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A BASAL AREA GROWTH MODEL FOR PEATLAND SECOND-GROWTH BLACK SPRUCE

INTRODUCTION:

Harvest with regeneration protection has become a preferred silvicultural technique for peatland black spruce (*Picea Mariana* (Mill.) B.S.P.) forests in the Northern Clay Section of the boreal forest in northeastern Ontario and Quebec.

Forecasts of stand growth, yield, and structure are needed for regional wood and wildlife habitat supply analyses, but even-aged stand forecasting techniques are inappropriate for the heterogeneous stands created by harvest with regeneration protection. For example, if stand age is considered equivalent to time since harvest, then empirical yield curves may substantially underestimate the yield of second-growth black spruce stands. Furthermore, uneven-aged management may be feasible for some peatland black spruce stands; even-aged stand forecasting techniques are even less suitable for this type of management. Individual-tree growth modeling is likely more suitable for forecasting the development of stands that are not managed with classical even-aged silvicultural systems. Growth models based on individual trees allow the exploration of a wide range of silvicultural manipulations.

Uneven-aged stands originating from horse-logging.

The objective of this research was to construct an individual-tree growth model capable of predicting the development of second-growth peatland black spruce stands under a range of management regimes.

LOCATION:

Plot and stem analysis data were obtained from a study comparing the structure of natural and second-growth peatland black spruce stands in northeastern Ontario (Groot and Horton 1994). Second-growth stands were originally harvested in the first half of the 20th century by horse skidding, which produced a post-harvest stand structure similar to the structure resulting from present day harvest with regeneration protection.

RESULTS:

The research involved two stages of modelling:
- Stage I: the calculation of past DBH (diameter at breast height) and plot basal area;
- Stage II: modelling the 5-year basal area growth of individual trees.

In Stage I analysis, basal area mortality steadily increased from negligible values in the first growth intervals to about 12% of the gross basal area growth in the final growth interval. Considerable stand-to-stand variation in stand characteristics was evident.

In the model, 5-year basal area growth of a tree was expressed as a function of tree diameter, stand-level competition, and peat thickness. There was considerable change in the growth-size relationship over time. A random parameter approach was applied in model construction to account for the spatial and temporal correlations of the observations. The proposed model explicitly incorporates factors normally included in a "random error" term and, therefore, should provide more sensitive tests of the contributions of the various factors to growth prediction. The estimated model showed only slight bias against the modeling data and the predicted stand basal area development was comparable with that given in other studies.

Despite the slight bias in the low-density stands, the model produced reasonable estimates of future stand basal area without any biased trends in later years. The average predicted basal area development corresponded to that of the best yield class as defined by Whynot and Penner (1992). The present model needs to be calibrated to cover the first 10-year period after harvest, when trees show a strong response to the harvest. Since it is probable that the pre-harvest

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The model is applicable to the heterogeneous structures created by current harvest with regeneration protection techniques.

density as well as the harvest intensity influence the rate of the growth response, these factors should be accounted for in the calibration.

CONCLUSIONS:

This individual-tree basal area growth model was developed from data representing a wide range of combinations of peatland black spruce individual tree and stand characteristics. The model showed low bias over this range and should be useful in predicting individual tree growth in second-growth stands of peatland black spruce.

MANAGEMENT IMPLICATIONS:

This model is well suited to serve as the core of a growth simulator applicable to the uneven-sized second-growth stands resulting from current harvest with regeneration protection operations in northeastern Ontario. Such a growth simulator, which would also need to include mortality and regeneration models, should provide better yield forecasts than yield tables derived from even-aged stands.

SOURCES OF RELEVANT INFORMATION:

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