Forest management

Burning issues in fire control

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THE use of fire for forest management may seem a strange concept to those accustomed to the extensive fire breaks, warnings and precautions usually associated with commercial forests in northern Europe. But fire is now a regular feature of forestry in North America and is being proposed[1] as a means of efficient management for the dry forests of South-East Asia.

In the 1960s it was estimated that an average of 4.8 million acres of forest in the United States was burned each year as a result of accidental fires[2]. But it was also recognized that the accumulation of dry brushwood beneath the canopy was an important factor in forest flammability, and that this build-up was itself an undesirable consequence of success in fire control. Periodic fires while the underbrush was still sparse could protect the forest from more intense and harmful fires at a later stage. So in 1967 controlled burning was carried out in 2.9 million acres of both private and government-owned forests, with the destruction of an estimated 61 million tons of brushwood. This was the culmination of 30 years of gradually altering opinion on the part of foresters in North America. The value of such prescribed burning is now sufficiently well established for its use over 10 million hectares of pine forests in the south-eastern United States alone[3].

The ecological justification of prescribed burning depends to a considerable extent on historical precedent, as well as practical benefit in reduced wildfire frequency. Wright[4] reviewed the palaeoecological evidence from charcoal in lake sediments and fire scars within the annual growth rings of trees and showed that areas of Minnesota during the past few centuries had burned fairly regularly on an approximate 100-year cycle. In the redwood forests of the West, Weaver[5] found that there had been at least 45 fires in the past 1,100 years and that fire suppression by white settlers was an innovation of dubious value to the forest. Similar studies in Canada[6] show that a natural fire cycle with a wavelength of about a century was occurring a thousand years ago, but without change in the overall forest composition.

Artificial removal of the fire factor could destroy this stability and precipitate a new development in the forest succession, perhaps leading to replacement of the characteristic conifers by hardwood species. Williamson and Black[7] carried out controlled fires in forest stands of pine (*Pinus palustris*) and two oak species (*Quercus laevis* and *Q. geminata*). By measuring temperature profiles in the different forests using waxes of various melting points, they found that although pine burns at almost 300 °C at ground level and achieves a maximum of 150 °C at a height of 4 m, the corresponding figures for oaks are only about 200 °C at the base of the tree and less than 100 °C at 4 m. The ecological implication is that litter fires under a pine canopy are sufficiently hot to eliminate invasive oaks. The flammability of pine litter is therefore a method of competitive exclusion of the oaks that might otherwise invade and develop a more fire-resistant forest.

Dry season fire in savanna forest, Thailand. Note the arc effect of the flames (courtesy of P. Stott).

The drier areas of South-East Asia are occupied by deciduous dipterocarp savanna forests that often abut sharply into the neighbouring semi-evergreen forests, the abrupt divisions being maintained artificially by regular burning in the former. These dry forests, consisting largely of *Dipterocarpus* and *Shorea* species, are widely distributed between Burma and Vietnam. In Vietnam, the rural population clears the forest between January and March, before the wet season begins, using felling and burning techniques[8].

Stott's[1] detailed studies of the effects of such fires in Thailand show that, as in the boreal forests of temperate regions, the major fuel is the dry litter on the ground. About 90 per cent of the leaves have been shed by the end of January and are a considerable fire hazard, especially when accompanied by dry grasses. Stott investigated the temperatures of the fires using 'thermacolor' paints[9] which change colour at different temperatures. In most fires the highest temperatures attained were near the ground and reached 300–400 °C. At 2 m, the outer bark temperatures of trees were usually less than 200 °C and most trees could cope with outer bark temperatures of 300 °C because of the insulating properties of the bark itself; inner bark temperatures rarely exceeded 75 °C.

Where litter had been allowed to accumulate to a depth of more than five or six leaves, or where ground cover of herbs, bamboos and small shrubs had built up, the burn became much more intense and temperatures of between 700 and 900 °C were recorded. Fortunately, the very low organic matter content of the soil always prevented significant penetration of the burn and just 5 cm below the surface the temperature was usually only about 35 °C and did not exceed 75 °C.

The current policy of the Thai Royal Forest Department is to prevent these dry-season fires because of the risks involved, especially in wildlife parks and sanctuaries. Stott regards this policy as inappropriate, because it permits the accumulation of litter and low-growing vegetation and so increases the likelihood of intense fires when they eventually take place. It would be better to learn from the American experience and institute a management regime in which regular and relatively frequent fires of low intensity are encouraged. □

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