CANADA

Department of Forestry

FOREST RESEARCH BRANCH

EFFECTS OF MECHANIZED LOGGING ON THE COMPOSITION OF A BALSAM FIR STAND IN THE GASPE PENINSULA

(Project Q-40)

by

J.D. MacArthur

Quebec District
November 1962

Que. 62-5

EFFECTS OF MECHANIZED LOGGING ON THE COMPOSITION OF A BALSAM FIR STAND IN THE GASPE PENINSULA[1]

J.D. MacArthur[2]

ABSTRACT

Marked differences in the pattern of regeneration appearing after partly mechanized clear felling in a balsam fir stand are described. Normal successional trends in the forest are shown to be easily changed by logging disturbance. Since all logging methods disturb it is suggested that a complete evaluation of a logging method must include consideration of what changes may results from its application.

INTRODUCTION

The influence of mechanized logging on the physical and biological characteristics of the forest is cause for concern. Developments in mechanized logging have been so rapid and their application so widespread that there is relatively little information available concerning their silvicultural implications. The influence of logging method upon subsequent stand development is often obscure immediately after cutting but when regeneration has developed on cut-over areas marked differences in patterns of stand composition and structure may appear.

The purpose of this report is to show how easily the normal successional trends in the forest can be altered by a logging method. It is hoped that consideration of this brief case history, in which the effects were very marked, will stimulate interest in more comprehensive studies of the changes that may be brought about by mechanical logging.

THE ORIGINAL STAND AND THE LOGGING OPERATION

In 1941-42 a uniformly well stocked balsam fir[3] stand averaging 20 to 25 cords per acre was clear cut for pulpwood on the Little Pabos River watershed

---

1/ Contribution No. from the Forest Research Branch, Department of Forestry.

2/ Research Officer Forestry, Forest Research Branch, Department of Forestry, Quebec, P.Q.

3/ Botanical names of tree species are those used in "Native Trees of Canada", Dept. of Forestry Bull. 61, 6th ed., 1961.

in the southeastern portion of the Gaspé Peninsula about 20 miles north of Chandler, P.Q. (Boynton 1953). The area, about 1,000 feet above sea level, forms part of an extensive upland which slopes gently south from the Shickshock Mountains. The stand was on an unusually level tract of land and was quite typical of the extensive stands of balsam fir that occur in this part of Boreal Forest Section B.2 (Rowe 1959). Normal soil in the area is a shallow but well-defined podzol (8 to 14 inches to parent material). The top soil is a clay loam (60 per cent silt and clay) containing shale fragments which vary greatly in size and in frequency of occurrence.

The logging method departed from conventional practice in that all hauling was done by trucks, with the pulpwood being picked up practically at the stump. A system of parallel roads 12 feet wide and 60 to 70 feet apart, and covering about a fifth of the area, was made by bulldozing stumps and other debris aside. In the process most of the organic matter and occasionally some of the mineral soil was inadvertently removed also.

THE STAND 20 YEARS LATER

In 1961 it was evident that distinctive changes in stand condition that will persist for at least one rotation were associated with the road system. The logging roads divide the cut-over area into long narrow compartments with a recurrent pattern of stand composition across their width (Figures 1 and 2).

The central portions of the compartments support uniformly dense stands of balsam fir having a dominant height of 12 feet. Scattered white birch, white spruce, and black spruce are also present (Table 1). About 70 per cent of the balsam fir had originated as advance growth before the cut and the stand is typical of stands resulting from clearcutting of balsam fir in much of the Quebec Boreal Forest; the establishment pattern conforms to that described by Hatcher (1960) in Forest Section B.1, 40 miles north of Quebec City.

Table 1. Number of stems per acre 0.6 inch d.b.h. and greater in the strips between haul roads. (Basis 25 fortieth-acre plots)

Species	Number of stems per acre	Per cent of total
Balsam fir [1/]	7,920	77.5
White birch [2/]	2,160	21.1
White spruce	120	1.2
Black spruce	20	0.2
TOTAL	10,220	100

1/ In addition there are about 10,000 fir and spruce stems less than 0.6 inch d.b.h.

2/ The number of white birch is inflated by plots which fell in concentrations of birch along roadsides.

Along the edges of the compartments on the bulldozed debris the stand is almost pure white birch which completely occupies the deep organic seedbed. The birch originated from post-cut seedfall although only very few scattered seed trees were present.

On the roads the deeply scraped areas and compacted wheel tracks are usually devoid of any vegetation. The seedbed is quite unsuitable and should not be called bare mineral soil in the usual silvicultural sense of the term. Two to three inches below the surface of the wheel tracks an abnormally compacted soil zone largely precludes the extension of root systems from either side.

In the centre strips of the roads, where relatively superficial scraping had reduced the depth of litter and humus, dense hedge-like strips of spruce 4 to 5 feet high predominate. Some birch occur , but no balsam fir.

CONCLUSIONS

The present stand composition appears to be largely an expression of the ecology of the species involved. On all bulldozed areas the trees now present originated from post-cut seedfall and species composition in the roads is quite unlike that of the original stand. Where the seedbed was not changed mechanically to any extent stand composition following cutting is much the same as before.

This is in accord with the silvical characteristics of the species involved as evidenced by their general occurrence and distribution in the region. The representation of black spruce and white birch in predominantly balsam fir stands is low and fairly constant. Both spruce and birch persist through the ability to seed in readily when windthrow or fire create suitable openings. Such openings may range in size from a few square feet where a tree is uprooted to burns covering many square miles. Both species, but particularly black spruce, are fitted for a pioneering role by seeding characteristics and both are also largely restricted to this role by the establishment requirements of their seedlings. Balsam fir, on the other hand, is less well-suited by seeding characteristics to occupy disturbed seedbeds but, because of the shade tolerance and rooting habit of its seedlings, it maintains its position in the forest by colonizing seedbeds where moss or shade, or both, exclude spruce and birch.

All logging methods, but particularly mechanized ones, disturb the forest floor and thus influence established and potential regeneration. Careful consideration of the ecology of the species present will, in many cases, suggest combinations of machinery and method that will either minimize undesirable changes in composition or promote desirable ones. Mechanized logging provides, to a far greater extent than the older conventional methods, an opportunity to manipulate species composition following clear felling. Evaluations of mechanized logging methods must be judged incomplete if they do not include an adequate ecological assessment.

REFERENCES

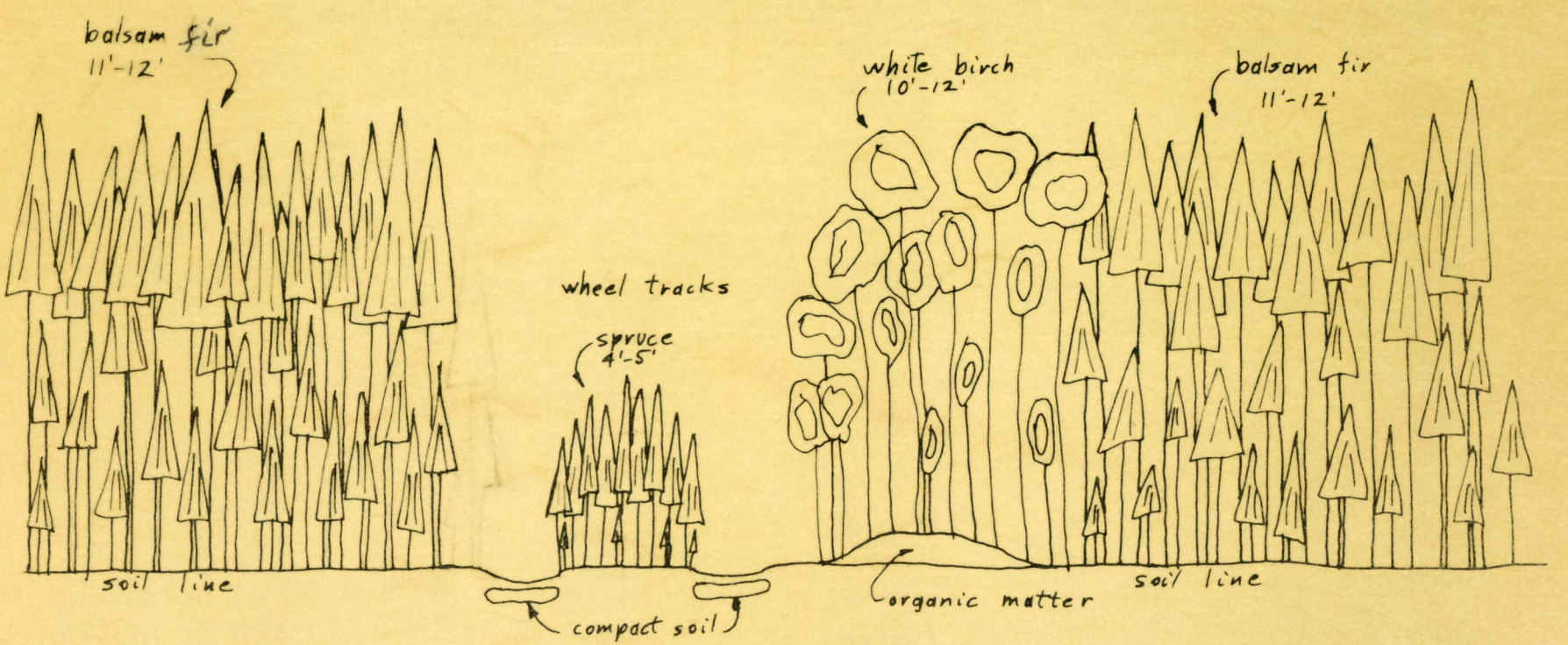
Boynton, J.C. 1953. A report on the establishment of Observation Area No. 8, Little Pabos River, Chandler, P.Q., Canada, Dept. of Forestry, For. Res. Branch. Unpub. M.S.

Hatcher, R.J. 1960. Development of balsam fir following a clearcut in Quebec. Canada, Dept. of Northern Affairs and National Resources, Forestry Branch, For. Res. Div., Tech. Note No. 87.

Rowe, J.S. 1959. Forest regions of Canada. Canada, Dept. of Northern Affairs and National Resources, Forestry Branch, For. Res. Div., Bull. No. 123.

Figure 1. 1956 aerial photograph of the 1941-1942 logging area showing conspicuous road pattern 15 years after cutting. Scale 1 inch = 20 chains.

Figure 2. Diagram of typical cross section of a haul road showing stand and soil conditions. Scale : 1 inch = 6 feet (approx.)



Scale: 1" = 6" app.

Figure 2: Diagram of typical cross section ~~across~~ of a haul road showing stand and soil conditions. Scale: 1 inch = 6 feet (approx.)