Logging Impacts on White Spruce Floodplain Communities in Timber Berth 408 of Wood Buffalo National Park[1]

by

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Introduction

This report is based upon a two day evaluation (October 16-17, 1991) of timber berth 408 in Wood Buffalo National Park (WBNP) and approximately 25 stops on the ground throughout the timber berth accessed by helicopter and on the ground. Blocks harvested between 1970 and 1990 were examined. Unfortunately due to the brevity of the visit and limited number of generally qualitative observations, statistical confidence limits cannot be assigned to the observations and the report makes no pretext of being scientifically rigorous.

The author has confined his observations and comments to those of a biological and ecological nature and has deliberately avoided comment on regulatory matters *per se*. However, many of the observations reported below may well be a function of forestry practices contrary to those specified in the Alberta Timber Harvest Planning and Operating Ground Rules.

The white spruce stands of economic value in timber berth 408 lie entirely within the Big Slough Plain District of the Delta Plains Section within the Northern Plains Physiographic Region of Pettapiece (1986). The landforms are fluvial floodplains and terraces of the Peace River. The origin and structure of the white spruce (*Picea glauca* (Moench) Voss) stands in the study area have been described by Lacate *et al* (1958) and Jeffrey (1961). Conditions favoring the regeneration of white spruce in the study area have been documented by Wagg (1964) and most recently in a report by Pearson (1991).

White Spruce Regeneration

A major concern of the Canadian Parks Service (CPS) is the scarcity of natural spruce regeneration becoming established following logging. Jeffrey (1961) identified natural spruce regeneration as occurring in the study area through three separate processes: 1) stand removal by fire, 2) stand removal by windthrow and 3) vegetational succession from balsam poplar. Spruce regeneration in each case is greatly facilitated by the provision of a mineral soil seedbed.

Winter clearcutting in the timber berth has removed the valuable trees and has left the forest floor consisting of a 5-20 cm accumulation of feathermosses, more or less intact. With the exposure to direct solar radiation the feathermosses (predominantly Hylocomium splendens (Hedw.) B.S.G.) die, and shade intolerant species such as fireweed (Epilobium angustifolium L.) Marsh reedgrass (Calamagrostis canadensis (Michx) Beauv.) wheatgrass (Agropyron sp.) and tall (Mertensia paniculata (Ait) G. Don) increase rapidly following the removal of the white spruce overstory.

Exposure of mineral soil has long been demonstrated to be a desirable prerequisite to natural white spruce establishment by seed (Rowe 1955, Jarvis et al 1966, Stiell 1966). Mineral soil exposure in timber berth 408 was observed on some of the recent clearcuts where block roads and landings were bulldozed. In these situations, the road and landings were occupied by abundant aspen (Poplar tremuloides Michx.) and balsam poplar (Populus balsamifera L.) and often plentiful white spruce, apparently all of seed origin. The chances of white spruce establishment by natural seeding are greatly enhanced when seed trees are present within 5 chains (approx. 100 m) (Rowe 1955). Uncut spruce trees were often present at intervals less than or equal to this distance on the clearcuts observed, but their effectiveness on producing seed could not be ascertained due to the lateness of the season. White spruce seed production perhaps every five to seven years (Stiell 1976) and longer farther north is episodic (Zasada and Viereck 1970) and establishment of white spruce seedlings will be dependent upon not only seed source but suitable exposed mineral soil or moist organic seedbeds such as rotted logs (Wagg 1964).

Small white spruce trees (< 2m tall) growing on the clearcut blocks were upon examination, found to be predominantly "advance growth" that had originated prior to logging. These small trees were invariably rooted in rotted logs. There was also evidence of trees originating from the adventitious rooting of branches on fallen trees, upon contact with the ground. Adventitious rooting of white spruce on the alluvial soils of the Peace River was documented by Wagg (1964). Natural germinants on organic substrates were rare in the timber berth 408 area.

Succession

The post-clearcut environment may differ significantly from the post-fire environment. Fire will consume varying amounts of the humus layer, depending on fire intensity and will expose mineral soil, the amount depending upon fire intensity, moisture conditions and humus depth. The amount of mineral soil exposed will influence the establishment of white spruce seedlings.

The forest community developing after clearcutting in timber berth 408 appears destined to be dominated by the hardwoods, balsam poplar, white birch (Betula papyrifera

Marsh.) and aspen, with densities dependent upon pre-harvest stand composition, proximity to seed sources and mineral soil exposure. Poplar seed especially is prolific and easily blown by wind. The largest clearcut examined, compartment 15 had few remaining standing spruce and little white spruce advance growth less than 2 m tall. There were however, abundant balsam poplar seedlings less than 70 cm tall on a block road on the east end. Balsam poplar was still present but much less abundant on the body of the cleared block. White birch stems originating from the root systems of mature trees of the previous forest stand were also abundant within the clearcut at the stop on the east end of compartment 15.

It seems inevitable that given enough time, these clearcuts will again be dominated by spruce, but the elapsed time required to do so may be extended by 200 years or more in the absence of a proximal white spruce seed source and mineral soil exposure. It should be noted that a historically frequent deposition of mineral soil, favorable to white spruce establishment, during spring flooding of the Peace River is now much less frequent due to the construction of the WAC Bennett dam in British Columbia.

It is the author's opinion that before there is significant white spruce encroachment on the clearcuts in timber berth 408, a closed hardwood canopy will have to develop to create shady, moist forest floor conditions conducive to white spruce seedling establishment on rotted logs and deadfall. Time required to develop such closed canopy conditions will likely be in the order of 30-40 years judging from the appearance of 20-22 year old stands east of the Garden Creek community. The rotted logs that will provide a seed bed at that time will not likely be those left by the logging operation but rather, stems that have been down and decomposing several decades before logging, due to slow decomposition in the boreal environment.

Timber Harvest and Silvicultural Considerations

Lacate et al (1958) documented the common occurrence of ground ice late in the growing season in old white spruce stands in the timber berth 408 area. They recommended clearcutting as the silvicultural system best suited to the area because of the tendency for standing trees to blow over readily when the ground ice melts following opening of the stand. Steve Otway of the WBNP Warden Service service showed us stands that had been logged during the past two years where the operator was required to leave more individual trees and clumps of trees than previously. Also narrow (15 m) strips of uncut timber were left between clearcuts. It was evident that some of these trees have blown over since the logging operation was completed. While undesirable from a timber management perspective, these fallen trees may eventually provide habitat for some birds or small mammals and the over-turned root system provides mineral soil exposure for regeneration of white spruce and other species. The retention of more spruce trees should thus provide both a seed source and a seedbed. Alternatively mineral soil may be exposed by mechanical or manual scarification or prescribed burning although the latter method may have limited success where humus depths exceed 15 cm (D. Kiil personal communication). Planting or seedling following scarification should use local seed sources to maintain the genetic resource. An examination of a 12 year old stand resulting from wildfire in the study area showed very little evidence of mineral soil exposure.

The large areal extent of some of the clearcuts is remarkable. Large clearcuts such as compartment 15 are likely to be subjected to more sun and drying winds in winter and summer than are smaller clearcuts. Chances of natural white spruce regeneration by seed are also greatly reduced by exposure and desiccation of the humus layer. Smaller cutblocks in the order of 20-30 ha should facilitate natural white spruce regeneration. The impact of large clearcuts and absence of treed buffers on wildlife populations are discussed by B. Stelfox in a companion report.

It is apparent from the appearance of the clearcuts harvested three or more years ago that there was usually no special effort made to protect white spruce advance growth during the logging operation. Work done by Brace (1990) indicates that 33% to 66% of the spruce understory in aspen-spruce mixedwood stands can be saved during harvesting of the aspen component, using conventional logging equipment and better planning, layout and operator training. These benefits can be achieved by reducing productivity as little as 8% (Brace 1990). The type of equipment used, while important, is less important than operator effort in protecting spruce understory (Brace 1990). Gingras et al (1991) found that grapple skidders destroyed more spruce understory than cable skidders operated under similar conditions.

Winter logging on generally level terrain does not severely disrupt the humus layer. This is desirable from the standpoint of minimizing stream sedimentation through erosion. Site degradation through soil displacement and compaction is also likely minimal. The maintenance of a 10-25 cm humus layer may however have long term detrimental effects upon site productivity. Thick humus layers tend to insulate the mineral soil from solar radiation producing cold soil conditions, decreased nutrient cycling and conditions that further favor increased humus layer accretion.

Ecological Values

The white spruce forests of the timber berth 408 area are impressive from the standpoint of the large size and great age of many of the spruce trees. The fluvial floodplain environment with its abundance of moisture and nutrients have created some of the largest trees and most productive stands of this latitude in Alberta and in Canada east of the Rocky Mountains. The tallest tree in Alberta is reported to be within timber berth 408. This forest is in sharp contrast to the much less productive forest on the uplands north and south of the Peace River. From a national perspective the fluvial white spruce stands along the Peace River in Wood Buffalo National Park are floristically similar to boreal fluvial ecosystems farther south. They are significant because of their regionally limited areal extent and possibly for other non timber values that could not be evaluated as part of the present study. The author is unaware of similar extensive fluvial white spruce ecosystems within a park or other protected area elsewhere in boreal Canada, and for this reason strong efforts to protect remaining old growth white spruce stands in Wood Buffalo National Park are justified. Examples of similar white spruce ecosystems outside protected areas such as along large rivers like the Liard, Mackenzie, Peace and North Saskatchewan, have with the exception of the Northwest Territories, already been heavily exploited for saw timber.

Summary

A two-day overview of logging operations in timber-berth 408 of WBNP yielded the following observations:

1. Natural white spruce regeneration in the study area is limited by the scarcity of exposed mineral soil seedbeds and seed supply.

2. Natural white spruce regeneration will not likely occur on the clearcuts in the study area until moist, shady forest floor conditions are created as a result of 30-40 years of natural succession of native hardwoods.

3. White spruce regeneration may be facilitated by silvicultural intervention:
    a) Leaving more standing trees and groups of trees on the clearcuts. Windthrow of these trees may create conditions favorable for natural regeneration.
    b) prescribed burning
    c) Mechanical or manual scarification followed by seeding or planting.

4. The post-logging plant community differs considerably from the old-growth forests harvested, being dominated by shade intolerant forbs and grasses succeeding to dominance by aspen, balsam poplar and white spruce.

5. The old growth white spruce forests are being depleted much more rapidly than they are being replaced through natural succession i.e., the logging operation is not sustainable within the timber berth 408 area at the present level of utilization.

6. The logging operation does not appear to be depleting the potential productivity of the site nor causing site degradation through soil compaction or erosion due to winter operations on gentle slopes and the ubiquitous 5 to 20 cm humus layer.

References

Brace, L.G. 1990. A test of three logging systems in Alberta. Canadian Forest Industries 110:24-29.

Gingras, G.F., D. Cormier, J.C. Ruel and D. Pin. 1991. Comparative study of the impact of three skidding methods on advance regeneration. Forest Engineering Research Institute of Canada. Wood harvesting Tech. Note TN-163. 12 pp.

Jarvis, J.M., G.A. Steneker, R.M. Waldron, and J.C. Lees. 1966. Review of silvicultural research - white spruce and trembling aspen cover types, Mixedwood Forest Section, Boreal Forest Region, Alberta - Saskatchewan - Manitoba. Can. Dep. For. Rural Dev., For. Branch, Dep. Publ. 1156.

Jeffrey, W.E. 1961. Origin and structure of same white spruce stands on the lower Peace River. Canada Dep. For., For. Res. Branch Tech. Note 103.

Lacate, D.S., K.W. Horton and A.W. Blyth. 1958. Forest conditions on the lower Peace River. Canada Dep. North. Aff. and Nat. Res., For. Res. Fiv. S. and M. 58-8.

Pettapiece, W.W. 1986. Physiographic Subdivisions of Alberta Land Resource Research Centre, Res. Branch Agric., Can. Ottawa.

Pearson Timberline Forestry Consultants. 1991. Post-harvest surveys and natural reforestation assessment in timber berth 408, Wood Buffalo National Park for the period 1981-1990. Prepared for Canadian Parks Service.

Rowe, A.D. 1955. Factors influencing white spruce reproduction in Manitoba and Saskatchewan. Can. Dep. North. Aff. North. Resour., For. Branch, For. Res. Div. Tech. Note 3.

Stiell, W.M. 1976. White spruce: Artificial regeneration in Canada. Forest Management Inst., Ottawa, Ont. Can. For. Serv. Dep. Envt. Info. Rep. FMR-X-85.

Wagg, J.W.B. 1964. White spruce regeneration on the Peace and Slave River lowlands. Can. Dep. For., For. Res. Branch Publ. NO. 1069.

Zasada, J.C. and L.A. Viereck. 1970. White spruce cone and seed production in interior Alaska, 1957-68. U.S. Dep. Agric., For. Serv., Res. Note PNW-129.