.; Wiley: New York, NY, USA, 1993; pp. 447-493.
28. Yazzie, V. The tribal perspective of old growth in frequent-fire forests—Its history. *Ecol. Soc.* **2007**, *12*, Article 21.
29. U.S. Census Office. *Twelfth Census of the U.S., Volume 5, Agriculture, Part 1*; US Government Printing Office: Washington, DC, USA, 1902; p. 767.
30. Ivey, B.D. From river to rail in Pickens county. *Alabama Rev.* **1954**, *7*, 53-65.
31. Burdette, D. The Southern Forests: 1800–1850. *Ala. Treas. Forest.* **1995**, *3*, 22-23.
32. Pyne, S. *Fire in America: A Cultural History of Wildland and Rural Fire*, 2nd ed.; University of Washington Press: Seattle, WA, USA, 1997; p. 680.
33. Mohr, C. *The Timber Pines of the Southern United States*; ISDA Division of Forestry: Washington, DC, USA, 1896; p. 176.
34. Varner, J.M.; Kush, J.S. Remnant Old-growth longleaf pine savannas and forests of the southeastern USA: Status and threats. *Nat. Area. J.* **2004**, *24*, 141-149.
35. McDaniel, J.; McGuire, J.; Gjerstad, D.; Johnson, R.; Schelhas, J. *Land Use History of Longleaf Pine Ecosystems: Case Studies in the Retention and Management of Forested Lands. Final Report: National Commission on Science for Sustainable Forestry*; Auburn University: Auburn, AL, USA, 2004
36. Brockway, D.G.; Outcalt, K.W.; Tomczak, D.J.; Johnson, E.E. Restoring Longleaf Pine Ecosystems in the Southern U.S. In *Restoration of Boreal and Temperate Forests*; Stanturf, J.A., Madsen, P., Eds.; CRC Press: Boca Raton, FL, USA, 2005; pp. 501-519.
37. Mann, W.R., Jr. Techniques and progress in regenerating southern pines. *Forest Prod. J.* **1969**, *19*, 10-16.
38. Schultz, R.P. Loblolly—The pine for the twenty-first century. *New Forest.* **1999**, *17*, 71-88.
39. Trimble, S.W. *Man-Induced Soil Erosion on the Southern Piedmont 1700–1970*; Soil Conservation Society of America: Ankeny, IA, USA, 1974

40. Boyce, T.C.; Dumont, D.; Bailey, M. *Alabama Forest Legacy Program Assessment of Need Document*; Alabama Forest Resources Center: Mobile, AL, USA, 2002.
41. Cubbage, F.W.; O'Laughlin, J.; Bullock, C.S., III. *Forest Resource Policy*; John Wiley & Son: New York, NY, USA, 1993.
42. Goebel, N.B. Growth and yield of planted loblolly pine. In *Proceedings of Symposium on Management of Young Pines*, Alexandria, LA, USA, 22–24 October 1974; pp. 264-275.
43. Allen, A.W.; Bernal, Y.K.; Moulton, R.J. *Pine Plantations and Wildlife in the Southeastern United States: An Assessment of Impacts and Opportunities*; Information and Technology Report 3; United State Department of the Interior, National Biological Service: Washington, DC, USA, 1996; p. 32. Available online: http://www.nwrc.usgs.gov/wdb/pub/others/1996_03.pdf (accessed on 15 April 2010).
44. Hilliard, T. *Longleaf-wiregrass Restoration at Fort Stewart, Georgia: The Military's Role in Restoration, in Ecological Restoration and Regional Conservation Strategies*; Longleaf Alliance Report No. 3; Kush, J.S., Ed.; Solon Dixon Forestry Education Center: Andalusia, AL, USA, 1998; p. 32.
45. McMahon, C.K.; Tomczak, D.J.; Jeffers, R.M. Longleaf Pine Ecosystem Restoration: The Role of the USDA Forest Service. In *Proceedings of the Longleaf Pine Ecosystem Restoration Symposium, Society of Ecological Restoration, 9th Annual International Conference*, Fort Lauderdale, FL, USA, 12–15 November 1997; Longleaf Alliance Report No. 3, pp. 20-31.
46. MacCleery, D.W. *Brief History of U.S. Forests*; USDA Forest Service: Washington, DC, USA, 1990.
47. Egan, A.; Jones, S. Do landowner practices reflect beliefs? *J. Forestry* **1993**, *91*, 39-45.