Live Oak:

Pillars of a Nation

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Live oak (Quercus virginiana) can be a massive tree of the Southern coastal plain. Live oak is also a mature small tree growing on sand ridges near the ocean. Live oak as a species is represented by a diverse set of individual traits and a number of varieties and hybrids. Live oaks were the focus of the nation's first publically owned timber reserves for building naval vessels. The largest trees were valuable to sailing ship builders because of their branch shapes and wood strength. Live oaks were also the first tree to suffer forest-wide timber thief and old growth decimation in North America.

Live oak has served humans and animals as food, fuel, lumber, chemicals, and shade. Live oak is symbolic of history, survival, struggle, and romance. Today live oak represents both an ecological and a cultural heritage. The mystic feelings and grandeur of the Spanish moss-draped, monestrous live oak is a emblem of both the old and new South. Live oak was selected to represent the State of Georgia as its state tree. This publication looks at the scientific basis for the tree called "live oak."

Names

Oaks are in the beech (Fagaceae) family. The oaks (Quercus spp.) are the largest genera of trees in the United States. The nation's oak species are composed of approximately 58 trees and 12 shrubs. There are more than 70 recognized hybrids formed from the crossing of the various species. One unique species of oak is live oak. The scientific name for live oak is Quercus virginiana, officially named in 1768. The Latin and Celtic derived meaning of the scientific name is a "fine tree of Virginia." There still remains some confusion regarding live oak taxonomy dealing with varieties, hybrids, and regional differences.

Other scientific names which have been used in the past for live oak at one time or another are Quercus andromeda, Q. eximea, Q. fusiformis, Q. geminata, Q. maritima, Q. oleoides var. quaterna, Q. sempervirens, and Q. virens. Live oak has many common names most derived from its evergreen habit, its geographical location, or its preference for growing sites. Some of the common names for Quercus virginiana are: live oak, Virginia live oak, Virginia oak, Southern live oak, bay live oak, Spanish live oak, encino, sand live oak, and scrub live oak.

Range

Live oak is found growing and reproducing on the lower coastal plain of the Southeastern and South-central United States beginning from the extreme eastern coast of Virginia growing south in a narrow band along the ocean to the middle of the South Carolina coastline where its range begins to expand farther inland. The range of live oak continues to expand inland as it moves south, growing across the southern 1/4 of Georgia and covering all of Florida south to the first few Florida keys. Live oak covers the Florida panhandle and Mobile, Alabama's immediate basin, on across the Southern-most two county tiers of Mississippi and across the Southern third of Louisiana, except for the barrier islands and parts of the farthest south parishes. Live oak's range continues into Texas and narrows to hug the coast until just past Port Lavaca, TX. Figure 1.

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Sites Called Home

Live oak is found in single or mixed species forests, dotting savannahs and as occasional clumps in grasslands along the lower coastal plain. Live oak grows on soils with heavier textures, or sands with layers of organic materials or fine particles. Live oak can be found dominating some maritime forests, especially where fire is limited. Live oak is also found on higher relief sites and hammocks in marshes and swamps. Live oak is rarely found above 300 feet in altitude.

Live oaks grow across a wide range of sites with many moisture regimes – ranging from dry to moist. Live oak will survive well on dry sites and in wet areas, effectively handling short duration flooding if water is moving and drainage is good. Good soil drainage is the key resource component for live oak growth. Required precipitation is 40-65 inches of water per year, preferably in Spring and Summer. Soil pH should be between 5.5 and 6.5.

Northern Limits

The Northern boundary for the native range of live oak is controlled both by cold temperatures, and by summer dryness and evaporative index. Live oak does well in cold hardiness zones 8b through 11. Live oak's Northern growth limit for temperature is roughly the 42°F minimum sustained winter air temperature zone. Sites which provide non-freezing temperatures maximize the chances for live oak survival. The other constraint on live oak growth range is heat and soil moisture. Live oak handles heat well when combined with plenty of precipitation in the growing season. Live oak can tolerate limited summer droughts. The architecture of live oak is designed for hot weather with plenty of precipitation. The farther North and West live oak ranges, the greater the evaporative forces drying growing season soils and the greater the heat loading on leaves, both of which limit survival.

Live oak is a facultative upland species usually found in non-wetland soils and upland sites, even if surrounded by wetland areas. Live oak requires 1-3 feet of aerated soil above the water saturation level in a soil. For best growth, a well-drained sandy loam or heavier soil, which has good moisture but is not wet, is ideal. Live oaks need large amounts of soil space to occupy and colonize.

Growth Tolerance

Live oak is intermediate among trees in tolerance of competition and resources scarcity, such as shade. Live oak is relatively fast growing and long lived. Shoots continue to elongate throughout the growing season. Young live oaks are susceptible to fire damage. Short intervals between fires can eliminate live oak regeneration on a site. Because of sprouts from stumps and tops of large roots, and its intermediate tolerance of resource scarcity, live oak can successionally hold onto a site for decades, and as a consequence, live oaks tend to grow in clumps or family groups. Live oak is tolerant of salt spray on foliage compared with other plants. Moderately high concentrations of salt in soils is tolerated if drainage remains good and the soil is not saturated. Live oak is intermediate in tolerance of construction damage and soil compaction. Live oak is cited as tolerant to sulfur dioxide air pollution, and phenoxy and dicamba pesticides. Due to poor fall root growth, fall transplanting is not recommended – use spring transplanting exclusively.

Size & Age

Live oak is a medium height tree which develops a massive stem over time. Primary branches can grow to be large in diameter and long. A number of permanent branches are generated low on the trunk, growing large and many times remaining almost horizontal. Branch spread in large mature trees can easily be greater than tree height. Branches can recline on the soil surface and some form roots where they touch the soil. The maximum size of live oak is approximately 80 feet tall, 12 feet in diameter, and 170 feet crown diameter or branch spread. An expected normal mature size is around 40-65 feet tall, 4-6 feet in diameter, and 80-110 feet crown diameter. At a distance, natural crown shape appears as a short, shallow, and widespread dome of dense foliage. In poorly drained or very thin soil, the trunk basal flair may be buttressed. The root plate area (zone of rapid taper) at the trunk base is relatively large in diameter, compared with other trees, containing a few large diameter roots growing horizontal just below the soil surface.

On a good site, a live oak should reach mature proportional size in under 75 years. The largest trees which remain in most of the native range, especially along the Atlantic coast, are seldom over 200 years old with a maximum expected lifespan of 400 years. Many old large trees have myths developed around them regarding their age and historic value. Many large live oaks are not as old as people believe. In addition, some large diameter live oaks may actually be a number of sprouts from an old stump which have grown together. Due to the hardness of the wood and the decay columns in old live oaks, it is many times difficult to accurately determine actual tree age.

Storm Survival

Live oaks grow in hurricane areas. Live oak is cited as being resistant to hurricane wind forces and surviving with only minor to moderate damage. In one major hurricane event, 30% of live oaks were undamaged, 50% had bent and broken limbs, 16% were heavily defoliated, 5% had broken tops, 2% had broken stems, and 3% were uprooted or knocked down. In another storm event live oaks were found to uproot rather than break. Arborists were able to successfully lift some of these uprooted trees back into place (in cases where prompt actions and carefully designed cable support systems could be applied -- associated with relatively small root damage.) A good pruning program helped live oaks be more resistant to winds. In summary, live oaks tend to loose leaves and small branches, escaping major damage in most storms. (In other words – short and fat survives over tall and thin.)

Number One Pest

Live oak has a limited number of pests which cause serious damage. Foremost among live oak pests is oak wilt caused by a fungi Ceratocystis fagacearum. Oak wilt is especially damaging in the Western portion of live oak's native range. Oak wilt is a vascular parasite which colonizes the water conducting vessels in the outer ten annual increments of sapwood. Almost all new tree infections in live oaks are cause by the fungus growing in one tree growing into other trees through root connections. Live oaks tend to grow from sprouts from a shared root system (clonal) or develop root graphs with other live oaks in the area. The fungus can travel through these root graphs and spread up to 100 feet per year.

Oak wilt infected live oak symptoms include stunted leaves on trunk sprouts, leaves wilting in late spring, veinal death in leaves, and massive twig dieback progressively spreading throughout the crown. The most susceptible trees usually die in 4 - 6 months. Wood dead less than one year can still harbor living fungi capable of infecting new trees. Fire wood should not be moved from infection sites. Chemical root barriers can be installed in trenches to control fungal spread through root graphs.

Other Pests

Live oak has a number of additional serious pests which can cause problems. These major pests which can have a significant impact on live oak are: Cryphonectria parasitica -- Chestnut blight; oak decline syndrome; Hypoxylon atropunctatum – Hypoxylon canker; Phytophthora cactorum – bleeding canker; and, Curculio spp. – acorn weevils destroying a high percentage of the acorn crop.

Live oak has many pests which at times takes advantage of a weakened or damaged tree. These pests include: anthracnose; Armillaria mellea -- shoe string root rot; Botryosphaeria rhodina -- bot canker; Callirhytis operator – wooly flower gall; Clitocybe tabescens – mushroom root rot; Coryneum japonicum – Coryneum twig canker; Enaphalodes rufulus -- red oak borer; Endothia gyrosa – Endothia canker; Phoradendron serotinum -- mistletoe; Prionoxystus robiniae – carpenterworm; and, Xyletta fastidiosa -- bacterial leaf scorch.

Generally, live oak has relatively few pests which merit attention. Abiotic problems, especially cold, construction damage, poor soil drainage, and summer droughts make live oak susceptible to a number of pests.

Epiphytes

The live oak bark surfaces provide a rich ecology to support many living things. There are three large and common Epiphytes associated with live oaks. These are Spanish moss (Tillandsia usneoides), ball moss (Tillandsia recurvata), and resurrection fern (Pleopeltis polypodiodes). They are not parasitic, but

instead live only upon what rain and the surface bark of the tree can provide. They occupy crown volume and bark area, and so can become so dense as to shade tree foliage and increase wind loading. After major storm events, Epiphytes tend to increase in numbers for several years and then return to pre-storm numbers as live oak foliage density and crown structure recovers.

The two Tillandsia species absorb water through their surfaces, but require regular rainfall and relatively high humidity to grow well. Both of these Epiphytes depend upon specific lichen communities on the bark surface for fixed nitrogen and other materials. The Tillandsia species maximize their growth around ½ full sunlight, opening stomates and absorbing carbon dioxide only at night, or for short periods immediately after rain in the daytime. There are a number of other Epiphytes which occupy live oak bark surfaces, ranging from common algae to endangered orchid species.

Good Things For Good Trees

The key components to good management of live oak throughout its life is water, space, training, great soil, and wound prevention. Proper planting when root growth can be quickly started is essential. Spring, not Fall planting is critical. Field grown, root pruned, hardened young trees make great candidates for planting success. Plenty of water paired with plenty of soil drainage, in a large planting area is ideal. Do not amend the planting hole soil. Do not fertilize in the first growing season. Use a thin layer of a lightweight, non-compressible organic mulch over the planting site except for the six inches cleared from around the stem base.

Training is difficult in live oak because it requires some intensive pruning early to prevent young live oaks from becoming a bush. Keep as many green branches on the tree as possible. Subordinate (nodal-centered branch reduction) any branch approaching 1/3 the diameter of the main stem. Try to conserve a single dominant stem pathway from the stem base to the highest point in the crown. In oak wilt areas only, use a commercial pruning paint on wounds, and do not prune in Spring and early Summer. As the tree matures to fit its soil and air space, directional pruning can be used to maintain shape and site objectives.

Soils & Space

Environmental factors such as freezing temperatures, hot summer droughts, and fires can severely damage or kill live oak. Young live oaks are especially susceptible to fire damage. Live oaks do best in groups or clumps where each tree shades the base and soil of the other trees. In the wild, many oak stands can be related genetically through centuries of sprout development. Soil health under live oak includes good soil organic matter (delivered as compost in a thin layer over the soil surface several times a year), good soil drainage and minimizing compaction (fence or place other plant materials to prevent vehicular parking and pedestrians), adequate water (supplemented in summer drought periods), and carefully planned light fertilization and liming (based upon the tree's life stage, and soil and tissue testing).

Old growth trees need plenty of space to mine for resources with plenty of water throughout the summer. Soil drainage is one of the most important features of sustaining good live oak growth. Soil compaction, pavements, building activities and grade changes can all negatively impact soil drainage and initiate many, quickly compounding problems in old trees. Aging live oaks will tend to develop spreading low branches. Be sure you have allowed enough space for this natural process or keep the tree well trained throughout its life. Always prune branches before they reach 1/3 the diameter of the stem (where branch is attached) to minimize decay and discoloration, and maximize effective growth over the pruning wound. There is an upright cultivar for use in relatively narrow spaces.

Traditional Competition

Beware of over-planting the wide understory beneath old trees. Traditional landscapes did not stack too many root systems on top of each other beneath live oaks. Go easy with plant materials and be patient with old trees. Live oaks should not be covered with vines. If vines are used at all, they should be maintained at six feet up the tree's trunk. Do not allow vines to climb up the trunk, especially to the first branch union. Do not allow a dense ground cover to live under the tree if the ground cover receives full

sun during large portions of the day. Well tended mulch and compost layers beneath live oak accentuates the beauty and size of the tree, as well as providing an ecologically healthy soil.

Old live oak trees should not be propped, have hardware installed such as lights, or be painted – as tree injuries can occur. The old tradition of white-wash liming of trunks may disrupt some of the soil overwintering pests, but should be avoided as a damaging treatment. Good arboricultural practices required to make trees biologically efficient and structurally sound should be applied by skilled arborists. Cable and bracing, and lightning protection hardware installation are the most common and valuable. Seeking pest and stress management expertise is a great investment for these most important of trees.

Historic Tragedy

Live oaks have dense, hard, and strong wood which is resistant to weather, water, and mechanical strain. The massive, low, curved branches and sweeping stems were useless for the straight-grained, dried lumber made from other trees. But the natural growth pattern of live oak made the perfect structural components for wooden sailing ships. Live oak forests first seen by Europeans were storm whipped but extensive with many massive specimens. Commerce and war of the 1700's generated demand for this premium wood of ship hull ribs, knees, and binding parts. The old growth live oak forests were decimated by European nations, colonists, and early acts of our new nation.

"Live-oaking" was a way of life for ship builders. Live oaks accessible to water transport were targets. Large trees were first cut to see if they were sound, and then divided into the largest and most effective parts for use in ship design. Many trees damaged by centuries of storms, were cut only to reveal they were internally decayed, not meeting the stringent specifications of New England or English shipwrights. Local people and hired gangs of carpenters from all over were dispatched to hunt and convert live oaks into wooden ship components. The new United States federal government attached preserves, laws and bounties to the trees. Tree poaching, timber theft on public and private lands, federal agent corruption, and timber pirates were so common (and the results so lucrative), only the demise of easily accessible live oaks and iron boats halted the slaying. Major parts of the Atlantic coast old-growth live oak forests were gone by 1870. The Gulf coast live oaks were conserved more effectively.

Remember & Celebrate

We today cannot image the tree sizes and distribution of the extensive live oak forests of the 1700's. What is lost cannot be recreated except through our appreciation of history and a celebration of some of the remaining tree giants (i.e. survivors). Live oaks are today the pillars of the Southern coastal cities and towns, and the large wooden sailing ships are but a romantic memory.

(For further information on live oaks please see the other publications in this series which cover – identification and biological characteristics, major pests, genetic variability and varieties, and a bibliography of important live oak information.)

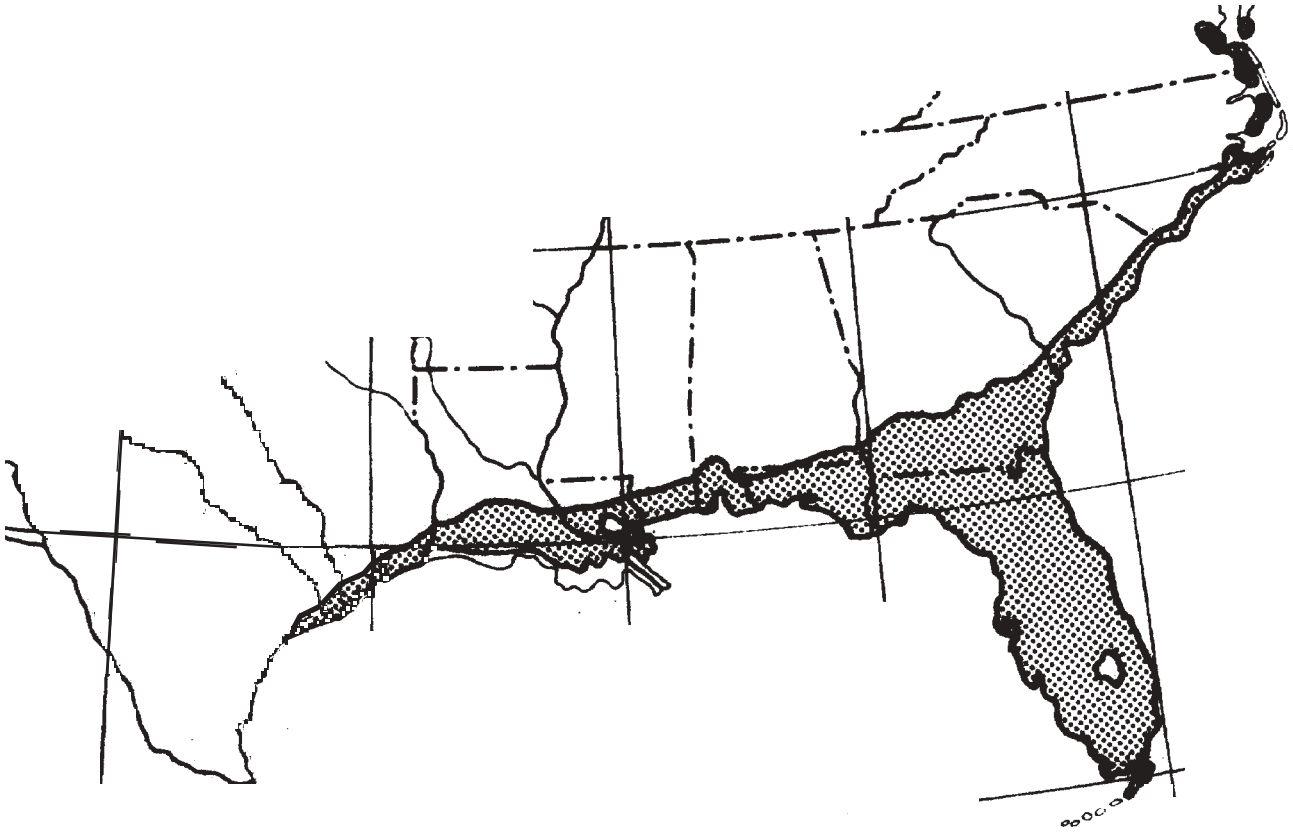

Figure 1: Live oak (Quercus virginiana var. virginiana) native range.

Modified from 1) Little, Elbert L., Jr. 1971. Atlas of United States Trees: Volume #1 -- Conifers and Important Hardwoods. USDA-Forest Service, Miscellaneous Publication #1146. Washington D.C.; and from, 2) Muller, C.H. 1961. The origin of Quercus fusiformis. Journal of the Linnean Botanical Society 58:1-12.