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HISTORICAL ECOLOGY OF THE SOUTHEASTERN LONGLEAF AND SLASH PINE FLATWOODS: A SOUTHWEST FLORIDA PERSPECTIVE

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ABSTRACT.—Before EuroAmerican settlement of the southeastern U.S., longleaf pine (*Pinus palustris* Mill.) was present and largely dominant on an estimated 85 percent of all upland area within the longleaf's botanical range. Today, longleaf is present on only about 2.6 percent of those uplands. In addition, uplands forested with slash pine (*Pinus elliottii* Engelm.) have been reduced from a pre-EuroAmerican 3.3 percent to just 0.4 percent (Frost 1993). This dramatic landscape change is a result of long-term relations between the pine ecosystems and human activity. Understory plants, soil moisture, and periodic fire were ecological factors while domestic animals, agriculture, the naval-stores and lumber industries, and fire reduction were human-related factors. Some of the Southeast's last old-growth pine forests were logged in south Florida during the 1920s, 1930s, 1940s, and 1950s. Mostly of the pine flatwoods type, these were the southernmost forests in the longleaf pine's range and they included both longleafs and the south Florida variety of slash pine (*Pinus elliotti* var. *densa* Little & Dorman). In southwest Florida's Lee County, historic and oral-historic research focused on the pine flatwoods near Fort Myers, north and south of the Caloosahatchee River. South of the river, an archaeological survey documented the remains of a major component of the 1924-1944 logging operation that greatly impacted the flatwoods of both areas. The results of this historical ecology research illustrate the heterogeneous process of landscape change at regional (Southeast U.S.), subregional (south Florida), and local (southwest Florida) scales.

Key words: historical ecology, longleaf and south Florida slash pines, southwest Florida, oral history, archaeology.

RESUMEN.—En el sudeste de los Estados Unidos, y antes de la colonización de los euro-americanos, la presencia de los pinos de hoja larga (*Pinus palustris* Mill) dominaban en gran parte el terreno elevado que quedaba dentro del área demarcada botánicamente para este tipo de pino. Se estimaba que el área compendia un ochenta y cinco (85) por ciento del terreno. Hoy día, tan solo el dos punto seis (2.6) por ciento de los pinos de hoja larga están representados dentro del terreno demarcado botánicamente. Además, las areas en los bosques de terrenos más altos donde se encuentran los pinos cortados (*Pinus elliottii* Englem) han sido reducidas a cero punto cuatro (0.4) por ciento, en comparación a el tres punto tres (3.3) por ciento que existía durante la época pre euro-americana (Frost 1993). Este cambio tan dramático en el paisaje es el resultado de las relaciones que han existido durante mucho tiempo entre el sistema ecológico de los pinos y la actividad humana. Esto es nos indica que las plantas, la humedad en terreno, y los incendios

que occurieron periódicamente, fueron los factores ecológicos. Los factores humanos que contribuyeron a éste cambio fueron, los animals domésticos, la agricultura, las tiendas de tipo marino o náutico, las industrias de madera, y la reducción de los incendios. En el sudeste se encuentra el crecimiento de algunos de los bosques de pino más viejos y que fueran registrados en el sur de la Florida durante los años 1920, 1930, 1940, y 1950. En su mayoría, los pinos del tipo se encuentra en las areas de terrenos llanos están en la parte sur de Florida y son de hoja larga, así como la variedad de pino cortado (*Pinus elliotti* var. *densa* Little & Dorman). En el Condado de Lee, que se encuentra en el sudoeste de la Florida, hay estudios históricos y de historia oral donde se enfoca el tema de los pinos en las llanuras cerca de Fort Myers y en la parte norte y sur del Río Caloosahatchee. En un estudio arqueológico que se realizó al sur del río, se hizo possible el documentar los restos de uno de los componentes principales en la operación de la extracción de madera durante los años de 1924 a 1944 y lo que causó un gran impacto en los bosques que se encontraban en los terrenos llanos de ambas áreas. En una inspección de tipo histórico-ecológico se pudo documentar el processo etereogéneo donde se demuestra en gran escala la grandesa en el cambio del paisaje de la región (sudeste de los Estados Unidos), la sub-región (sur de la Florida), y la parte local (al suroeste de la Florida).

RÉSUMÉ.—Avant l'implantation euro-américaine dans le sud-est des Etats-Unis, le pin des marais (*Pinus palustris* Mill.) était courant et prédominait largement avec une estimation de 85 pour cent de tout le haut pays classé dans la variété botanique du pin des marais. Aujourd'hui, le pin des marais se trouve seulement dans 2,6 pour cent du haut pays. De plus, les hautes terres boisées de pitchpins américains (*Pinus elliottii* Engelm.) ont été réduites d'un pourcentage preéuro-américain de 3,3 pour cent à seulement 0,4 pour cent (Gel de 1993). Ce changement dramatique de paysage est le résultat de relations à longs termes entre les écosystèmes du pin et l'activité humaine. Les plantes des sous-bois, l'humidité du sol et les feux périodiques furent les composants des facteurs écologiques alors que les animaux domestiques, l'agriculture, l'équipement naval et les industries du bois, la réduction de feu, furent les facteurs relatifs à l'homme. Certaines des dernières anciennes forêts de pins du sud-est furent abattues dans le sud de la Floride dans les années 1920, 1930, 1940 et 1950. Principalement forêts de pins, on les trouvait le plus au sud sous la variété de pins des marais et elles comprenaient à la fois les pins des marais et la variété de pitchpins américains (*Pinus elliotti* var. *densa* Little & Dorman) de Floride du sud. Dans le County Lee de Floride du sud-ouest, la recherché historique et orale historique s'est focalisée sur les forêts de pins près de Fort Myers, au nord et au sud de la rivière Caloosahatchee. Au sud de la rivière, un étude archéologique a révélé les restes d'un élément majeur de l'opération de 1924-1944 sur l'exploitation du bois qui a grandement influencé les forêts de chacune des régions. Les résultants de cette recherche écologique historique illustre le processus hétérogène de changement de paysage à l'échelle régionale (le sud-est des Etats-Unis), sous-régionale (le sud de la Floride) et locale (le sud-ouest de la Floride).

INTRODUCTION

Historical ecology, as defined by Crumley (1994a, 1994b, 1998) and others (Balée 1998; Headland 1997; Winterhalder 1994), is the multidisciplinary, multiscalar study

of the dialectical relations between people and the physical environment. This approach views the cause of cultural and ecosystem change as interactive rather than deterministic. Crumley (1994b:6-7) states that "long-term sequences may be traced through the study of changing landscapes, defined as the material manifestation of the relation between humans and the environment." Examination of landscape change at more than one temporal and spatial scale is crucial to the analysis because the process of change at one scale may not be the same at another scale (Marquardt and Crumley 1987:2-9). Combinations of archaeology, ethnohistory, ethnography, ethnoecology, ethnobiology, history, geography, and the environmental sciences are appropriate to the integrative study called for by a historical ecology approach. Ethnobiology, for example, focuses on the relations between people and plants and animals but does not emphasize the historical (including archaeological) continuum or landscape elements other than plants and animals. Historical ecology is broad in scope, potentially encompassing the multiscalar past and present, and multiscalar landscape elements such as climate, fire, geomorphology, soils, plants, animals, and humans.

Employing the approach of historical ecology, I examine a landscape change that occurred across the Coastal Plain region of the U.S. Southeast—the greatly diminished forest ecosystems of the longleaf pine *(Pinus palustris* Mill.) and the slash pine *(Pinus elliottii* Engelm.) (Little 1971; Wunderlin 1998)—but with a local-scale focus on the pine flatwoods of southwest Florida's Lee County. Longleaf pines were once so abundant in the Atlantic and Gulf Coastal Plain states that they and their plant and animal associates composed one of the dominant forest ecosystems of the region (Frost 1993; Wahlenberg 1946; Walker 1991). Old-growth longleaf and slash pine forests greeted early European and EuroAmerican explorers, travelers, and settlers to the Southeast; these once-seemingly endless forests were described as open stands of pines towering over a low understory often dominated by grasses or saw palmetto (*Serenoa repens* W. Bartram). Deforestation of the region's old-growth pine forests was a long process encompassing several hundreds of years but intensifying primarily during the eighteenth through twentieth centuries. Frost (1993) presents an excellent synthetic environmental history of the longleaf at this long-term regional scale.

Examining the longleaf pine from a south Florida perspective is also important because this subregion supported the southernmost forests of longleaf and their penetration into Florida's subtropics is not well documented or understood. Longleaf pine forests in south Florida were and are of the flatwoods type, the land generally being too low to support the sand-hills longleaf forest type. In addition, the subregion's slash pine is *Pinus elliottIi* var. *densa* (Little & Dorman), distinct from the typical northern variety, *Pinus elliottii* var. *elliottii*; the former has some characteristics similar to longleaf (Abrahamson and Hartnett 1990:112; Moyroud 1996-1997:11; Small 1930; Snyder et al. 1990). Earlier in the twentieth century, the south Florida slash pine was thought to be *Pinus caribaea* Morelet, the Caribbean pine (e.g., Harshberger 1914; Small 1930:42). Indeed, the southernmost slash pinelands (e.g., Everglades National Park) exhibit a distinct assemblage of plant taxa owing to their subtropical location (Snyder et al. 1990). The distributions of longleaf and south Florida slash pines overlap at least in the northernmost areas of south Florida (e.g.,

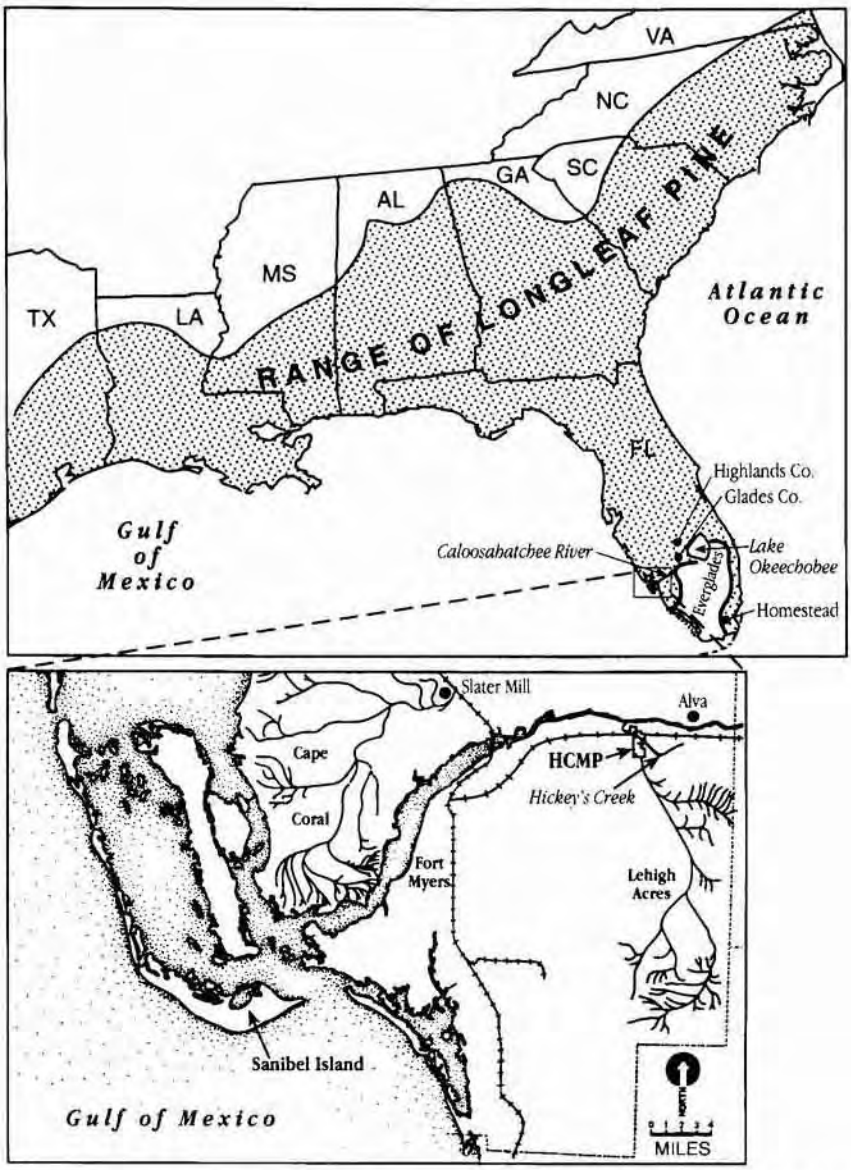

FIGURE 1.—Map showing estimated pre-EuroAmerican Southeast U.S. range of longleaf pine *(Pinus palustris* Mill.) and botanical ranges of typical slash pine *(Pinus elliottii elliottii* Engelm.) and south Florida slash pine (*Pinus elliottii densa* Little and Dorman). The longleaf range is generally based on Frost's reconstruction synthesizing numerous sources (1993:Figure 2). The more detailed southwest Florida range is based on Harshberger (1914) and Sudworth (1913:Map 35). The slash pine ranges are from Little (1971, 1977). Inset map is of Lee County showing the Hickey Creek Mitigation Park (HCMP) and the Cape Coral and Hickey's Creek/Lehigh components of the McWilliams/Dowling & Camp logging system (as reconstructed by James Pickens from 1944 aerial photographs), Slater Mill, and other locations mentioned in the text. The shaded areas are hypothesized to have been forested with a mix of old-growth south Florida slash pines and longleaf pines.

Lee County, Highlands County). A third native pine, the sand pine (*Pinus clausa* Chapm.), is found in the western half of Lee County with its southernmost occurrence in extreme western Collier County (Harshberger 1914:Map; Little 1978:Map 4). South Florida was one of the last areas of the Southeast to experience intensive EuroAmerican settlement. Thus, the subregion's pine forests were some of the last of the Southeast's old-growth pine forests to be logged. Clear-cut logging, the final phase in the Southeast's pine-deforestation process, did not begin in southwest Florida until the 1920s (Zeiss 1983), continuing to as late as 1956 (Tebeau 1957). Thus, a few individuals with first-hand knowledge of south Florida's old-growth forests and their destruction are still living today, representing valuable oral-historic resources. And logging-related features and archaeological deposits are still evident on the landscape, allowing documentation.

THE PRE-EUROAMERICAN PINE FORESTS

A Problematic Documentation.—Researching historical documents concerning the southern pines is problematic (Frost 1993:18; Wahlenberg 1946:268). This is largely due to the botanical similarity of the four yellow pines—longleaf, slash (two varieties), shortleaf (*Pinus echinata* Mill.), and loblolly (*Pinus taeda* L.) (Wunderlin 1998:62)—and their often overlapping distributions (Little 1978:Maps 5, 6, 8, and 10). Of these four pines, however, only the south Florida slash and longleaf pines are native in south Florida. Even so, whether referring to south Florida or areas to the north, early land surveys, maps, and travelers' accounts seldom specify the species of pine recorded.

A plethora of common names have been used at any one time for these pines, all described as "yellow" because of their wood color (Record and Hess 1943). Wahlenberg (1946:268) explains that patterns of geography and sometimes economics (i.e., pine products) could be observed in the variation of names. For example, longleaf pine was generally called "fat" pine in the deep south, "longleaved" and "longstraw" pine in the Atlantic states, "turpentine" and "rosemary" pine in North Carolina, "brown" pine in Tennessee, and "orchard" pine in Texas. Loggers and lumbermen variously called longleaf "yellow" pine, "heart" pine, "southern" pine, "hard" pine, and "pitch" pine (see also Mohr 1896:28; Panshin and deZeeuw 1980; Record and Hess 1943). Mohr (1896:28) lists "slash pine," "swamp pine," "bastard pine," "meadow pine," and "she pine" as common names used for slash pine.

Most bothersome to researchers, the word "longleaf" was sometimes used in the lumber industry to indicate any of the yellow pines that met lumber standards of high quality. To Wahlenberg (1946:268), this confusion was understandable from a lumberman's point of view because the yellow pines that are easily distinguished morphologically cannot always be distinguished (anatomically) by their wood (see also Record and Hess [1943] and Panshin and deZeeuw [1980] for examples of gymnosperm keys that reflect this problem). In addition, early forestry surveys often combined longleaf and slash pines in a category called "turpentine pines" when reporting acreages (Wahlenberg 1946:xiii-xiv, 1), in part due to intergrading (i.e., mixed stands) of the two species.

Archaeological and paleoecological documentation of the pines is equally as problematic, if not more so, as historical and ethnobotanical documentation. The most frequently recovered archaeological plant remains are in the form of small fragments of charred wood, often found in great quantities. Although charred wood fragments often can be identified to species under microscopic examination, wood anatomists and archaeobotanists are not able to distinguish between the southern species of *Pinus* (Panshin and deZeeuw 1980; Record and Hess 1943). Unfortunately, this inability also applies to preserved, waterlogged wooden artifacts. Paleoecologic study of pine pollen is also limited to the genus level, as pollen from the various species are "difficult or impossible" to distinguish (Watts 1993:15). However, one promising, indirect, avenue of identifying past longleaf woodlands is the determination of the mass and relative abundances of associated understory plants based on phytoliths recovered from soils (Kalisz et al. 1986:187).

Estimates of Acreage and Range.—Despite the difficulties of historical research, reconstructions of acreage and range have been approximated for pre-EuroAmerican times, especially for longleaf pine. Reported estimates for the acreage of southeastern longleaf forests range from 50 to 92 million (e.g., Frost 1993; Landers et al. 1995; Wahlenberg 1946:8; Walker 1991:128). For example, Frost (1993) calculates that 92 million acres of the region's woodlands included "some longleaf pine" and of that acreage perhaps roughly 74 million acres were longleaf-dominated woodlands. One writer reports that only .002 percent of the old-growth forests remains (Winn 1996:15). Estimates for current acreages range from 1 to 5 million (e.g., FCMP 1995; Landers et al. 1995; Longleaf Alliance n.d.). A 1995 systematic inventory by county of longleaf pine (comprising more than 50 percent of the tree cover) resulted in an estimate of 2.95 million acres (Outcalt and Sheffield 1996:2). Of the current longleaf acreage, Virginia has none and Florida has the most, almost one million acres (Outcalt and Sheffield 1996:20).

Estimates of longleaf's pre-EuroAmerican areal distribution also vary. Wahlenberg (1946:46) distinguishes between a botanical range (potential range) and a commercial range (range of exploitable forests), pointing out that most reconstructed distributions were probably based on commercial (i.e., exploitable) ranges, resulting in conservative boundaries (e.g., Mohr 1896; Sargent 1884). Thus, he concludes that the pre-EuroAmerican longleaf-forest boundaries lay somewhere between the two ranges. Frost's (1993:18) recent reconstruction of longleaf's range may be the best to date at the regional scale because it is a synthesis of the major studies published between 1861 and 1971. But it does not depict the true nature of longleaf's southernmost distribution. Wahlenberg (1946:49-50) notes that longleaf is restricted in its northern distribution by snow, which is dangerously heavy when accumulated on the tree's long needles. However, competition from deciduous species may be a more important factor. Generally, longleaf pine extended across the Coastal Plain (Figure 1), from southeastern Virginia across to portions of Louisiana and a small area of eastern Texas (Frost 1993). Distribution maps also consistently show that longleaf pine was found throughout Florida's panhandle, and its north and central peninsular regions. Typical slash pine had a more restricted, even more southern range, generally distributed from southern South Carolina to central Florida and west to southeast Louisiana (Little 1971; Figure 1), often characterized as concentrating along the coastal areas (e.g., Sargent 1884:520).

The southern longleaf boundary may be the more difficult of the two to reconstruct because the distribution of the south Florida slash pine overlaps with the southernmost longleafs (Figure 1) and the similarity of the two yellow pines has resulted in an often ambiguous historical record. Apparently, it is increased soil moisture that marks the longleaf's southernmost extent (Abrahamson and Hartnett 1990:111-112; Peet and Allard 1993:61). Like typical slash pine, south Florida slash pine is more tolerant of poorly-drained soils and as a result is the more dominant pine across south Florida. The majority of pre- and post-EuroAmerican maps depict longleaf's range as halting northwest of Lake Okeechobee in south-central Florida and at the Caloosahatchee River in southwest Florida, limited to the mainland (e.g., Frost 1993:18; Little 1978:Map 8; Schwarz 1907; Wahlenberg 1946:44). It may be that these south Florida boundaries were "commercially drawn," as Wahlenberg called it, and therefore are conservative. (This is certainly the case with the forest-survey maps of Mohr [1896] and Sargent [1884].)

For example, University of Florida herbarium records document scattered longleafs in the Estero area (FLAS 120603, collected 1975) of southwestern Lee County and an "extensive open stand of [longleaf] trees" on Pine Island (FLAS 82831, collected 1961), west of mainland Lee County (Figure 1 inset). Outcalt and Sheffield's (1996:19) inventory shows acreages of longleaf-dominated forest in two south Florida counties, Glades and Highlands, west and northwest of Lake Okeechobee (Figure 1). Frost's (1993:18) reconstruction includes this Okeechobee locale, depicting it as part of a division called "scattered longleaf pine in slash pine areas transitional to south Florida communities."

Importantly, botanist John Harshberger (1914:89) traveled through Lee County (including what is today Collier County) early in the last century and reported that "on the west coast, south and north of the Caloosahatchee River, the slash-pine mingles with the long-leaf pine, *Pinus palustris* Mill." and in another entry, "scattered growths of longleaf-pines, *Pinus palustris* Mill., continue south of the Caloosahatchee River into Lee County on the authority of J. A. Davison, an engineer, as far as Surveyor's Creek, and the tree has been reported at Henderson's Creek, but it is not an important element of the forest, which consists of the slash-pine, *Pinus caribaea* Morelet [today known as *Pinus elliottii* var. *densa*] and associated species." Surveyor's Creek, today known as the Imperial River (Grismer 1982:330), is located in southernmost Lee County (Figure 1 inset). Henderson's Creek is located even farther south, between Naples and Marco Island, in today's Collier County. Sudworth's (1913:Map No. 35) botanical range for longleaf pine includes most of Cape Coral. It also extends south of the Caloosahatchee River including a locale overlapping eastern Lee County and western Hendry County, a band along the river, Pine Island, and a locale in the Estero area of southern Lee County. Based on Harshberger and Sudworth, Frost's presettlement transitional mixed longleaf-slash zone should be extended to include parts of southern Lee County in order to depict more accurately longleaf's southernmost botanical range, as I have indicated in Figure 1.

Longleaf and Slash Pine Forest Ecosystems.—Eighteenth and nineteenth-century accounts of travels through the Southeast paint images of extensive open forests of tall pines (e.g., Bartram 1791:43, 186, 191; Brinton 1869:95, 104; Romans 1775:14-

17; Vignoles 1823:86-87). One could see for a great distance into the forests. It was thus also easy to travel through them and to hunt game animals, described as abundant. In some cases, longleaf was clearly the dominant tree being described (e.g., Bartram 1791:33, 52; Romans 1775:16) but more commonly, only the generic "pines," "pinelands," "pine flatwoods," etc. were indicated. Similarly, Harshberger (1914:90) and Small (1930) described the south Florida slash pine forests as "unusually open" with an unobstructed view, and "endless." These early accounts and others suggest that pre-EuroAmerican slash- and especially longleaf-dominated forest ecosystems may have been characterized by a lower understory than most pine forests of today. The interpretation is far from certain (Myers 1990:182), however, because by the eighteenth century, feral and free-ranging European-introduced hogs and cattle were abundant in the pine forestlands, grazing and foraging in the understory (e.g., Romans 1775:16).

General characteristics of mature longleaf-dominated pine ecosystems include: low longleaf stand density; minor hardwood component, mostly oaks; grass-dominated groundlayer; high plant species richness; frequent surface fire; occurrence across a wide geomorphic and hydrologic gradient (although well-drained sandy soils are most common); and stands of uneven-aged trees (Landers et al. 1995:40; Palik 1995:6; Schwarz 1907:3-17). An important difference between longleaf and slash forests is the much slower rate of longleaf growth while in the seedling stage, leading to the undeserved reputation of being slow to reach timber size (Franklin 1997:5; Landers et al. 1995:42). Longleaf forests are often visibly distinct from slash pine forests in that bunch grasses (especially the wiregrasses *Aristida stricta* Michx. in the north and *Aristida beyrichiana* Trin. & Rupr. in the southernmost areas) are the dominant understory plant of the former while saw palmetto and to a lesser extent gallberry (*Ilex glabra* L.) typically dominate in a slash pine forest. However, recent studies recognize a wide diversity of longleaf ecosystems based on vegetational composition and soil moisture (e.g., Harcombe et al. 1993; Peet and Allard 1993), including a longleaf system with saw palmetto along the northern Gulf Coastal Plain (Peet and Allard 1993:57, 58). Most of Florida's longleaf forests of the Gulf Coastal Plain, including those of southwest Florida were or are probably of the "southern longleaf flatwood" type, described as often including slash pine and saw palmetto in the relatively wetter areas (Peet and Allard 1993:61, 65). Whatever the dominant pine, "natural" flatwoods generally are highly stratified with a high tree canopy (pines drop their lower limbs, sometimes a result of fire) and a low plant understory.

Longleaf pine itself is most readily distinguished from other southern pines by its long needles, 10 to 15" (25-38 cm), and large cones, 6 to 10" (15-25 cm) (Harrar and Harrar 1962:51-60; Little 1980:291; Wahlenberg 1946:3). Longleaf has the potential to live 500 years or more but usually trees are victims of storms, if not humans, long before reaching such an age (Bengtson et al. 1993; Landers et al. 1995:39-40). Compared to other southern pines, longleaf is the most resistant to disease, insects, and rot, adding to its value as timber wood. South Florida slash pine is less resistant than longleaf but more resistant than typical slash pine.

Longleaf pines are intolerant of competition but remarkably tolerant of surface fire; thus, frequent—at least once a decade and optimally every 2-3

years—low-intensity fires are the key to controlling the growth of competitors such as hardwoods and even slash pines (Abrahamson and Hartnett 1990:132; Landers et al. 1995:40; MacLaren and Stevenson 1993:407; Rebertus et al. 1993). South Florida slash pine is less fire resistant than longleaf but more fire resistant than typical slash pine (Abrahamson and Hartnett 1990:112, 131; Snyder et al. 1990:259). Along with fallen pine needles, highly flammable wiregrasses (Moore 1996a:18; Peet and Allard 1993:46-47) and saw palmetto (Arahamson and Hartnett 1990:129) provide fuel for the fires, usually ignited by lightning strikes. In the absence of human influence (either Indian or EuroAmerican), fires would have been seasonal, primarily limited to the summer lightning season of April to mid August (Myers 1990:185). In pre-EuroAmerican times, a single-ignition fire could burn extensively without the limitations of roads and other human-made barriers. The pines themselves withstand fire in part because of their multi-layered fire-resistant bark (Snyder et al. 1990:259). Longleaf seedlings also regularly survive fire; the seedlings of south Florida slash pine have a lower survival rate yet fare better than those of typical slash pine (Small 1930:42; Snyder et al. 1990:259). Thus, longleaf and South Florida slash flatwoods are especially fire-maintained and fire-dependent. A high frequency of 2 to 3 fires a year would enhance and expand longleaf stands (Rebertus et al. 1993) and slash pine stands as well. In addition to reducing woody competitors, fire contributes to the germination of seeds (especially of longleaf and the understory grasses) by producing appropriate soil conditions; to turnover of litter, humus, and nutrients; and to increased vigor of some species populations (Abrahamson and Hartnett 1990:129; Myers 1990:178).

In addition to wiregrasses, a high diversity of fire-adapted groundcover plants in both longleaf- and south Florida slash-dominated flatwoods sustains a diverse animal life (Abrahamson and Hartnett 1990:116; Engstrom 1993; Guyer and Bailey 1993; Johnson 1995; Moore 1996b:19). This is in part because many of the fire-adapted plants produce new growth, providing food, soon after a fire has burned through the forest. Pine seeds also provide food for many birds and small mammals (Frost 1993:31; Wahlenberg 1946:179). Gopher tortoise (*Gopherus polyphemus*), box turtle (*Terrepene carolina*), eastern diamondback rattlesnake (*Crotalus adamanteus*), black racer (*Coluber constrictor*), pine woods tree frog (*Hyla femoralis*), great horned owl (*Bubo virginianus*), bobwhite quail (*Colinus virginianus*), red-cockaded woodpecker (*Picoides borealis*), turkey (*Meleagris gallopavo*), fox squirrel (*Sciurus niger*), and white-tailed deer (*Odocoileus virginianus*) are some of the animals native to the flatwoods. Most, if not all, benefit from periodic fire. For example, gopher tortoises, more typical of high pinelands (Myers 1990:186) but also present in the drier flatwoods and scrubby flatwoods (Abrahamson and Hartnett 1990:119), cannot survive dense woody vegetation. The underground burrows of tortoises serve as fire refuges not only for the tortoises but also for over 300 other vertebrate and invertebrate animals (e.g., Dodd 1995; Folkerts et al. 1993:165-166, 181-182; Myers 1990:186). Early EuroAmerican observers also recorded bison, black bear, panther, red wolves, and even elk in the longleaf forests of the Southeast (Engstrom 1993:128).

Today there is general agreement among researchers that pre-EuroAmerican pine forests differed from most present-day ones in that they had higher fire fre-

quencies, more uneven age structure, and a more open understory with greater grass components and less shrub plants (Abrahamson and Hartnett 1990:104). Researchers also agree that the reduction of fire frequency may be responsible for much of the difference (Abrahamson and Hartnett 1990:104; Frost 1993:21, 34-35).

The American Indian Factor.—The occurrence and distribution of woodlands (pine and mixed hardwood) and other plant communities and how they changed throughout pre-EuroAmerican history are increasingly being linked to human influence, and in particular to human use of fire (Delcourt and Delcourt 1997, 1998; Delcourt et al. 1998; Pyne 1998). While there are many reasons recorded in historic accounts (Wagner in press) for why American Indians set fires in eastern North America, perhaps two of the most important ones were to stimulate browse plants for attracting wildlife and to drive game. While traveling in north Florida, Bartram (1791:139) stated that "fires are set almost every day throughout the year in some part or other, by the Indians, for the purpose of raising the game, as also by the lightning." Attracting wildlife may have been the primary reason for American Indian management of Florida's pine flatwoods, especially in pre-agricultural times (generally before A.D. 1200 in north Florida). In south Florida where crop agriculture was not practiced, attracting wildlife and improving visibility for hunting undoubtedly would have been the primary reason for setting fires. White-tailed deer and other game animals of the pine forests are highly visually oriented, needing to see their surroundings (Johnson 1995:29).

To date, little research has focused on American Indian use of woodland fire in Florida. One study by Kalisz et al. (1986), however, identified a spatial correlation between archaeological sites associated with non-agricultural Indians and present-day longleaf stands (occurring as "islands" in a landscape of predominantly sand pines) in north-central Florida's Ocala National Forest. In addition, quantification of wiregrass phytoliths in the soils beyond the present-day longleaf stands strongly suggests that they were once more extensive. Kalisz et al. (1986:191) hypothesize that "the longleaf pine islands were maintained through annual or frequent burning by early humans; longleaf pine islands are prehistoric cultural features." Change in the natural fire regime of either sandhill pine stands (as in the Ocala case) or pine flatwoods due to an increase in the number of fires and the addition of a second burn season (winter dry season), if maintained, would have resulted in forest expansion, especially where longleafs or south Florida slash pines were present.

Fifty-six years earlier, in his study of south Florida slash pine "islands" within the Everglades ("Everglade Keys"), botanist John K. Small (1930:41-42) hypothesized about the ecological influence of American Indians:

> ...when the aborigines first occupied the Everglade Keys, they doubtless found them clothed with hammock. ...without doubt, the aborigines purposely set fire to the hammocks in order to drive the game into the open places, thus facilitating their primitive means of hunting game. ... But there had been developed plants that were fire-proof, so to speak, just for such regions...the Caribbean-pine (*Pinus caribaea*)...the seedling pine-trees after several years of uninterrupted growth will survive fire, and when a little

older they are normally perfectly fire-proof. Thus the pinewoods were developed and have spread as the hammock retreated.

DEFORESTATION OF THE SOUTHEASTERN AND SOUTH FLORIDA PINE FLATWOODS

Human-related factors involved in the complex process of pine deforestation include American Indian agriculture, introduced European animals, the naval-stores and logging industries, EuroAmerican agriculture, and reduction of fire. Both American Indians and EuroAmericans contributed to the landscape change, although clearly the latter played the greater role. Importantly, African Americans, masked by the EuroAmerican economic histories, comprised the greater percentage of the labor force for EuroAmerican southeastern agricultural production and for the naval-stores and logging industries.

American Indian Agriculture.—In prehistoric times, agricultural American Indians may have cleared portions of the more fertile flatwoods but no attempts have been made to estimate how much pineland was impacted in the southeast region. Studies that identify and estimate agricultural lands surrounding large Mississippian-period population centers are on the increase, but so far these have focused on areas outside of the longleaf and slash pine ranges (see summary in Wagner in press). Frost (1993:28) notes that Alabama Indian farmers may have cleared much longleaf pineland for their extensive agricultural fields. Many towns of these Mississippian-period agriculturalists were palisaded, representing an additional impact on forests (Wagner in press), possibly including pinelands. Moreover, palisades were replaced, sometimes several times over the occupation of a site. Alabama's Moundville, for example, was palisaded at least three times using a minimum of 10,000 logs each time (Scarry and Steponaitis 1997). Maize agriculture spread throughout north and central Florida after about A.D. 1200 and may have impacted pinelands of these subregions. South Florida's prehistoric Indians, on the other hand, did not practice agriculture.

Introduced European Animals.—Except for the possibility of Indian agriculture as a significant factor, one might argue that the pine deforestation process, in a broad sense, began in 1539 with the Spanish expedition led by Hernando de Soto (Smith 1968). De Soto entered the Southeast in west central Florida and brought with him a food supply that included droves of pigs (Milanich and Hudson 1993:38), herding them along the exploration route throughout much of the southeastern range of longleaf and slash pines. In addition to the resultant, immediate short-term foraging and grazing of the forest groundlayer, unknown numbers of pigs are believed to have escaped, forming the basis for a non-native feral population, one that proliferated in the pine flatwoods. The use of pinelands for grazing continued and diversified when an area's first EuroAmerican settlers learned—perhaps from American Indians—that purposely set surface fires in the woods, especially those with longleafs and south Florida slash pines, reduced the shrub layer (saw palmetto, etc.) and produced new grass forage for their grazing animals. Romans (1775:16) wrote of the north Florida longleaf forests "that immense stocks of cattle

are maintained, although the most natural grass on this soil is of a very harsh nature, and the cattle not at all fond of it, it is known by the name of wire grass; and they only eat it while young...the woods are frequently fired, and at different seasons, in order to have a succession of young grass." The periodic burning of the forest floor by Indians and EuroAmericans benefitted the forests as did fires ignited by lightning, and especially in the case of longleaf and south Florida slash pine forests, perhaps even expanded them if their burning episodes represented an increase in overall fire frequency. However, there was generally an important difference between Indian and EuroAmerican forest management. Prehistoric and many historic-period Indians "fire-managed" pine forests primarily to increase the abundance of native wildlife which they hunted for food. Although grasses, wildlife, and fire were elements of the native flatwoods ecosystem, EuroAmerican livestock was not. Feral and domestic hogs and cattle and even sheep and goats (in some areas), free from fencing as late as the 1950s in south Florida, fed on the many grasses and pine seedlings in these open woodlands (Sargent 1884:492). Departing from the pattern, however, historic-period American Indians in Florida, notably the Seminole, also engaged in cattle-raising on the open range, first in north and central Florida and later in south Florida. Great numbers of feral cattle, many from Spanish origins, roamed the pinelands free for the taking.

The feral hog population had reached a saturation point across most of the longleaf range by 1850, and probably earlier although pre-1840 documentation doesn't exist (Frost 1993:32). While the grasses may have benefited from hog and cattle grazing, the collective rooting, grazing, and trampling of the non-native animals proved to be too much for the pine seedlings, especially those of the slow-growing longleafs. It is reported that a single hog in one hour can root as far as 30 feet, eating some eighty starch-laden longleaf seedlings (Walker 1991:129, 192-193). Thus, feral hogs, in particular, were responsible for the destruction of countless longleaf seedlings, preventing forest regeneration (Frost 1993:30-34; Schwarz 1907:94; Wahlenberg 1946:178-179). In addition, soil compaction and trampling caused by these animals contributed to the inability of seedlings to survive (Abrahamson and Hartnett 1990:146).

South Florida was still in many ways a frontier during the first half of the twentieth century. For example, many south Florida cattlemen continued centuries-old burning practices in the pine woods so that their stock could graze on new grass growth (Akerman 1976:246-247; Franklin 1997:19; Zeiss 1983:118-119), a practice that was compatible with pine forests if seedlings survived their fire-intolerant stage. Wild pigs, on the other hand, still very populous in the 1940s and 1950s in south Florida, continued to consume pine seedlings in massive quantities, significantly impacting the region's source of forest regeneration.

Naval Stores and Logging.—EuroAmerican settlers soon realized more lucrative uses for the longleaf and slash pine forests. The naval-stores industry faced trees (as many as three or four sides of mature trees) and attached cups or boxes to collect resin that was used for the production of rosin, pitch, tar, and turpentine (Butler 1998; Frost 1993:24-27; Mohr 1896:69; Wahlenberg 1946; Walker 1991:77, 146-151). The first three products were enormously important to the shipbuilding industry, while the numerous uses for turpentine varied from lamp oil to laxatives. The

1834 introduction of the copper still for turpentine distillation resulted in a proliferation of turpentine operations (Butler 1998:72-73; Frost 1993:26-27). The still allowed the resin to be reduced to turpentine at the extraction sites and thus saved significant shipping costs. Mature stands of longleaf often produced for only about four years (Mohr 1896:70). Pine trees tolerated extraction of resin but were weakened significantly and thus became more vulnerable to fire, insects, and storms (Mohr 1896:61, 72).

The most lucrative and most destructive of all the pine industries was timbering. The tall, straight longleaf pines with their rot- and insect-resistant wood, for example, made excellent ship masts, long-lasting dock pilings, and when milled, made beautiful homes. Southern longleaf pine, in general, had the reputation in European, Caribbean, and South American markets of being North America's strongest wood due to its density (Mohr 1896:53). Initially, transporting longleaf and slash pine logs to the mills was a slow and difficult task. Logs were floated via natural and human-excavated waterways to mills; thus, the area of forest that could be logged was limited to that which had access to the waterways.

That limitation vanished with the nineteenth-century arrival of the steam-driven locomotive and railroads to the southeastern forests. In addition to the locomotive, steam-powered log skidders, sawmills, and circular saws contributed significantly to the new logging technology. Almost as soon as the main rail lines were laid by railroad companies, lumber companies leased logging rights or bought extensive acres of forested lands adjacent to the lines. Logs were taken from the woods to the sawmills by railcars pulled by a steam locomotive. Due to this acceleration of the logging industry based on steam technology, most of the region's remaining old-growth longleaf and slash pine forests were clearcut between 1870 and 1920 (Frost 1993; Wahlenberg 1946). Just as EuroAmerican settlement had been late coming to Florida, especially the southern half of the peninsula, the state was late in receiving attention from the railroads. The logging of south Florida's pine forests began in the 1920s. Old-growth pines were still being logged in this subregion in the 1950s although much of the focus had shifted to cypress in the Big Cypresss Swamp and Fakahatchee Strand (Tebeau 1957).

EuroAmerican Agriculture.—Before broad-scale logging, many pinelands were cleared by EuroAmerican settlers for the purpose of establishing agricultural fields. Much of the landscape across the region was converted to cotton plantations in the 1800s. Later, especially after 1940, many logged pinelands and old plantation lands were planted in slash or loblolly pines. Slash (primarily the typical *P. elliottii elliottii*) and loblolly were thought to be fast-growing (due to their early rapid growth) compared to the longleaf, and thus were considered more economical to grow, ignoring the higher quality of longleaf wood. Dense plantations of slash and loblolly, with trees planted in neat rows, became the accepted management approach in forestry practices on public-, industry-, and other private-owned lands. In still other areas of the Southeast, including parts of south Florida, citrus groves and non-woodland cattle pastures replaced the old-growth flatwoods.

Reduction of Fire.—The reduction of fire frequency in the Southeast's pine forests intensified with the progression of EuroAmerican settlement. As roads and agri-

cultural fields became more numerous, the pine woodlands became more fragmented, requiring a higher frequency of fire ignitions to burn large areas. Prior to fragmentation, a single lightning ignition could burn extensively across the landscape. With fragmentation, fire was effectively eliminated from many parcels of pine forests (Frost 1993:34). Thus, early fire suppression was perhaps an unintentional result of EuroAmerican settlement. Many of the logged Southeast lands, including longleaf woodlands, experienced serious erosion and flooding (Walker 1991:170-175). This situation, combined with poor agricultural practices, led to the Southeast's navigable rivers being muddied and even clogged. As a result, the federal government began in 1911 to buy the logged lands to protect the Southeast's watersheds. In this manner, over 10 million southern acres were added to the National Forest system, and trained foresters took on their management (Walker 1991). Nonetheless, many millions of acres, especially those forestlands that supported longleaf pine, were not allowed to regenerate naturally.

Perhaps the most critical barrier to regeneration was what might be called the "Smokey Bear Myth." Although purposeful fire-suppression steadily followed the progression of EuroAmerican settlement, the U.S. Forest Service's Smokey Bear campaign, culminating in the 1950s, left no doubt in the minds of Americans that all forest fires were destructive and dangerous, and were not to be allowed under any circumstances (Landers et al. 1995:41; Moore 1996c:22; Walker 1991). Because foresters did not understand the beneficial role of frequent surface fires (e.g., Mohr 1896:62), they unknowingly contributed to the degradation of the pine forests. Without frequent surface fire, the forest floor became thick with pine needles and cones and the shrub layer grew dense, all providing fuel for highly destructive fires when fires did occur. Without fire, the longleaf pines were eventually outcompeted by other pines and hardwoods, the slash pines were often out-competed by hardwoods, and the various understory plants and animals specifically adapted to the longleaf and slash forests declined in abundance (Peet and Allard 1993:46). Even in the relatively remote rock pinelands of today's Everglades National Park, twentieth-century fire suppression resulted in a reversal of Small's (1930) hypothesized scenario in that a succession toward hardwood hammock has occurred (Hofstetter 1974:203).

DEFORESTATION OF SOUTHWEST FLORIDA'S PINE FLATWOODS

Archaeological Survey and Historical Research of the HCMP.—During January of 1996, Robin Denson (Gulf Archaeology Research Institute) and I conducted an archaeological survey on a tract of Lee County-owned land just south of the Caloosahatchee River and east of Fort Myers in southwest Florida (Figure 1 inset) (Walker et al. 1996). Prior to and during this same time, I also conducted historical research and a series of interviews with long-time local residents. Much of the area today is characterized by seasonally wet south Florida slash pine/saw palmetto flatwoods and dense saw-palmetto prairies. The county property, known as "Hickey Creek Mitigation Park" (HCMP), was named for Hickey's Creek (after nineteenth-century settler Dennis O. Hickey) which runs through it toward the Caloosahatchee. In part, the park is intended to be a preserve for gopher tortoises in perpetuity to

offset tortoise habitat destroyed elsewhere in southwest Florida (Roger Clark, personal communication, 1996; Riley et al. 1993), hence, the use of the word "Mitigation."

Our archaeological survey documented five American Indian archaeological sites on the park property. Artifact collections include primarily a few pottery sherds, one bone pin, and one bone point; no other faunal remains or other dateable organic materials were found. The sherds are all of the Sand-tempered Plain type, also known as "Glades Plain," and are only roughly diagnostic of time period. Because they are not very thick, a post-A.D. 500 date is suggested. These are all small sites and four are associated with the banks of Hickey's Creek (Walker et al. 1996). One site tenuously was based on a single chert flake likely produced from working or reworking a projectile point. Unlike other sites, it is located in the middle of today's slash pine/saw palmetto flatwoods. Larger sites are reported for the mouth of Hickey's Creek on the Caloosahatchee River and just to the south of the park property on Hickey's Creek. The latter produced a relatively large sample of pottery sherds that suggest a post-A.D. 500 habitation, more long-lived than the small sites within the park. It is possible that all sites are contemporaneous. The two large sites may have been the main habitation villages for the area while the smaller creekside sites may have been short-term hunting/fishing camps. The chert flake may have been lost during a hunting episode in the flatwoods. The bone point also suggests food procurement, associated with either fishing or hunting. Freshwater and periodically estuarine fishes would have been available in Hickey's Creek and white-tailed deer, raccoon, opossum, turkey, gopher tortoise, quail, and other game animals would have inhabited the flatwoods, all offering substantial food resources for the Indian residents.

The EuroAmerican homesteader of the Hickey's Creek area was Dennis O. Hickey (Little in Walker et al. 1996:Appendix A) who during the post-Civil War decades farmed, growing "large crops of cabbage, eggplant and squash" (Grismer 1982:109), "raised" cattle in the woodland tradition and also operated a store in Fort Myers (Little in Walker et al. 1996:Appendix A). Also, during the period of 1870-1926, cattle drives (Dodrill 1993:10), some led by Hickey, regularly pushed through both the Hickey's Creek (Little in Walker et al. 1996) and Cape Coral (Zeiss 1983:26; 111-113) areas grazing and trampling in the pine woods on their way to Punta Rassa where the animals were then shipped to Cuba. Hickey's descendent, Mrs. Beverly Little, believes the location of Hickey's home, however, was beyond the boundaries of our survey parcel.

The park includes the archaeological remains of a logging rail system, two logging camps, and associated refuse dumps, all dating to the 1930s and 1940s. Only the younger of the two camps had been recorded with the Florida Site File. Our primary informant, Mr. Dan Garner (Figure 2), told us that an earlier, 1930s camp and rail line had existed, and he took us to this location in what today is a dense, high saw-palmetto prairie (Walker et al. 1996:Appendix D). There, the survey crew found a few surface artifacts reflecting the decade.

We soon learned that the Hickey's Creek area was an important part of what once was an extensive logging network run first (1924-1929) by the J. W. McWilliams Lumber Company and later (1929-1944) by the Dowling & Camp Company (Pickens

in Walker et al. 1996:Appendices B and C). Two brothers, William and James, were sons of Thomas Dowling, who ran a logging operation in north Florida along the Suwannee River centered at Dowling Park (Anonymous 1988; Doris Dowling Crews, personal communication, 2000). Vaughn Camp was of the Camp family, which centered its extensive operations in Franklin, Virginia (Rouse 1988). Dowling and Camp's logging network included what are today two major population areas of Lee County—Cape Coral and Lehigh Acres—the former located on the north side of the Caloosahatchee and the latter located just to the south of Hickey's Creek.

At the beginning of the HCMP survey project, we assumed that only south Florida slash pine had been logged from the Hickey's Creek and Cape Coral areas. But after our initial historical and oral history work, we began to consider that the logged forest adjacent to and south of Hickey's Creek also may have included significant longleaf pine and wiregrass components (Walker 1997; Walker et al. 1996). Both areas share in large part a common soil association, the Pineda-Boca-Oldsmar, which falls into the category of nearly level, poorly drained, deep sandy soils with a pine flatwoods association (USDA SCS 1984).

Despite the poorly drained soil association, the land south of the river was recorded by Vignoles as "high pine" land on his 1823 natural history map of Florida. He typically used "high pine" to refer to longleaf pinelands similar to its use today (Myers 1990:153, 174). Botanist John Harshberger (1914) was more explicit when he stated that longleaf occurred mixed with the more dominant south Florida slash pine, both north and south of the Caloosahatchee. Efforts to locate company records that might more clearly identify the species of logged pines—through

FIGURE 2.—Author's primary informant, lumberman and cattleman Mr. Dan Garner of Alva, Florida, was interviewed in January of 1996 near Hickey's Creek.

Dowling relatives and other avenues—were unsuccessful. A Fort Myers 1926-1927 telephone directory listed the McWilliams Company as manufacturers of "Rough & Dressed South Florida Dense Long Leaf Yellow Pine" lumber (Walker et al. 1996:47). During the time of this listing, the McWilliams Company was logging Cape Coral (Zeiss 1983:98-108). Interpretation of the listing is not straight-forward. Both south Florida slash and the longleaf pine produced wood that was more dense than the northern slash pine. Might McWilliams have been advertising both south Florida slash and longleaf pine with no distinction, in light of Harshberger's mixed longleaf/slash record for Lee County and Wahlenberg's (1943:268) point that high quality pine wood was often sold as "longleaf," regardless of species? The name "longleaved yellow pine" is listed by Mohr (1896:13) as one of the common names for longleaf and thus suggests that at least some of the Cape Coral pine was longleaf. And furthermore, Sudworth's map records the presence of longleaf in the Hickey's Creek area but only slash pine to the south in the Lehigh Acres area, suggesting a longleaf component there. It is probably no coincidence that the areas targeted for logging first by McWilliams and later by Dowling and Camp were areas indicated on Sudworth's U.S. Forest Service map as including longleaf pine.

A lifelong local resident, lumberman/cattleman Dan Garner (Walker et al. 1996:Appendix D) (Figure 2), during the archaeological survey, described the old-growth forest just south of the Caloosahatchee at Hickey's Creek:

> That was the most beautiful pine you ever seen in your life. You just go out there, and you could see a turkey and anything else...there weren't no weed, no palmettos, no nothing. Heart pine. Big heart pine. ...it wasn't near this rough [with high saw palmetto like today]...lots of tortoises and hogs out here...deer, turkey, bobcat...when I was a boy, this was the best place in the world...you could kill all the game in the world.

Unfortunately, Mr. Garner and other local residents of the area knew these pine trees only as "heart pine" or "yellow pine." (Mr. Garner intended to take me to see a mature pine forest in the Lake Okeechobee area—one that is very similar to how he remembered Hickey's Creek's old-growth forest, but he died before we could go.) The same common-language problem is true of the Cape Coral oral histories that Zeiss (1983) collected. The phrases "virgin pine," "first growth trees," and "heartwood" appear throughout—but no mention of species. Most of Cape Coral was described as "high pineland" by early residents (Zeiss 1983:180).

The pre-logged areas of Cape Coral and Hickey's Creek may be characterized best by seasonally wet mixed south Florida slash and longleaf flatwoods. The wetter Lehigh Acres locale probably supported mostly slash pine and both the Hickey's Creek and Lehigh Acres locales included some areas of pond cypress wetland. Based on Sudworth (1913) and Harshberger (1914), Lee County's pre-logged flatwoods, while many included longleaf, were dominated by the south Florida slash pine. This characterization is a revision of my earlier hypothesis of longleaf-dominated flatwoods for northern Lee County (Walker 1997; Walker et al. 1996).

Cape Coral and Hickey's Creek/Lehigh Acres Logging Operations.—Typically, lumber companies clear cut southeastern old-growth pine forests, moved on to the next

FIGURE 3.—Photograph taken in north Florida of a mule-drawn high-wheeled log cart (with a longleaf pine log) fitting cattleman Mark Bateman's description of the circa-1940-1944 carts at Hickey's Creek.

area to be logged, and sold the logged land as soon as possible. The Cape Coral and Hickey's Creek/Lehigh Acres operations followed this pattern. Once the Atlantic Coast Line completed a line to Fort Myers and later the Seaboard Air Line Railway Company completed a line from Fort Myers east into interior south Florida (Grismer 1982:233-234; Turner 1999:33-36; Walker et al. 1996:Appendices B and K), nearby pinelands were purchased or leased by the lumber companies. McWilliams began logging in 1924 and cut pine to build a large sawmill and houses at Slater (Zeiss 1983:99) in what is now North Fort Myers (Figure 1, inset). McWilliams and, after 1929, Dowling & Camp logged the pine flatwoods of Cape Coral. Dowling & Camp later logged the pine flatwoods of the Hickey's Creek and Lehigh Acres areas from 1932 to 1935 and 1940 to 1944 (Walker et al. 1996). The intervening years were spent logging an area in neighboring Hendry County also on the south side of the Caloosahatchee River. This may be in part a locale depicted by Sudworth (1913:Map 35).

Company rail crews laid "spurs" into the pine flatwoods; the rails were laid on ties hewn from pine. A logging crew of about 100 men cut 100,000 board feet a day, about 800 to 1,000 trees a day in the Hickey's/Lehigh area (Garner in Walker et al. 1996:56:Appendix D). Estimates of 50,000 to 120,000 board feet a day are reported for Cape Coral (Board and Bartlett 1985:115; Zeiss 1983:100). Trees were felled by axe or reciprocating saw and logs were chained to high-wheeled carts, and then pulled, dragging one end, by teams of mules to the rail spur (Figure 3). Cattleman Mr. Mark Bateman (Walker et al. 1996:Appendix H), a local resident, recalls the scene from his youth:

> What I was impressed with — because as a young kid, watching the mules pull the logs out to the road...all the leather and chains [of the big-wheel log carts] and everything going together and hearing the mule skinner with the whips and what have you. ... they had the big chain wheels, you know, so high...sand wheels and they'd back over the logs. ... They had the steam engine. ... But they snaked everything to the edge with mules. ... That was something to see. I can hear it and see it just as plain as you and I talking right now.

The 1940s logging episode saw the addition of at least one Caterpillar tractor, operated by Mr. Garner, to the Hickey's/Lehigh operation (Garner in Walker et al. 1996:Appendix D); one artifact collected during the archaeological survey is a ca. 1940s Caterpillar clutch disc. Mules, however, continued to be the primary haulers of logs out of the woods. Mr. Garner also noted the addition of an electric saw toward the end of the operation, ca. 1943-1944. Logs were loaded onto flatcars using steam-powered draglines and a company-owned steam locomotive (fueled by pine slabs) then pulled the logs to Slater Mill. At one time, Dowling & Camp operated with ten locomotives. In 1944, seven remained. Engine #103 (Figure 4) was used to remove logs from the Hickey's/Lehigh area, taking them to Slater.

As soon as an area was "cutover," rail crews picked up the iron spurs and relaid them in new, uncut areas of forest (Garner in Walker et al. 1996:Appendix D; Zeiss 1983:102). The railroads and their rail spurs, even when taken up, left visible grades, especially in south Florida where beds often were raised to avoid the sea-

FIGURE 4.—Dowling & Camp's Engine 103 hauled pine logs from the Hickey's Creek operation to the mill at Slater. Photo courtesy of James Pickens.

sonally flooded lowlands. The grades are usually paralleled by excavation ditches as is the case at Hickey's Creek. Lost railroad spikes and spent ties are often found in the ditches. In addition, as the logs were dragged from the woods, they left linear "scars" in the ground, all leading to the closest rail spur. Studied from aerial views, the spurs and log scars can be traced, revealing dendritic or feather-like patterns (Pickens in Walker et al. 1996:Appendix B). A series of aerial photos taken in 1944 covering the two Lee County areas documents the spurs and log scars, which allowed Mr. James Pickens to reconstruct the logging system (Figure 1, inset). The feathery patterns show the two major components of the system. The eastern Hickey's/Lehigh component is the smaller of the two. The larger, western, Cape Coral component originated at Slater Mill where logs from both areas were milled until the mill and all logging closed down in 1944 (Board and Bartlett 1985:115; Godown and Rawchuck 1975:108; Walker et al. 1996:Appendix F; Zeiss 1983:99).

Cape Coral and Hickey's Creek Logging Camps.—Temporary camps for the logging and rail crews and their families were established in the woods. Typically, only one woods camp would exist at a time. Zeiss interviewed several individuals who remembered various camps in the Cape Coral area. Locations for at least four camps were described (Zeiss 1983:103, 105). One of these consisted of "shacks" and others used boxcars or railroad passenger cars for housing. Detailed memories of the Hickey's/Lehigh logging operation and its camps come from Mr. Garner

FIGURE 5.—Photograph taken in a west Florida longleaf forest shows a boxcar logging camp similar to those described for Hickey Creek circa 1932-1935 and 1940-1944 (mules were used at Hickey's Creek instead of oxen). Photo courtesy of Florida State Archives, Tallahassee, FL.

(in Walker et al. 1996:Appendix D). When about 10 years old, Mr. Garner frequented the ca. 1932-1935 camp and while in his teens he worked with the logging crew of the ca. 1940-1944 camp. Both camps consisted of railroad boxcars serving as year-round, portable homes for the logging and rail crews and their families. Both crews of both camps were African American. The crew supervisors were EuroAmerican and lived in the nearby town of Alva and elsewhere. Mr. Frank Gay at one point supervised the Hickey's Creek crew (Mrs. Serena Gay, personal communication, 1996). A photograph taken in a northwest Florida longleaf forest shows a boxcar logging camp (Figure 5) similar to the one described for Hickey's Creek except that mules were used instead of oxen. The camps had outhouses, and although temporary, the 1940s camp had substantial government [WPA]-built privies with cement foundations.

Both camps had commissaries for purchasing groceries, dry goods, and personal items. The 1930s commissary, like the workers' homes, was a boxcar. This was probably also the case with the Cape Coral camps since there was a large commissary not far away at Slater. The 1940s Hickey's Creek commissary, on the other hand, was a substantial one-story structure built of "heart pine" lumber. Workers were paid with company "scrip" and aluminum tokens, a common practice among logging companies, particularly during the Depression era. Children rode a bus to attend school in Fort Myers. A medical doctor visited once a week from Fort Myers and administered medicines contained in bottles such as those found during our survey (Walker et al. 1996). Mr. Garner describes camp life with images of children, baseball, sour-orange wine, whiskey made from cane-skimmings, and "good times." Vegetable gardens, commissary pork and beef, and local wildlife including gopher tortoises, raccoons, and fish, were central to the diet of the woods community.

Post-Logging Decades.—Like many of the Southeast's pine flatwoods, those of the Cape Coral and Hickey's/Lehigh areas were clear cut. In addition to removing the seed source, the logging activity greatly disturbed seedlings that were present, along with the seedbed itself. Combined with the destructive feeding behavior of feral pigs, the competition from fast-growing oaks, the reduction of fire, the introduction of citrus and other agricultural crops, and open-range cattle grazing, the mixed longleaf/slash pine forests had little opportunity to regenerate. The remaining old-growth pine stumps at Cape Coral were extracted from the land and transported to Mississippi and to Brunswick, Georgia for use in naval-stores products (Zeiss 1983:180). At some point, stumps at Hickey's Creek also may have been taken out (Roger Clark, personal communication, 1996; Riley et al. 1993:22); we observed telltale depressions in the ground during our survey. Taking advantage of the highly desired dense pine to the very end, landowners salvaged the lumber out of the old Hickey's Creek commissary building during the 1950s (Crawford in Walker et al. 1996:Appendix I) to use elsewhere.

For a while, the land that today is the county's HCMP and is largely in south Florida slash pine, scrub oaks, and saw palmetto, was used for cattle grazing by cattlemen, including Mr. Garner. Through the late 1940s, the 50s, 60s, 70s, and 80s, Garner and others conducted burns in order to provide new grass growth for their cattle, a longstanding woodland-grazing tradition (Garner in Walker et al. 1996:Ap-

pendix D). Despite these burns, however, the Hickey's Creek pine forest only partially recovered from the clear-cut logging. During these same decades, feral pigs were still in abundance and citrus groves were planted in some of the area (Little in Walker et al. 1996:Appendix A).

During the 1940s and 1950s, cattle also continued to be an important element of the Cape Coral and Lehigh Acres landscapes but this use of those logged lands came to an end during the latter part of the 1950s. Lee County's human population increased dramatically in the post-war years, a time of housing shortages. And many WWII servicemen who had been stationed in Fort Myers returned with their families to establish new homes. So, not surprisingly, most of the cleared land in the Lehigh Acres locale, first transformed into ranchland, soon (by 1954) ended up under the ownership of a development firm initially called Lee County Land and Title Company, and later, Lehigh Development Corporation (Dodrill 1993:6). The developers' marketing strategy to lure families to Lehigh Acres included a 1961 promotion in which a new home was offered as Grand Prize on the TV show "*The Price is Right*" (Figure 6) (Board and Bartlett 1985:186). Similarly, in 1958, a massive housing development was initiated in the western sector of Lee County's logging system (Dodrill 1993; Zeiss 1983). Today Cape Coral (Figure 1, inset) has become, landwise, the second largest city in area in the south next to Jacksonville, Florida (Gainesville Sun, Sept. 11, 2000).

FIGURE 6.—In 1961, TV game show *The Price is Right* offered as Grand Prize a new south Florida (Lehigh Acres) home located in the logged pinelands that were part of the Hickey's Creek/Lehigh pine logging system. Photo from Board and Bartlett (1985).

SCALAR PERSPECTIVES

Following the introduction of European domestic animals, the degradation of old-growth forests accelerated and largely followed the transgression of non-Spanish EuroAmerican settlement (Frost 1993; Wahlenberg 1946; Walker 1991). The process was slow at first, in the eighteenth century, and intensified with the arrival of railroads in the nineteenth and twentieth centuries that were pushing farther and farther into the southern states. Thus, while southeastern Virginia was the first subregion to lose the longleafs on a massive scale, mostly in the eighteenth century, south Florida was the last, losing its old-growth longleafs and south Florida slash pines in the 1920s through the 1950s.

The local historical ecology of Lee County's pine forests at Cape Coral and Hickey's Creek/Lehigh Acres may be largely typical of the process of landscape change that occurred with other south Florida pine forests. One important difference, however, stands out. The majority of Lee County's pre-EuroAmerican pine flatwoods may have been characterized by a mixture of south Florida slash and longleaf pines, with longleaf representing the southernmost limit of its range. It may be more appropriate to conceive of two south Florida subregions in terms of pine forests. One is the transitional south Florida where longleaf diminishes in dominance, mixes with south Florida slash until a point is reached when only slash occurs. The latter situation of "pure" south Florida slash flatwoods is the second south Florida subregion.

The reconstructed pre-EuroAmerican composition of south Florida's pinelands is in reality nothing more than a reconstruction of one ecological episode in the historical continuum. Representing today's southernmost extent of longleaf, this marginal subregion is the ideal area to test for the long-term climatic episodes—commonly known as the Roman Optimum, Vandal Minimum, Warm Medieval Period, and Little Ice Age—of the past two millennia. During the cooler/drier periods (VM, LIA), longleaf may have expanded farther into south Florida while during the warmer/wetter episodes (RO, WMP), longleaf may have retreated north. The nineteenth and early twentieth centuries correspond with the end of the LIA; thus our perception of a reconstructed pre-EuroAmerican forest might better be situated in the LIA, an episode of hypothesized longleaf expansion. And our concept of a twenty-first-century range of south Florida pine flatwoods and their composition might better be situated in our current warm and wet trend with a hypothesized retreating longleaf distribution. Unfortunately, tracking of fluctuating pine forest composition through time awaits the development of methods to identify the archaeological and paleoecological remains of longleaf versus slash pine.

At the local scale, the historical ecology of Lee County's pinelands is generally similar to that of the greater southeastern Coastal Plain region, but important differences exist. First, although it remains to be tested (if possible), I hypothesize that like many subregions of the Southeast, Lee County's American Indians fire-managed their local pine flatwoods. However, whereas in other areas of the Southeast, clearing for agriculture by American Indians may have been a factor, it wasn't in south Florida. Rather, here the purpose likely would have been for maintaining game populations, especially those of white-tailed deer.

The impact of cattle and especially pigs may have been longer, extending later in time in south Florida than in other southeast subregions. Still the frontier in the nineteenth and early twentieth centuries, south Florida continued its open-range tradition (historic American Indian and EuroAmerican) and cattle drives (EuroAmerican) through both the Cape Coral and Hickey's/Lehigh locales on the way to Punta Rassa for shipment to Cuba as late as the 1920s. Even so, it might be argued that cattle and pinelands may have been compatible rather than in conflict with the pinelands. Although today most of the cattle industry exists to the east in interior lands of south Florida, feral pigs are still a challenge for management and restoration of the HCMP pinelands.

One element in the broader-scale Southeast trajectory that may be largely missing from Lee County's forest history is naval-stores production. Despite the fact that the Hickey's Creek property at one time was owned by Consolidated Naval Stores Corporation (Walker et al. 1996:69-70), I found no record or memory of actual turpentining. Zeiss's (1983:98) explanation for the absence of turpentining in the Cape Coral area is that the pines were more valuable as lumber for building material because it "was loaded with pitch, which served to protect it against dry rot as well as from invasion by termites." Perhaps by the time broad scale industrial exploitation of forests reached south Florida, the importance of turpentining had faded and clear-cut logging was economically more desirable.

Another difference is that fire suppression may not have been as important a factor in the inability of the Cape Coral and especially Hickey's Creek forests to regenerate: during the post-logging years, the area's cattlemen regularly burned the logged lands. For Cape Coral and Hickey's Creek, the impact of clear-cut logging (destruction of the seed source) followed by the pressures of cattle and feral-hog grazing, trampling, and rooting, the introduction of citrus trees and other agriculture (in some areas), was too great for any remaining longleaf seedlings. Furthermore, Cape Coral and the southern portion of the Hickey's Creek logging system (Lehigh Acres) were quickly transformed by developers into residential communities. During this time (1950s), however, a close watch was kept and fires were suppressed in the Cape Coral area, as more and more new residents arrived.

Another difference, more temporally related, is that logging everywhere in south Florida was more rapid than in more northern subregions. This was due, at least in part, to advances in logging technology during the 1940s. The operation at Hickey's Creek combined the old ways—axe, mule and cart, railroad, locomotive—with some of the new ways—electric saw, tractor—although the old still dominated. By the 1950s, trucks were regularly replacing the need for railroads and locomotives in some areas of south Florida (e.g., Collier County). Again, we see two south Florida logging histories, one characterized by a transition in technology, the other by an essentially modern technology.

CONCLUSION

What became of the once extensive old-growth southeastern pine forests involved a long process of dynamic interplay between numerous environmental and cultural factors possibly beginning as early as A.D. 800 in some parts of the

region. Generally (i.e., at the long-term regional scale), the same process of landscape change happened across the entire Southeast distribution of longleaf pine. A historical ecology approach to southeastern pine deforestation, however, contributes to the recognition of heterogeneity within the process of this broad-scale landscape change. In particular, examination of the southernmost margin of longleaf clarifies the extent of its pre-EuroAmerican penetration into southwest Florida (at least for the LIA). The study of Lee County's pine flatwoods from a historical ecology approach has resulted in the hypothesis that longleaf pine was a component of Cape Coral's and Hickey's Creek's pine forests. Intergrading with south Florida slash pines, these longleafs would have been the southernmost of their range. Harris (1999) makes the point that south Florida's tropical forests have been under documented and thus under appreciated. The same can be said for south Florida's pine forests.

Southwest Florida experienced the longest history of pre-logging pine deforestation with perhaps one of the swiftest of logging culminations. It was a subregion of transition where longleaf and south Florida slash pines intergraded and where old and new logging technology came together, but also an area where the longstanding tradition of compatible fire-managed woodland grazing persisted into modern decades. To cap the processual continuum, large portions of Lee County's logged old-growth pinelands were transformed into two of the earliest post-war massive suburban housing developments, the beginning of a new era for south Florida—one of enormous human migration to the Florida's subtropics.

Estimates for upland landscape changes are presented by Frost (1993:19-20). An astonishing 85 percent of the Coastal Plain's pre-EuroAmerican uplands included longleaf pines (71 percent consisted of longleaf-dominated uplands). Slash pine, on the other hand, is estimated to have characterized only 3.3 percent of the pre-EuroAmerican uplands. Estimates for 1990 are a stunning 2.6 percent for "natural" longleaf (2.1 percent for longleaf-dominated uplands) and 0.4 percent for "natural" slash pine uplands, with successional mixed hardwood-pine forests (44 percent), croplands (20.8 percent), pine plantations (15.2 percent), developed lands (10.2 percent), and pasture (6.4 percent) having replaced the old-growth native pine forests.

According to a 1995 inventory, longleaf pine acreage continues to decline in the greater Southeast and in Florida (Outcalt and Sheffield 1996:2, 20). Most losses have occurred on privately owned lands. Because remaining stands on private lands are continuing to reach saw-timber size, losses will most probably continue at a high rate. Based on a study of North Carolina longleaf, Frost (1993:21) figures that few existing stands are being fire-maintained and as a result the majority of stands are heavily invaded by hardwood species. If this pattern is typical of the Southeast region, Frost estimates that less than 0.7 percent of the pre-EuroAmerican longleaf forests remains under "natural" conditions. Restoration efforts on county, state, federal, and even some industry and private lands are increasing (e.g., Boyette 1996). However, of the longleaf states, only Texas shows small increases on both public and industry lands (Outcalt and Sheffield 1996:20). No increases are shown for private lands.

Restoration efforts aimed at both longleaf and slash pine forests include new

management plans that emphasize periodic burning of the forest ground layers. Efforts by conservation groups large and small, such as The Nature Conservancy, Tall Timbers Research Station (north of Tallahassee, FL), Longleaf Alliance (Johnson 1996; Longleaf Alliance n.d.) of Auburn University's School of Forestry, and the Longleaf Partners Funds/Longneedle Press (Moore and Goodwin 1995, 1996) and Longleaf Ecology and Forestry Society (LEAFS), both of Gainesville, Florida, are educating the public and landowners of the values of restoring native longleaf ecosystems. For example, a recently published management guide for landowners (Franklin 1997) provides guidelines for burning practices and for compatible timber and cattle production, once again following the centuries-old tradition of pineland grazing. The developing trend in landowner education is the promotion of compatibility between longleaf reforestation and economic viability (e.g., Franklin 1997; Landers et al. 1995). Modern studies show that with appropriate management, overall longleaf growth rates are comparable to the other pines on most lands (Franklin 1997:5).

Southwest Florida's Lee County together with the Florida Game and Fresh Water Fish Commission have initiated reforestation in the new HCMP, planting a mix of south Florida slash and longleaf pines. A restored, fire-managed pine forest would be good habitat for a gopher-tortoise preserve, fulfilling one conservation goal of the HCMP. In addition, an archaeological National Register nomination (for the multiple historic logging sites) and a public education program including on-site ecological and historical interpretation and trails are being considered for the near future.

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