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Fire Effects in New Jersey's Pine Barrens by Silas Little

Large forest fires in the New Jersey Pine Barrens frequently take newspaper headlines in the spring, and sometimes in summer or fall, but hundreds of small fires throughout the year attract little attention. Fires are not rare in this section. Indians burned the woods extensively to improve hunting conditions. Ever since the first white men settled in New Jersey, fires have been common in the Pine Barrens.

Effects of these fires are all too frequently overlooked or misjudged—partly because new growth quickly masks the burns, partly because there are many differences in possible effects. The principal effect of fires has been on the vegetation, especially on the above-ground parts. On upland sites, most the root systems are in mineral soil which is heated appreciably by any type of forest fire. In addition, studies have indicated that forest fires have relatively little effect on upland soils.

FACTORS MODIFYING FIRE EFFECTS ON UPLAND SITES

Succession

If fires are kept out and there are no other disturbances such as cutting, the usual forest growth that develops on cleared land in the Barrens follows this pattern: first, a pine stand develops; then hardwoods, chiefly oaks, seed under the pines. Later, as the pines mature and die, hardwoods dominate the stand. The succession from pines to hardwoods is due to two factors:

- (1) hardwoods can live and grow under more shade than pines, and
- (2) hardwood seeds, being bigger, can become established in the thick cover of dead leaves that accumulates under unburned stands.

Species Susceptibility

Pines and oaks differ in their susceptibility to fire. Oaks have thinner bark than the pitch and shortleaf pines of the Barrens, so less heat is needed to kill their cambium. However, pine crowns are burned far more frequently than the crowns of oaks because most fires occur when oaks are leafless. Most of the fire damage to oaks is through killing of the cambium near the base. When only part of the cambium is killed, the tree usually lives but an open wound develops. When all of the cambium is killed, the stem dies but sprouts may start from buds just underground.

On pitch and shortleaf pines, fires usually damage the foliage and well-developed buds first. More heat is needed to kill the basal cambium, particularly of large trees. Thus, these pines may have only their foliage killed they may also have their major buds and branches killed, yet live through forming new crown sprouts from dormant buds. If the part above ground dies but sprouts arise, they usually arise from protected dormant buds. A tree is completely killed if no sprouts develop.

Tree Size

Large trees have thick bark and crowns farther from the ground so they tend to suffer less damage than small trees. Certain fires have killed back all pines 1 to 4 inches in diameter (at breast height), but no pines with a breast height -diameter of over 13 inches. Less intense fires have killed back all oaks 1 to 4 inches in diameter, but only 12 percent of the oaks larger than 13 inches. (A tree is "killed back" if the part above ground is dead, but the root is still living and can produce sprouts. A tree is completely killed if the root, too, is dead.)

Effects of Heat

The temperature of a fire varies within its various sections, its size and its burning conditions. In some large fires, the head-fires have killed 68 percent of the pine stems

5 to 8 inches in diameter while the less intense side-fires killed no pines of that size. Small fires are usually less intense and cause less damage than large ones. When air temperatures are low, heat is more quickly dissipated and more fire is needed to raise the temperature of plant tissues to the killing points. Thus, fires do less damage at low winter temperatures than in spring or summer. The intensity of a fire is also affected by fuel conditions. When the debris on the ground is dry only on top, fires may start and spread but they cannot create as much heat as when all the debris burns. Similarly, where there is less fuel, the fire will be less intense.

Fire Frequency

Frequent killing fires keep an area covered with small sprouts. Severe fires at fairly frequent intervals (less than 20 years) eventually eliminate species that do not bear seed at an early age—the apparent reason why shortleaf pine and black, white, and chestnut oaks are absent from existing stands of pitch pine and scrub (bear) oak.

ROLE OF FIRE IN SHAPING UPLAND STANDS

Most of the effect of fire on present forests of the Pine Barrens has come from large, very hot fires.

Plains Stands

Low growth of pitch pine and scrub (bear and blackjack) oaks, such as that found near the Burlington-Ocean County line along Route 72, is due chiefly to repeated killing fires that keep sprouts young and small. These sprouts' growth is retarded by the age of the stumps from which they grow and by competition among large numbers of sprouts—as many as 249 one-year-old sprouts have been counted in a single clump. Recent studies indicate that the Plains stands' fire history has favored a race of pitch pines that is relatively slow-growing, develops a mature form relatively early and has a crooked form and serotinous cones. (Serotinous cones are pitchy enough to stay closed, at least for several years, unless opened by a fire's heat. By these mechanisms, fire produced the "miniature forest" that was once considered such a mystery.

Pitch Pine-Scrub Oak Stands

Stands similar in composition to those in the Plains arise from slightly less frequent or less intense fires which give the pines more growing time. However, these pines are usually slow-growing for two notable reasons: (1) many stems probably started as sprouts and (2) many of the pines lived through one or more fires that killed their crowns.

Oak-Pine Stands

These usually have a dense understory of oak (black, white, chestnut, etc.) sprouts with some scattered pine sprouts, both having started after the last severe fire. Over this understory is a scattering of large pines that survived the last and, often, earlier fires. This composition apparently results from severe fires at intervals of possibly 30 to 40 years, certainly at longer intervals than in the pitch pine-scrub oak areas. In the oak-pine stands, large pines have usually been deformed by past fires and if any oaks survived the last fire, they will probably have basal wounds.

FIRE EFFECTS OF SHRUBS AND HERBACEOUS VEGETATION

Just as a history of fire can alter the composition of a forest, it can also affect the undergrowth. On upland sites, an undergrowth of huckleberries and low-bush blueberries prevails under climax hardwoods and most oak-pine stands. Frequent light fires tend to reduce the shrub cover and favor herbaceous plants, especially along roads or under open stands. Severe fires can also reduce the shrub cover, especially of huckleberries. On sandy sites, severe fires favor such species as golden-heather until they are once again crowded out by the spread of blueberries and huckleberries.

Pine Stands

Foresters believe park-like stands of pine prevailed in the original forest, due to the frequent fires the Indians set, mostly in the fall and winter. Similar stands with mature trees reaching heights of 65 to 100 feet are apparently favored by frequent light fires. Prescribed burning, as used in the Pine Barrens by foresters in recent years, calls for

setting light fires, mostly in the winter, to reduce accumulation of fuel. Although this is mainly done to reduce the wildfire hazard, prescribed burning tends to create pine stands of seedling or seedling-sprout origin and to permit trees to develop without the deformities created by severe fires.

FIRE'S EFFECTS ON LOWLAND SITES

On lowland sites -- both the pine stands of poorly drained soils and the white-cedar stands of the swamps -- the effects of fire are just as varied as they are on upland sites. For example, deep-burning fires of the organic soils of swamps can create (1) ponds, flats with a shallow layer of water covered by leatherleaf (2) flats with a shallow layer of water covered by leatherleaf or (3) meadows containing a wide variety of interesting herbaceous plants. Killing fires that do not burn deeply enough to create any of the above conditions can result in forests of white-cedar, of swamp hardwoods, or of a mixture of cedar and hardwoods.

SUMMARY

On upland sites, all of the various combinations of species occur on a wide variety of soils, so fire history has been more important in shaping the present-day forest than soil differences. Though the organic content and drainage have created differences in the vegetation of the pinelands and swamps, here too, fire has been the overriding factor in shaping both the lowlands and swamps.

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