# Fire Ecology of Canebrakes

RALPH H. HUGHES[1]
*Southeastern Forest Experiment Station*
*Forest Service, U.S.D.A.*

SWITCH CANE,[2] *Arundinaria tecta* (Walt.) Muhl., a native bamboo, was once common and locally abundant throughout much of the southeastern United States and formed various types of canebrakes familiar in the songs and stories of the region (McClure 1958). By 1950, a combination of fire, uncontrolled grazing, and clearing of the land for cultivation had eliminated cane from many of the areas it once occupied.

Extensive stands remain in swamplands and low-lying coastal areas. Some 2 million acres persist in the Carolinas and Virginia (Fig. 1). Here cane is most frequently associated with pond pine (*Pinus serotina* Michx.) in areas that have been burned periodically over the years (Shepherd *et al.* 1951).

This paper reviews cane response to fire and lack of fire (Fig. 2). It is based upon experience in the canebrake country of North Carolina and upon the published reports that came out of a series of cooperative studies there.

[1] Stationed at Tifton, Georgia, working in cooperation with the University of Georgia College of Agriculture Coastal Plain Experiment Station.

[2] Although the two bamboos native to the eastern United States, *Arundinaria tecta* and *A. gigantea*, are often confused because of an unfortunate reference in the early literature to an ill-chosen criterion for their differentiation, they are really quite distinct, and may be identified readily in the field by their vegetative characters (McClure 1963). For example, the rhizomes of *A. tecta* have conspicuous air canals while those of *A. gigantea* do not.

## GROWTH HABITS

Cane is a woody perennial and produces a heavy underground stem or rhizome. The aerial stems vary considerably in size from a small fraction of an inch to over an inch in diameter and from a few inches to 30 feet tall (McClure 1958). Rhizomes also vary in size but never reach a diameter much over three-fourths of an inch. Canebreaks spread primarily by rhizomes.

Rhizomes have a protective value to the plant. They allow for the storage of plant food beneath the ground and beyond the reach of grazing animals and surface fire. Food reserves are accumulated in the rhizomes and stem bases during the summer and until late October. Total available carbohydrates in samples of rhizomes collected over a one-year period varied in a seasonal pattern from a low of 9 percent in June to a high of 26 percent in October (Lindahl *et al.* 1949). Digestible nutrients in the cane foilage are highest during May and June, then decline rather rapidly during the remainder of the summer and fall (Smart *et al.* 1960).

Woody stems and leaves of the cane plant are readily killed by fire, but they are quickly replaced by shoots arising from the underground stem bases and rhizomes. Following a winter surface fire the new shoots make phenomenal height growth during the warm humid days of late May and June. Several stems that were measured at Wenona, North Carolina, grew as much as 1½ inches in 24 hours (Biswell *et al.* 1945).

During the first season following burning, the new stems are unbranched and have 10 to 15 large leaves (Hughes 1957). Simple branches, each with six to eight somewhat smaller leaves are produced the second year. These in turn branch in successive years, ordinarily producing five leaves per branch. Leaves become smaller and more numerous with the increased branching as stems become older (Fig. 3). Stands tend to remain even-aged 2 or 3 years after burning, very few additional stems being produced during this period. Thereafter, new shoots appear and stands become uneven-aged.

While individual stems may live 10 years, the average age of a stand tends to remain near 3 or 4 years as a result of gradual mortality and replacement. In the absence of fire and grazing, dead

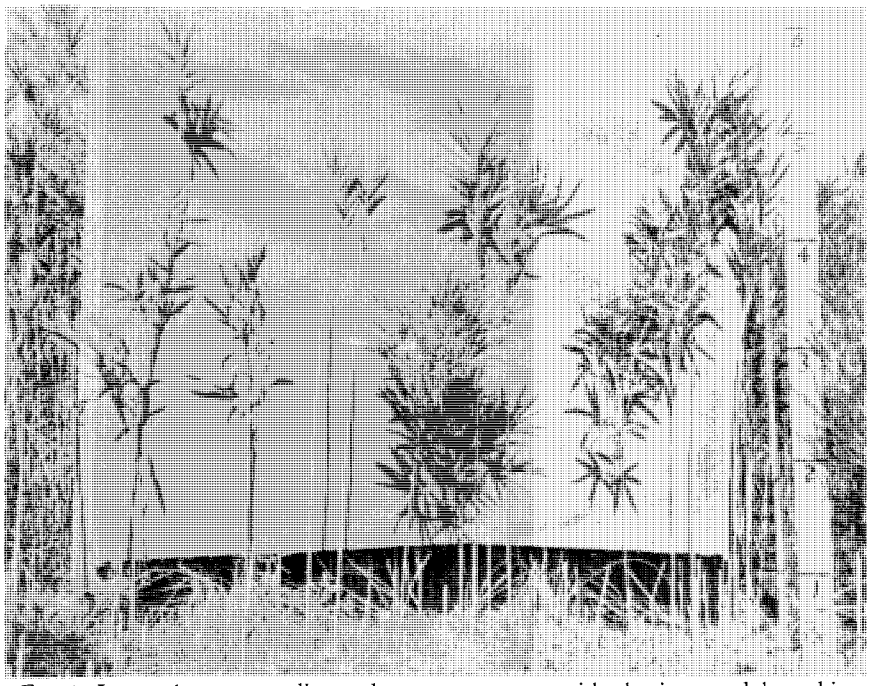

FIG. 3. Leaves become smaller and more numerous with the increased branching as stems become older.

stems may persist several years. Dense, tall cane forms almost impenetrable thickets in which even experienced woodsmen become lost. By the same token, an undisturbed canebrake presents a serious obstacle to management of the land for grazing by cattle, production of wood products, utilization of the game potential, and for various other uses.

## OVERSTORY

Pond pine is the chief overstory of the cane type (Fig. 4). It is the characteristic tree of the poorly-drained coastal flatlands and shrub-bogs, commonly called "pocosins" in eastern North Carolina.

Unlike most other pines, both seedlings and saplings of pond pine sprout profusely following fire. Seedlings sprout most prolifically

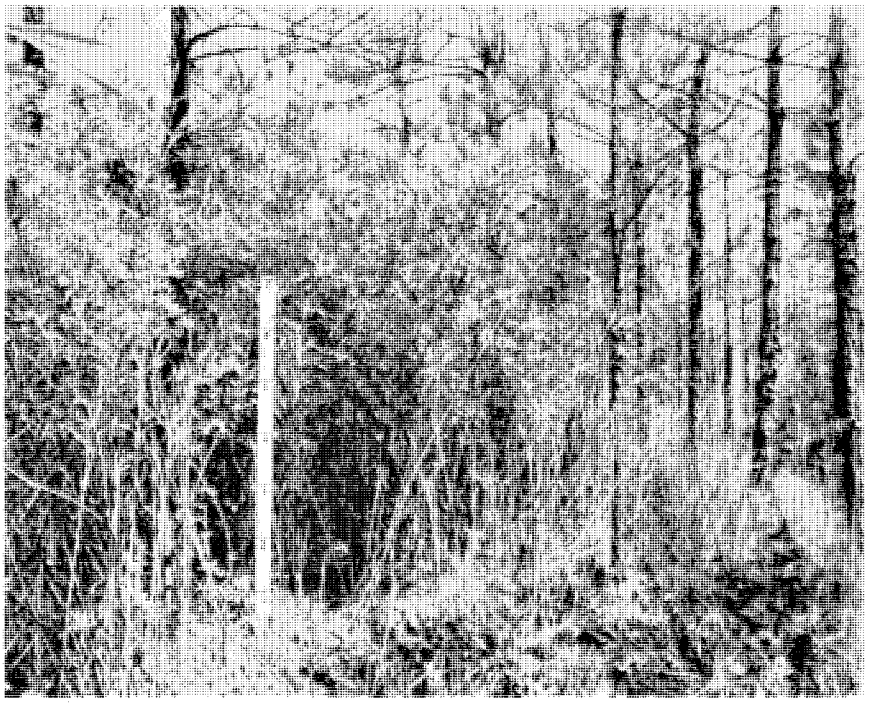

FIG. 4. Pond pine is the chief overstory of the cane type.

but stands up to sapling size are re-established by sprouting (Wenger 1958).

Cones remain closed on the tree for several years, if undisturbed. They open readily following a fire or the felling of trees. Natural regeneration is both slow and uncertain in the absence of fire. Scorching and intensive heat to which cones are subjected during fire have little or no effect upon viability of the contained seed. Seed from cones that are badly charred germinate as well as seed from slightly charred cones.

Exposed mineral soil is probably the best seedbed. Pond pine seed germinates readily on exposed surfaces. On the Hofmann Forest, very few seedlings were established on protected plots, but satisfactory numbers appeared following a burn (Shepherd *et al.* 1951). The favorable seedbed conditions created by burning deteriorate in a few years.

## NATURAL DECLINE

Under continuous protection from fire, cane stands lose vigor, thin out, and die. This characteristic poses many questions about the ecology and management of the cane type for timber production, wildlife habitat and grazing.

As the stand becomes older, production of new stems is not sufficient to replace natural dieback of old stems in the stand. In Tyrrell County, North Carolina, plots not burned in 11 years contained an average of 31 percent fewer stems than when inventoried 3 years earlier (Hughes *et al.* 1960). Decline in production of new stems during the brief span of 3 years was even more pronounced, from an average of 6 per square yard at age 8 years from burning to only 3 per square yard at age 11.

In adjoining Washington County, North Carolina, degeneration likewise was marked by a reduction in stem number which occurred in patches or as single individuals within the stand. When undisturbed 14 years, cane stems declined 65 percent in number during the final 7 years, i.e., from 27 per square yard in 1948 to only 11 in 1955 (Hughes 1957). Losses were similar beneath trees and in the open, although plots beneath pine contained only half as many stems as plots in the open.

Investigations in Jones County, North Carolina, where unpalatable shrubs comprised more than half of the understory vegetation, gave somewhat different results. After 11 years of fire exclusion the cane thinned out markedly while shrubs continued to increase (Shepherd *et al.* 1951). Brush completely dominated a cane stand after 12 years protection and four seasons of grazing.

That cane stands thin out or deteroirate after prolonged protection is not explainable on the basis of competition from trees or shrubs, or of grazing management. Overgrazing, to be sure, quickens the decline. Mature cane is easily killed by continuous heavy grazing (Fig. 5). At the Hofmann Forest, on sites that were poorly drained and of mediocre quality, number of living cane stems was reduced 50 to 60 percent by 4 year's heavy grazing (Shepherd *et al* 1951). Similarly at Wenona, in one of the most productive cane stands in the United States, a large percentage of the stems was killed when the canebrake was grazed heavily from late May through

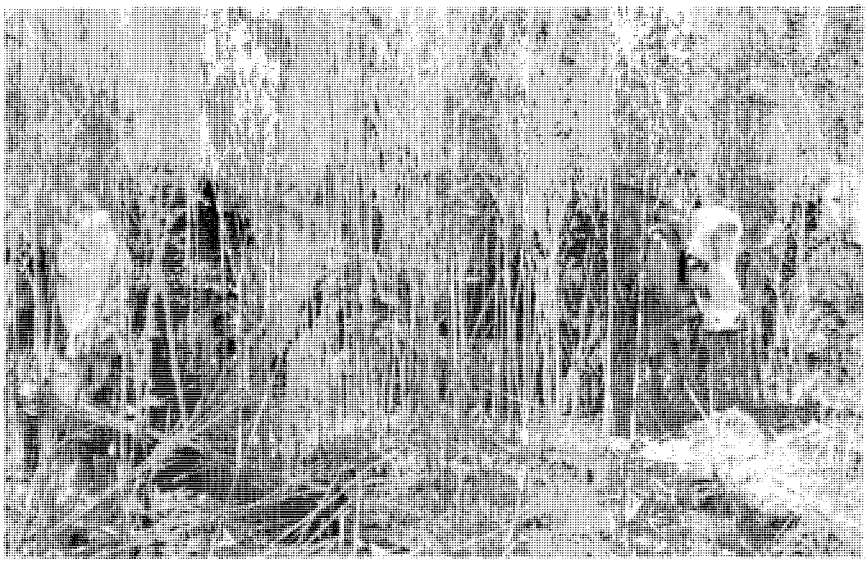

FIG. 5. Mature cane is easily killed by continuous heavy grazing.

November over a period of years (Shepherd and Dillard 1953).

Deterioration of a cane stand from overgrazing is reflected by a reduction in the number and size of stems and leaves. New stems, which ordinarily sprout in midsummer, are highly palatable and thus cattle seek them out. An appreciable number of new stems must escape grazing if the cane stand is to be maintained.

With or without grazing, the causes of natural decline are difficult to pinpoint because, in addition to a reduction in the number of living stems throughout the stand, losses occur irregularly in patches, as if from disease. Failure to reclaim the bare areas is characteristic of stands that are low in vigor.

Patchy losses may occur following flowering, after which the cane always dies (Hughes 1951). Present day stands rarely regenerate from seed. Seed production is scanty, sporadic, and unpredictable. Natural seedlings develop very slowly. Those observed were less than a foot tall by the end of the third growing season (Fig. 6).

FIG. 6. Cane seedlings develop very slowly. Those observed were less than a foot tall by the end of the third growing season.

Cultivated and fertilized seedlings developed more rapidly, but still were only half the size of nearby cane after 3 years.

It is obvious, then, that once cane is killed out, recovery is so slow that natural restocking requires several generations. The long delay or failure of re-establishment is due in a large part to the strong dependency on vegetative reproduction.

## RENOVATION BY BURNING

Historical records of canebrakes dating back to early colonial times indicate a usual interval between fires of 3 to 5 years. Even in poorly drained pocosins new cane growth seldom went beyond 5 years without fire (Wells 1942). So universal was fire that ultimate development of communities could not be ascertained.

Vigorous new stands of cane appear immediately following fire (Fig. 7). Even the second year following burning, cane always contained more digestible nutrients than unburned range (Smart *et al.* 1960). Greatest foliage production representing the optimum bal-

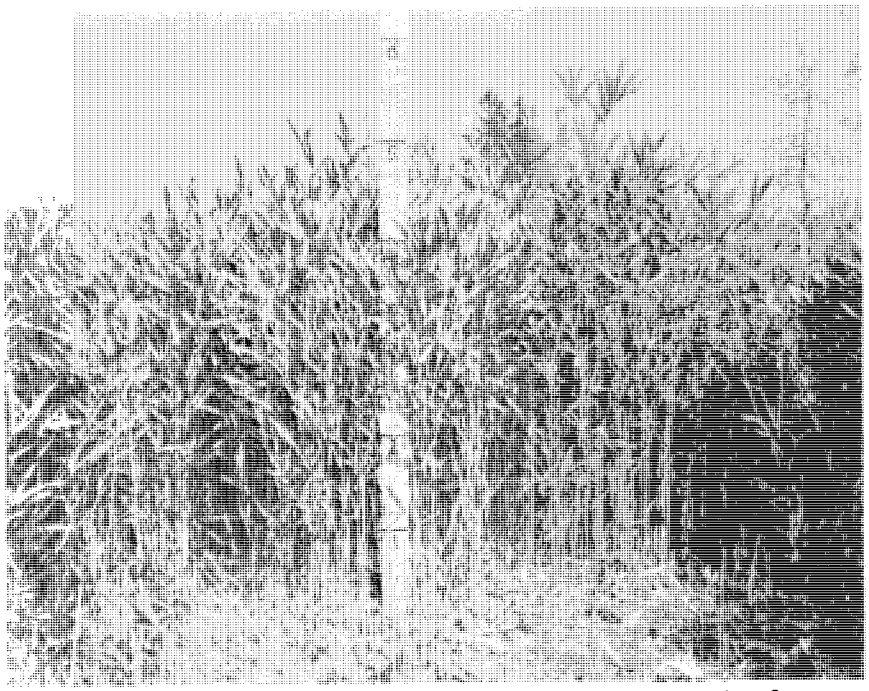

FIG. 7. Vigorous new stands of cane appear immediately following fire.

ance between height, number and age of stems and leaf size may be expected 3 to 4 years after burning in open cane, and 2 to 3 years following fire in forested range (Hughes 1957). An annual production of about 2000 pounds per acre in the experimental ranges continued until the tenth year. Thereafter, stands declined in productivity and vigor. Canebrakes reach maturity and begin to lose their dominant foothold in the plant community after 10 years continuous protection from fire.

Because new cane growth is particularly sensitive to grazing damage, use by cattle requires careful regulation. Grazing should be withheld for a part of the first growing season to assure full development of a sufficent number of new stems to replenish the stand. Beyond the first year and continuing for about a decade, foliage production may be maintained at a high level, without further renovation. Thereafter, if the major management objective is to keep

the cane most productive, fire should be introduced at intervals of about 10 years.

Burning eliminated the fire hazard the first growing season and reduced the hazard for 2 or 3 years. Fuels reached a peak of 5 to 7 tons per acre after only 3 or 4 years fire protection. Therefore, a short burning cycle should be preferable from the standpoint of continued fire hazard reduction.

## SUMMARY

Fire has played a vital role in the history of canebrakes. Cane thrives in a fire maintained community. With continuous fire protection, stands stagnate. Burning greatly improves ranges that have been left to grow 10 years or more. With periodic fire and carefully regulated grazing, cane is one of the most productive native grazing types in the United States.

Regeneration of pond pine, the common overstory component of the cane type, likewise is most probably the product of recurrent fires. Heat triggers opening of cones. Germination of seed is favored by seedbeds prepared by burning. In the absence of fire, regeneration is both slow and uncertain.

## LITERATURE CITED

Biswell, H. H., Collins, R. W., Foster, J. E., and Boggess, T. S., Jr. 1945. Native forage plants. N.C. Agr. Expt. Sta. Bull. 353, 27 pp.

Hughes, Ralph H. 1951. Observations of cane (*Arundinaria*) flowers, seed, and seedlings in the North Carolina Coastal Plain. Torrey Bot. Club Bull. 78(2):113-121.

———. 1957. Response of cane to burning in the North Carolina Coastal Plain. N.C. Agr. Expt. Sta. Bull. 402, 24 pp.

———. Dillard, E. U., and Hilmon, J. B. 1960. Vegetation and cattle response under two systems of grazing cane range in North Carolina. N.C. Agr. Expt. Sta. Bull. 412, 27 pp.

Lindahl, I., Davis, R. E., and Shepherd, W. O. 1949. The application of the total available carbohydrate method to the study of carbohydrate reserves of switch cane (Arundinaria tecta). Plant Physiol. 24:285-294.

McClure, F. A. 1958. Bamboo as a source of forage. 8th Pac. Sci. Congress (1953) Proc. 4B:609-664.

———. 1963. A new feature in bamboo rhizome anatomy. Rhodora 65 (762) 134-136.

Shepherd, W. O., Dillard, E. U., and Lucas, H. L. 1951. Grazing and fire influences in pond pine forests. N.C. Agr. Expt. Sta. Tech. Bull. 97, 57 pp.

———. and Dillard, E. U. 1953. Best grazing rates for beef production on cane range. N.C. Agr. Expt. Sta. Bull. 384, 23 pp.

Smart, W. W. G., Jr., Matrone, G., Shepherd, W. O., Hughes, R. H., and Knox, F. E. 1960. Comparative consumption and digestibility of cane forage. N.C. Agr. Expt. Sta. Tech. Bull. 140, 8 pp.

Wells, B. W. 1942. Ecological problems of the southeastern United States Coastal Plain. Bot. Review 8(8):533-561.

Wenger, Karl P. 1958. Silvical characteristics of pond pine. U.S. Forest Serv. Southeast. Forest Expt. Sta. Paper 91, 13 pp.