



Fig. 7. A rubber-tired skidder pulling logs from a cypress swamp.

(Priegel, 1981), but they cost more than twice as much as their rubber-tired counterparts and are more expensive to repair (Koger and Patrick, 1981). Both rubber-tired and tracked vehicles can ruin productive wetland soils by compaction (Priegel, 1981). Increased soil bulk density impedes root penetration, reduces aeration, and restricts the movement of air and water in the soil (e.g., Hanna, 1981), although it is not clear how much Florida's sandy soils may be affected. Advance regeneration is crushed by machines, and cypress seeds may not germinate as well in compacted soils where drainage has been impeded. Machines skin the bark off stumps, decreasing the likelihood of sprouting, and damage remaining trees, making them vulnerable to invasion by insects and fungi.

In spite of the damage they cause, cable-yarding systems - like those used until the 1940s - have been recommended as best for year-round logging in very wet sites (Priegel, 1981). Skyline systems, which carry more of the tree's length off the ground, cause less damage to remaining trees and to soil (Czerepinski, 1985).

Airborne systems, such as hot-air, propane-fueled balloons capable of hoisting 4,500 kilograms (5 tons), have been suggested for transporting logs where road-building is infeasible (McDermid, 1969). Helicopter logging might be economically justifiable where there are large volumes of high-quality timber and road building costs are prohibitive (Priegel, 1981).

Cypress Regrowth Following Logging

Even before the turn of the century, some foresters predicted that cypress would not regenerate after it was harvested:

The supply of cypress is considerable and the output is capable of material increase, but once gone, the present forests will be unable to replace the supplies, and it is doubtful whether cypress can be thought of as a timber of the future (Roth 1898).

After the era of intensive logging, cypress did not regenerate in cutover swamps where there were not enough seed trees and where water levels were higher than they were when the forests were established (Betts, 1938). Cypress reproduction was more abundant where cutting had been "conservative" versus a "clean sweep" (Mattoon, 1915). Very little regeneration of baldcypress was found in cutover areas in southwest Florida where only a few remnant cypress trees were left, and no regeneration was found in areas previously dominated by baldcypress that had been both logged and burned and where no cypress trees had been left standing (Gunderson, 1984).

Regeneration of cypress-tupelo swamps may not be successful unless all competing plants except annual herbs are eliminated (Putnam, 1951). Eight years after harvest of an uneven-aged stand of baldcypress, water tupelo, and swamp tupelo in a North Carolina river swamp, the site was dominated by black willow (*Salix nigra*). Clumps of young cypress and tupelo saplings were found where seed sources or advance regeneration had not been obliterated by skidders (Allen, 1962).

Selective cutting of cypress from mixed swamps may allow the remaining species to assume dominance. The practice of harvesting cypress and leaving water tupelo (which was considered worthless) has resulted in dominance of some swamps by water tupelo because it became the dominant seed source (Betts, 1945b), and because tupelo seedlings are abundant in undisturbed swamps (DeBell and Auld, 1971). After cypress was removed from the mixed swamp forests of the Big Cypress National Preserve, remaining subcanopy hardwoods assumed dominance (Duever et al., 1986). However, Wade et al. (1980) found that cypress was returning in many such swamps.

Rates of pondcypress reestablishment were high in a study of north and central Florida pondcypress domes that had been selectively cut (Terwilliger and Ewel, 1986). According to Stubbs (1973), clearcut baldcypress-swamp tupelo forests regenerate well if water levels stay low and competing vegetation is reduced as a side effect of harvesting.

Silvicultural Systems

Silvicultural systems that have been used in cypress swamps range in intensity from clearcutting to thinning. Because natural stands of cypress tend to be even-aged (Putnam, 1951; Stubbs, 1973), the most frequently prescribed silvicultural systems are clearcutting and