

Recovery of Florida Cypress Swamps from Clearcutting

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ABSTRACT. Vegetation analysis in ten central Florida cypress (*Taxodium distichum*) swamps was undertaken to determine the response of woody species composition to clearcutting. Line transects through swamps that had been harvested by clearcutting within the last 5 years demonstrated that all but one of these swamps are likely to recover their original species composition and a normal stem density. Cypress was the major tree species in all swamps examined except one that had been severely burned by a wildfire. Both natural seedlings and vegetative propagation are important avenues of cypress reproduction following clearcutting.

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Swamps comprise more than 25% of Florida's commercial forestlands (Dippon 1983) and occupy an important place in Florida's forest industry. Large, old-growth baldcypress trees in virtually all the swamps in the state were logged during the first half of the twentieth century. The heartwood in these trees, which required centuries to be laid down, was marketed as tidewater red cypress, and it was valued for its durability, workability, and at-

tractive appearance. Pondcypress (*Taxodium distichum* var. *nutans*) was not so valuable, but it was also extensively harvested, primarily for specialty products such as cross ties, pilings, and ladders, as well as lumber. In many of these swamps, biomass has reached merchantable levels once again. Harvesting practices have changed considerably. Both small and large trees are now likely to be cut, and modern equipment can penetrate deeper into swamps. Although second-growth cypress trees today contain little heartwood and require treatment with preservatives for outside use, the wood is attractive, workable, and used for many purposes, such as decorative fencing and lumber. Cypress mulch has become a popular specialty product and can be made from trees previously considered too small to be merchantable.

It has also become clear that swamps can be important for uses other than timber production. Maintaining water quality, conserving water for possible groundwater recharge, and providing wildlife habitat are values that are becoming increasingly important in this rapidly growing state. The consequences of current harvesting practices are therefore undergoing close scrutiny.

In the early days of logging, swamps were often high-graded, leaving a seed source to initiate regeneration. Many of these swamps recovered. Small pondcypress swamps in north and central Florida achieved their apparent

original species composition and basal area by approximately 50 years (Terwilliger and Ewel 1986). Many swamps did not, however. Drainage of swamps to improve access often favored hardwood regeneration at the expense of cypress (Marois and Ewel 1983). Logging followed by fire led to dominance by mixed hardwoods or willow, especially in south Florida (e.g., Gunderson 1984). Unfortunately, it is not always possible to determine cause and effect. For instance, a large cypress swamp near Wildwood, FL became dominated by ash (*Fraxinus* sp.) after harvesting (Wharton et al. 1977), but the cause of this change is not known.

Changes in harvesting equipment and marketing have made the clearcutting method of regeneration a much more common management alternative. Although conventional wisdom suggests that cypress swamps should recover from clearcutting (e.g., Riekerk 1983), there is little documentation of this in the literature (for one exception, see McGarity 1979). Because of increased perception of the many other values of swamps, it is particularly important to examine the response of clearcut cypress swamps to determine if the practice is likely to alter the nature of this important component of Florida's landscape.

METHODS

Study Sites

Ten swamps in central Florida were selected that had been harvested within the last five years (Table 1). Selection was based on ability to obtain access as well as information about time and method of harvest. Nine of the swamps had been harvested by the patch clearcutting method. The tenth was a long, narrow cypress swamp in which vegetated strips had been intentionally left (strip method); data from two of the cut strips were compiled to represent Swamp 10. No attempt was made to determine the original mix of

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Table 1. Location of study swamps, methods used in harvesting, and related ecological factors.

No.	Location	Date of harvest	Methods used	Comments
1	Sumter County, 15 mi south of Mascotte	1983	Felled with shears, chain saws; cable skidded.	Burned in May 1985.
2	Sumter County, same as Swamp 1	1983	Felled with shears, chain saws; cable skidded.	Severely burned in 1985.
3-5	Lake County, 12 mi south of Clermont	March 1983	Clearcut with feller buncher; logged with rubber tire skidders.	Burned 1981. Drainage system approx 20 yr old; perimeter ditch constructed in 1986.
6,7	Pasco County, 4.5 mi west of San Antonio	March 1984	No record.	Possibly receiving drainage from right-of-way.
8,9	Polk County, 12.5 mi north of Polk City	1983	Harvested with feller buncher mounted on track vehicle; logged with rubber tire skidders.	
10	Same as Swamps 8, 9	1983	Same as 8, 9	Two strips from partially clearcut swamp.

species on each stand or whether the trees in any of the swamps had been pondcypress or baldcypress.

Swamps 1 and 2 are swaths cut through large swamps by a power line right-of-way. Each is bounded on two sides by mature cypress and on the other two sides by upland vegetation characteristic of disturbed areas. Both swamps had been burned following harvest, and easily visible fire scars indicated that Swamp 2 had received a much more intensive burn.

Swamps 3, 4, and 5 are on private property. Swamps 3 and 4 were originally part of the same large swamp. Transects in Swamp 3 sampled roughly one-half of the cutting unit. Swamp 4 is a much smaller area that has been isolated from Swamp 3 for several years by drainage ditches and an access road. Swamp 5 is located several miles from 3 and 4. Only about one-half of this large swamp was sampled. Lateral drainage ditches surround all three swamps and may have lowered the water levels. Although a wildfire had burned through all three swamps before they were harvested, they had not been burned recently.

Swamps 6 and 7 are in a chain of swamps on private property along State Road 52. They were apparently part of a long cypress strand before the road was put in along the edge; both swamps were truncated by the right-of-way along their southern boundary. They are less than 2 km (1.5 mi) apart and had the deepest water of all our study sites. These swamps may receive more water

than the others because of runoff from the road and right-of-way. There was no evidence of recent fire in these swamps.

Swamps 8, 9, and 10 are also on private property. In Swamp 8 approximately one-half of the total area was sampled. Swamp 9 is a small cypress pond. Swamp 10 is a long cypress strand through which strips were cut perpendicular to the direction of water flow. Elevation of the uncut strips was noticeably higher (approximately 1 m, or 3 ft) than the harvested "troughs," where the transects were laid. There was no evidence of burning or change in drainage patterns in any of these swamps.

Vegetation Sampling

In August 1987, line transects [30-m (98-ft) long] were used to determine the importance values of each woody species regenerating in the swamps. The first transect in each swamp was established by arbitrarily selecting a point on the uplands near one corner and choosing a compass bearing that would run the transect out into the swamp. One random number between 3 m (10 ft) and 30 m (98 ft) was chosen to move along the upland boundary to the starting point, and another to advance 2 to 20 m (7 to 66 ft) into the swamp to the beginning of the transect itself. If the first transect did not reach to the far boundary, a subsequent transect was started at a random point 2 to 20 m (7 to 66 ft) from the end of the last; this process was continued until the swamp had been

traversed. Return transects were randomly established in a similar fashion. Each small swamp was sampled in this manner from one end to the other; approximately one-half of the harvested area in each large swamp was traversed by transects. In each of the two strips sampled in Swamp 10, one transect was established along the vegetated area and one was established in the middle of the cut area.

Each 30-m transect was divided into six 5-m (16-ft) intervals. Along each interval, the length (dm) of the transect that was either touched by a woody plant or that lay directly above or beneath it was recorded. Importance value for each species was calculated by summing its relative density (percentage of individuals represented by that species on the transect), relative dominance (percentage of interval length that each species intercepted), and relative frequency (percentage of vegetated intervals that each species occupied relative to all other species) (Curtis and McIntosh 1951). The sum of importance values for each swamp is 300.

Cypress seedlings, sprouts, and any mature trees that were left from the previous stand were identified. Water depth every 5 m (16 ft) along each interval was recorded to compare relative degree of flooding among the swamps. The presence of equipment ruts in an interval was noted, but it was not possible to record microtopographic conditions for all vegetated sites.

Table 2. Importance values of all woody species found in harvested cypress swamps.

Species	Swamp									
	1	2	3	4	5	6	7	8	9	10
<i>Taxodium distichum</i>	194		133	188	76	256	246	146	108	160
<i>Myrica cerifera</i>	23		11		44	33	34	10		8
<i>Lyonia lucida</i>			6	112	2		10	26	44	
<i>Nyssa sylvatica</i>	13	300			7	11				25
<i>Ilex cassine</i>			3		5		4	56		5
<i>Hypericum fasciculatum</i>	54				127				111	39
<i>Cephalanthus occidentalis</i>			102		22				20	26
<i>Itea virginica</i>			44		17			3		11
<i>Pinus elliotii</i> var. <i>elliotii</i>								14		21
<i>Persea borbonia</i> var. <i>palustris</i>								30	5	
<i>Ilex glabra</i>	10								12	
<i>Aronia arbutifolia</i>			2				7			
<i>Magnolia virginiana</i>								10		
<i>Acer rubrum</i>							7			
<i>Salix caroliniana</i>	7									
<i>Rubus cuneifolius</i>								5		
<i>Vaccinium fuscatum</i>										3
Total number of species	6	1	7	2	8	3	6	9	6	9

RESULTS

Seventeen species of woody plants were found among the 10 swamps (Table 2). Only one species (*Nyssa sylvatica*) was recorded at Swamp 2, the severely burned site along the power-line right-of-way. Two species were recorded in Swamp 4, a small swamp, and only three species were recorded in Swamp 6, one of the deep roadside swamps.

Cypress seedlings, sprouts, or residual trees were present in nine of the ten swamps, absent only from the severely burned site. Cypress had the highest importance value in all swamps in which it oc-

curred except for Swamps 5 and 9, where *Hypericum fasciculatum* had higher values. Among the other 14 species, only *Cephalanthus occidentalis* and *Lyonia lucida* had importance values greater than 100 in any of the swamps.

On the average, 45% of the intervals sampled in each swamp had at least one species of woody plant (Table 3). Lowest density of woody vegetation was recorded at Swamp 2, which had been severely burned; highest density was recorded at Swamp 9, the small, hydrologically isolated site where only one interval was unvegetated.

Cypress seedlings were recorded at all swamps except the

two with low density of woody vegetation (Table 3), although, in fact, scattered seedlings were seen near but not on the transects in Swamp 4. They were most common in Swamp 8, where they were widely distributed throughout the swamp, and many were observed growing in the ruts that were left by heavy equipment.

The study swamps ranged from very dry to very wet, but neither the presence nor the pattern of woody vegetation regenerating on these sites showed any relationship to water depth. More than one-half the swamps averaged less than 10 cm (4 in.) of standing water, although water depth varied considerably within sites.

DISCUSSION

Cypress swamps harvested by clearcutting are regenerating within 4 years. In only one of ten swamps examined were no cypress seedlings found, either on or off the transects. Among the swamps, cypress seedlings were found on 18% of the intervals. Two methods of regeneration are possible with cypress: seed and sprout. Buried cypress seeds may germinate and grow if conditions are favorable. However, seed production by cypress is erratic (Mattoon 1915, Ewel 1985), and viability is not well understood. Seeds may also be produced by coppice shoots that sprout from stumps shortly after harvesting. Sprouts can produce cones within 2 years (Ewel, unpubl. data); cypress trees can therefore reestablish dominance quickly even in the absence of a seed bank.

One to 42 seedlings were found

Table 3. Characteristics of vegetation, hydrology, and sampling intensity in study swamps.

Parameter	Swamp									
	1	2	3	4	5	6	7	8	9	10
Total number of cypress seedlings recorded.	1	0	11	0	23	1	5	42	6	13
Percent of intervals with cypress seedlings.	4	0	18	0	38	5	20	70	17	10
Percent of intervals with woody plants.	23	3	40	13	63	50	63	67	96	32
Mean water depth (cm ± SD).	5 ± 5	24 ± 11	9 ± 7	4 ± 4	16 ± 7	36 ± 16	58 ± 16	4 ± 6	0 ± 0	5 ± 7
Maximum depth (cm).	23	42	35	12	40	63	80	29	0	40
Total number of 30-m (98-ft) transects.	14	6	36	4	24	5	15	14	4	18
Area sampled [ha (ac)]	0.9 (2.3)	0.8 (1.9)	3.5 (8.7)	0.3 (0.6)	6.3 (15.6)	2.0 (4.9)	1.0 (2.5)	1.0 (2.5)	0.5 (1.2)	2.1 (5.2)

in eight of the ten swamps. Assuming that the transects are representative samples of 1-m wide belts, then minimum densities ranged from 24 to 1000 seedlings/ha (averaging approximately 300). In all but one swamp, this was greater than the density found by Terwilliger (1983, summarized in Terwilliger and Ewel, 1986) in swamps that had been clearcut 3 years previously. She located an average of 2 seedlings per swamp (44 seedlings/ha) among three swamps that ranged from 1.5 to 2.5 ha. Using the same assumption, minimum cypress tree densities (including sprouts and the few trees that were left in some of the swamps) ranged from 570 trees/ha in Swamps 1 and 3 up to 2800 trees/ha in Swamp 9. Brown (1981) recorded cypress tree densities ranging from 237 to 2567 trees/ha among six mature, small swamps in north Florida. These comparisons suggest that the swamps in the present study already have sufficient numbers of stems to retain dominance.

The other woody plants that are revegetating these swamps are typical of Florida cypress swamps (Godfrey and Wooten 1981, Ewel in press). Clearcutting therefore does not appear to have long-term, detrimental effects on the species composition of these swamps.

Pondcypress swamps can tolerate occasional burning (Ewel and Mitsch 1978), and fire may have value as a management tool to reduce competition from pines and hardwoods. Accordingly, Swamp 1, which was burned but not severely, had the third highest cypress importance value among the ten swamps. Excessive burning, however, may be catastrophic. An earlier study in the Big Cypress Swamp in south Florida demonstrated that logging followed by intensive burning can eliminate cypress from a swamp (Gunderson 1984). This appeared to be the case in Swamp 2, which was severely burned after logging and contained only *Nyssa sylvatica*. There is no record of fire after logging at any of the other sites.

The potential for coppice sprouts to provide an important seed source makes clearcutting an attractive alternative for cypress swamps. However, not all stumps produce sprouts and not all sprouts survive for more than one growing season. A preliminary study of partially cut swamps in central Florida demonstrates considerable variation from swamp to swamp in sprouting the first year after cutting, with differential mortality compounding this variation during the subsequent year (Ewel 1985). More attention now should be paid to a better understanding of the factors that control coppice production.

Cypress swamps provide other services to society in addition to wood production, and the importance of these must be kept in mind when designing a regional management plan. Cypress swamps help to maintain high regional water tables (Brown 1984); they provide important wildlife habitat (Harris and Vickers 1984); and they can also be used to provide advanced wastewater treatment for small communities (Ewel and Odum 1984). Because these swamps appear to regenerate rapidly after clearcutting, it appears that harvesting without burning immediately thereafter will have little long-term effect on ecological and hydrological patterns in a region. □

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