

NATURAL LODGEPOLE PINE IN WEST-CENTRAL ALBERTA PART I: REGENERATION STOCKING

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INTRODUCTION

Natural lodgepole pine (*Pinus contorta* Dougl. var. *latifolia* Engelm.) is generally considered to be a seral species and exhibits a very broad ecological amplitude. It commonly regenerates abundantly and rapidly following wildfire or scarification. Lodgepole pine is capable of rapid juvenile growth on a wide variety of forest sites, but overabundant regeneration often results in reduced tree growth and merchantable yield. Therefore, the usefulness of regeneration surveys could be much enhanced if they were to provide factual information on actual seedling densities in overstocked regeneration. This would facilitate the planning of any thinning treatments required to increase merchantable timber production. Many studies have shown that thinning a young, overdense lodgepole pine stand is the most effective stand treatment option for yield improvement.

Fertilization, in addition to regeneration stocking control and juvenile spacing, provides another opportunity to improve fiber production. Information is required on the kind, quantity, and timing of fertilizer application under a variety of stand conditions that produces the best returns on this investment.

STOCKING – DENSITY RELATIONSHIP

When stocking standards are defined in terms of stocking percentages, those percentages imply a certain minimum number of established, acceptable seedlings per hectare. Although this specified minimum number of seedlings is an important guideline, the actual number may be considerably higher and dependent on the spatial pattern of the seedlings over the area.

Past studies (Bella 1976; Bella and DeFranceschi 1978) have shown that over 90% of lodgepole pine natural regeneration has a clumpy pattern whether it originates after logging and site preparation or after wildfire. This aggregation, or clumping, of

seedlings generally means a surplus of seedlings on some stocked quadrats over the number implied by the stocking percentage. The degree of clumping and thus the number of surplus seedlings may vary considerably and depends on several factors including seed source, seed bed, and weather (moisture) conditions.

Although factual data on the number of these extra seedlings would assist intelligent, early planning of density-control treatments, only a limited amount of information is available. Bella (1976) published information on average expected number of seedlings in relation to stocking percentage. In a follow-up report, Bella and DeFranceschi (1978) presented trends of relative frequencies of stocked quadrats with at least 1, 2, 3, etc. established seedlings in relation to stocking percentages for the major commercial forest types in western Alberta. Using the same data base, this paper takes the analysis one step further for lodgepole pine types and provides detailed information on seedling densities per ha. based on estimates from 4- and 8-m² quadrats, when those density estimates include only one, up to 2, 3, 4, 9, or all coniferous seedlings per quadrat.

THE SAMPLE

Data for this analysis were collected in the Foothills Section, mainly in the B.19a-Lower Foothills area (Rowe 1972), fig. 1 (over), where the major coniferous species are lodgepole pine, white spruce (*Picea glauca* (Moench) Voss), black spruce (*P. mariana* (Mill.) B.S.P.), balsam fir (*Abies balsamea* (L.) Mill.), and alpine fir (*A. lasiocarpa* (Hook.) Nutt.). They cover a large geographic area encompassing a considerable variation in soil and site conditions. Soil moisture was probably the most important single variable affecting seedling establishment and growth.

Sampling was conducted in the springs of 1975 and 1977 in cutover blocks approximately ten growing seasons after logging. These blocks, therefore, represented a range of stocking and stand conditions in the region. Ground treatment (drag-type scarification) had generally followed logging within a year. On each cutover block sampled, three 0.04-ha² square plots were established to represent low, average, and high stocking levels in that stand.

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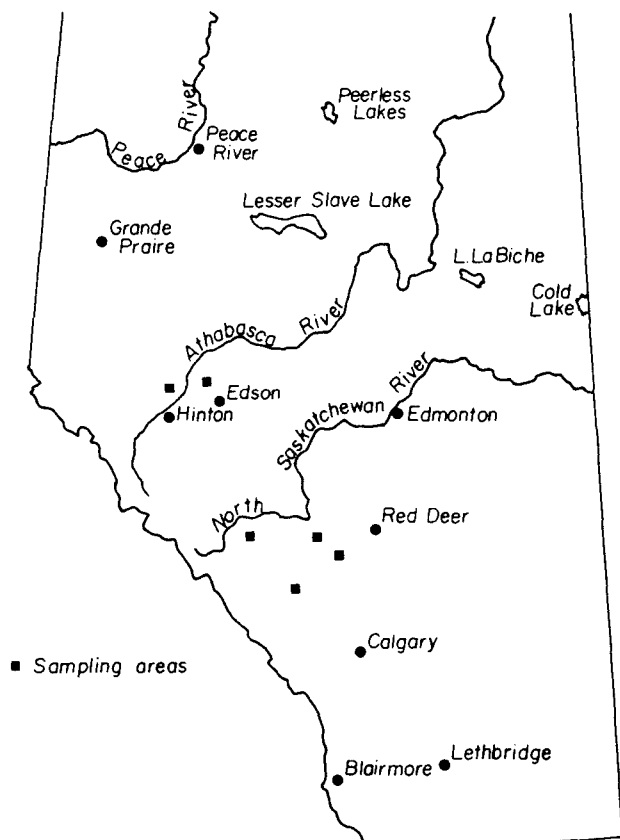


Figure 1.--General locations of sample plots.

The sample plots were subdivided into a grid of 10×10 4-m² (1 milacre) quadrats. On each quadrat, all seedlings 2 and 3 years old or older as well as vigorous advance growth were tallied by species, and the health of each individual recorded.

Data collected by J. Soos (on file at the Northern Forest Research Centre) in 1966 in 8-year-old lodgepole pine near the Upper Saskatchewan Ranger Station (Rocky-Clearwater Forest) were also used. This was a complete tally (100% sample) of pine regeneration only by a 4-m² quadrat of a 15.5-ha area where the original lodgepole pine stand had been destroyed by fire 8 years earlier. For this analysis, this sample was partitioned into contiguous 36- x 36-m plots (i.e., an 18 x 18 matrix of 4-m² quadrats). A total of 85 plots was used in the analysis. Plots that had roads or logging trails preventing regeneration were excluded from the analysis.

ANALYSIS

The number of seedlings per hectare in relation to stocking percentage was compiled from quadrat tallies on each plot considering only one, up to 2, 3, ..., 9 or all acceptable seedlings, viz, healthy 3-year-olds and older, and advanced growth per quadrat. Either pine or pine-spruce-fir were considered. Two quadrat sizes, 4-m² and 8-m², were used. The data were summarized by 5% stocking classes and freehand curves were drawn to class means.

RESULTS AND DISCUSSION

Figures 2 through 6 show trends of seedling densities per hectare in relation to stocking percentage when 1, 2, ..., 9 or all

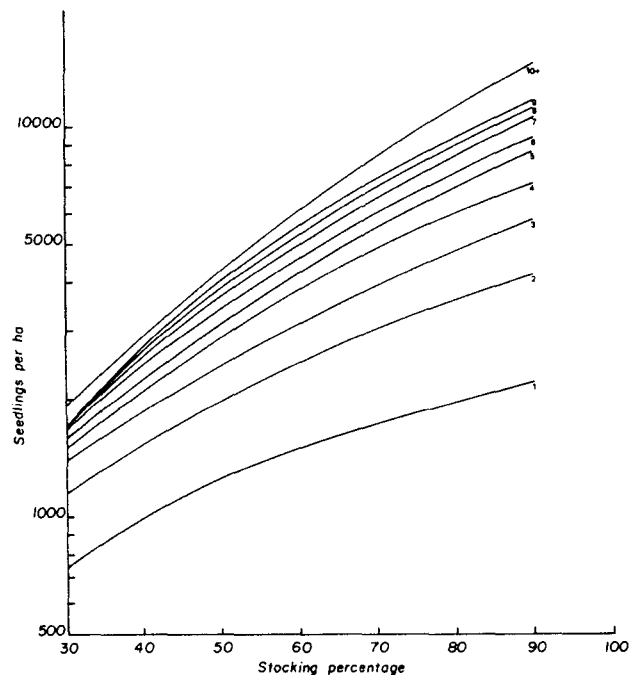


Figure 2.--Density-stocking relationships for pine after logging, based on 4-m² quadrats.

seedlings are considered. Figures 2 and 5 are based on 4-m² quadrats and those in figures 3, 4, and 6 on 8-m² quadrats. The implication of quadrat size in regeneration surveys in Alberta has been discussed at some length by Bella (1976).

These relationships indicate a substantially greater number of trees per unit area than is implied by a given stocking percentage. For instance, considering up to two pine trees per 4-m² quadrat means a density nearly twice as high at stocking levels above 50% than would be expected from the stocking percentage. At lower stocking, there are fewer extra seedlings, both in absolute and relative terms.

Increasing the number of trees counted per ha to 3, 4, ..., etc., after two trees means a fairly gradual increase in density per hectare; but there is a definite rise in the trend for "all" trees at higher stocking levels that indicates over-dense conditions. This suggests that, at higher stocking levels, a stocked quadrat often has two trees, although it may also have a clump of ten or more.

Essentially the same general relationship prevail when the trends are based on 8-m² quadrats (rather than 4-m²), although, as expected, they show lower tree numbers at low and medium stocking levels; at over 80% stocking (figs. 2 and 3), the two sets of trends tend to converge.

No substantial differences in seedling densities were found between logged areas and those regenerating after wildfire (fig. 3 vs. fig. 4), although a midrange of stocking (60-80%) density levels were higher after logging than after fire. These higher densities may arise from the clumpiness of pine regeneration associated with postlogging site treatment.

Spruce and fir, in addition to pine, in the quadrat tally do not seem to have much effect on these relationships, although a few more extreme-density values have occurred at high stocking levels with the inclusion of these two other conifers.

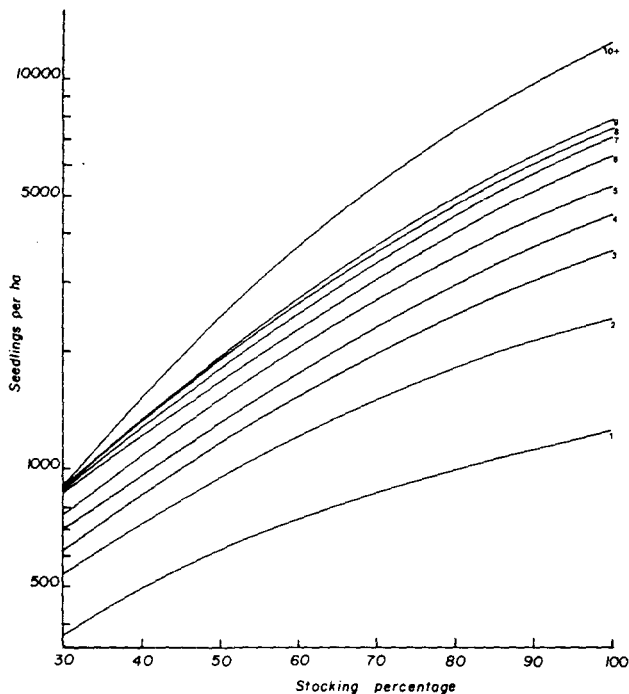


Figure 3.--Density-stocking relationships for pine after logging, based on 8-m² quadrats.

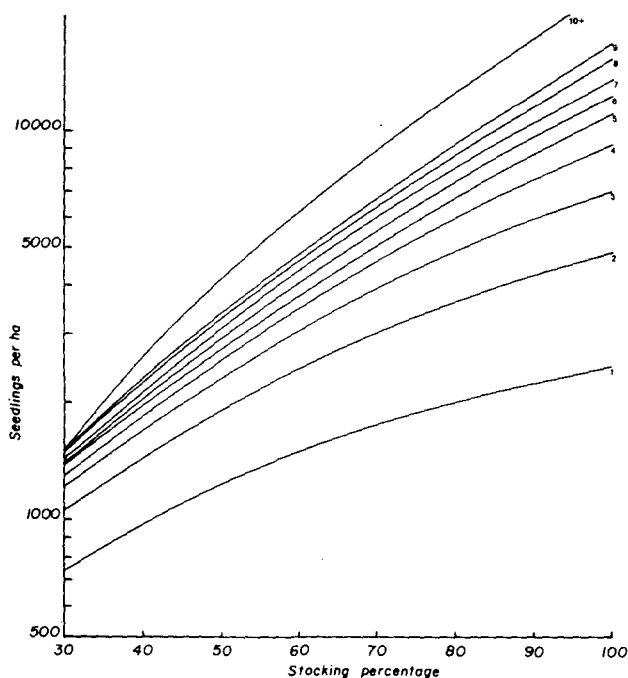


Figure 5.--Density-stocking relationships for pine-spruce-fir after logging, based on 4-m² quadrats.

CONCLUSIONS

Clumping and excessive crowding of lodgepole pine regeneration requires factual information on seedling densities in order to plan thinning treatments that will enhance merchantable wood production. Such requisite data may be obtained during regeneration surveys with relatively little extra work. Besides its direct use, such information would provide data for developing guide curves for the more important sites, cover types, and postlogging treatment combinations which later may be used to estimate seedling densities from stocking percentages.

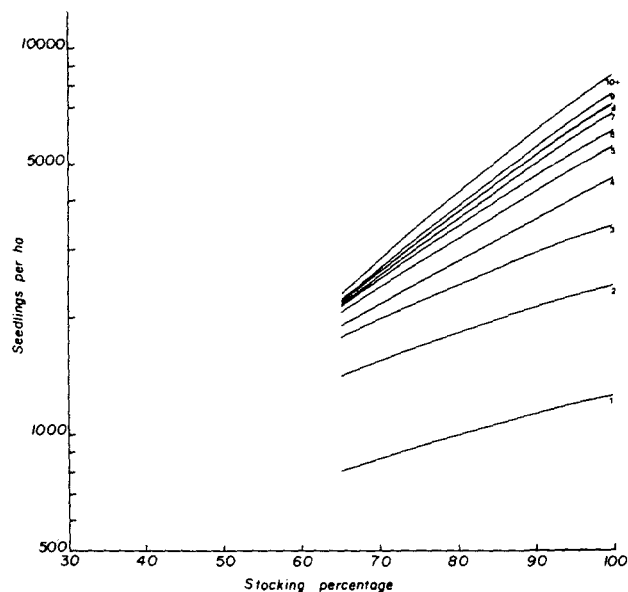


Figure 4.--Density-stocking relationships for pine after wildfire, based on 8-m² quadrats.

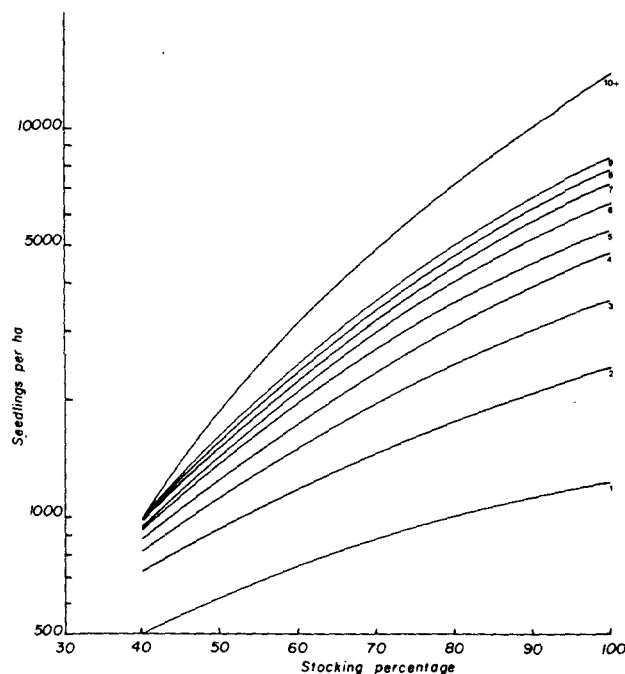


Figure 6.--Density-stocking relationships for pine-spruce-fir after logging, based on 8-m² quadrats.

LITERATURE CITED

- Bella, I.E. Assessment of regeneration stocking standards used in Alberta. Inf. Rep. NOR-X-211. Edmonton, Alberta: Environ. Can., Can. For. Ser., North. For. Res. Cent.; 1976.
- Bella, I.E.; J.P. DeFranceschi. Assessment of regeneration stocking standards used in Alberta: a follow-up. Inf. Rep. NOR-X-211. Edmonton, Alberta: Environ. Can., Can. For. Serv., North. For. Res. Cent.; 1978.
- Rowe, J.S. Forest Regions of Canada. Pub. No. 1300. Edmonton, Alberta: Environ. Can., Can. For. Service.; 1972.

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