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Fire and Climax Spruce Forests in Central Yukon

R.M. STRANG[1] and A.H. JOHNSON[1]

Observations made during recent studies into fire history of forests in central Yukon (Johnson and Strang, *in litt.*) suggest that, in the event of long-continued absence of fire, mixed stands of black and white spruce (*Picea mariana* (Mill.) BSP. and *P. glauca* (Moench) Voss) might become mono-specific black spruce stands. It is, however, unlikely that fires will often be absent for the long time periods needed for this change to develop.

An upland, open mixed spruce stand was found at km 280 along the Dempster Highway (approximately 66°N, 138°W) on a well-drained, dry ridge crest, with no obvious signs of high moisture content permafrost near the surface. Few mature trees were left standing, most having decayed and broken, though identifiable crowns lay on the ground. Not being recent, the cause of death could not be determined. Ground vegetation comprised a complete cover of lichens, mostly *Cladina* spp., *Cladonia* spp. and *Stereocaulon* spp. with frequent dwarf birch (*Betula glandulosa* Michx.) and ericaceous shrubs. Neither black spruce nor white spruce seedlings were found. This old open stand adjoined a younger, closed spruce stand not less than 150 years old, which was probably of fire origin.

Solitary, broken white spruce stumps stood isolated amongst the shrubs and lichens, but each black spruce stump was surrounded by a ring of vigorous saplings arising from layering of the lowest whorl of branches (Figs. 1, 2). Thus there was no replacement generation for dead or moribund white spruce but each black spruce was being succeeded by a cluster of young black spruce. Time did not permit measurements but this visual evidence points to an eventual pure black spruce stand unless fire intervenes and sets succession back to an earlier sere. It is, of course, very probable that the area will burn before it is wholly converted to pure black spruce. Indeed, of some 200 sites randomly located along the highway, this was the only one which had escaped burning for so long.

FIG. 2. Cluster of layered black spruce saplings surrounding dead parent tree.

This implies that the common mixed spruce stand may, in fact, be a pyric sub-climax. A climatic shift could possibly produce a similar effect, but Black (1977) has shown that any such shifts are effective only on a time scale measured in thousands of years, and at present a mixed stand of both species regenerates slowly after fire.

Successional trends in subarctic or northern boreal regions have received attention from a number of authors. Heilman (1966, 1968) has suggested that diminishing nutrient availability coupled with a rising permafrost table will cause a successional trend from closed forest to sphagnum bog in Alaska, and Strang (1973) postulated a somewhat similar tendency in open boreal forests of the Northwest Territories. Black and Bliss (1978) challenged this suggestion, the difference apparently centering on the extent to which black spruce will reproduce vegetatively. Viereck (1970), implicitly agreeing with Black and Bliss, identified a late seral change from a mixed stand of black and white spruce to an eventual black spruce/sphagnum community as increasing cold and soil humidity excluded white spruce. The case outlined here differs in that the site is dry and well-drained, and topographically situated to make paludification most unlikely. The causes of change

FIG. 1. Isolated white spruce stump in foreground, black spruce clumps behind.

[1]Faculty of Forestry, University of British Columbia, Vancouver, B.C., Canada V6T 2A2

are the unfavourable seed bed afforded by the complete ground cover of lichens, coupled with the ability of black spruce to reproduce vegetatively.

Conventional ecological thinking depicts succession as trending towards a climax of large biomass, low productivity and considerable species diversity (e.g. Whittaker, 1975; Odum, 1969) though Margalef (1963) postulated a diminished diversity. More recently, work such as that by Vitousek and Reiners (1975) has addressed the question of nutrients in succession. In the northern boreal forest diversity and biomass seem to decline with advanced age. We do not yet have good data on changes in productivity or nutrient balance. While it is undoubtedly risky to argue from the particular to the general, this rare example of a very old stand calls us to accept fire as a vital habitat factor and to recognize that what might easily be deemed climax — i.e., a mixed stand of black and white spruce — should be regarded as a pyric sub-climax. This is not only of academic interest, but also provides food for thought to those managing Ecological Reserves and Parks.

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