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Canadian Forest Service, Great Lakes Forestry Centre

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DENSITY STRESS AND ITS EFFECTS ON ABOVEGROUND MODULAR COMPONENTS WITHIN JACK PINE AND BLACK SPRUCE STANDS

INTRODUCTION:

Knowledge of competition processes and their effects on dry matter partitioning within forests is important in terms of silvicultural decision making and size distribution modelling. The ability of most coniferous tree species to retain their aboveground modular components for several years (e.g., stem, branch, and foliage components) allows demographic patterns to be followed through historical tree and stand reconstruction techniques. Consequently, historical tree reconstruction techniques are useful tools in determining the effects of density-stress within coniferous forest populations.

LOCATION/SITE:

The sample design is reflective of current management practices used in jack pine and black spruce stands in the boreal forest. Study sites are located on the transition between the Central Plateau and Nipigon Forest Sections of the Canadian Boreal Forest Region. Other study sites include Grand Falls, Newfoundland of the Canadian Boreal Forest Region, which is composed of black spruce stands.

METHODOLOGY:

The sample tree is divided into its component parts; stem, branch and foliage growth are estimated by age-class. Stem analysis consists of sectioning the main stem at the following points: 0.15m aboveground, 1.30m aboveground, and 10% height intervals along the entire stem. Stump height, interval lengths and cutting method are also recorded. The inside and outside bark diameters for each cross-sectional sample are determined and recorded. The fresh mass of each section is then determined. For each cross section, two geometric mean diameters are identified and treated with water or ferric nitrate to increase resolution of the annual rings. Using an annual ring measuring machine, the age of each cross section is determined. Using this system, the width of each annual ring along each diameter-based radius is obtained. Increment data is verified and processed using Newton's stem analysis algorithm. Destructive crown analysis consists of subdividing branch and foliage components by year of formation (age-class). Together these techniques allow for the estimation of component growth rates of individual trees.

RESULTS:

It was found that mass distribution among modular components was related to density stress. Results indicated that a reduction in stem growth is due to increasing competition from larger-sized competitors. Also, density stress favoured the partitioning of dry matter to foliage at the expense of branch production.

CONCLUSIONS:

In the studies completed on black spruce stands, density-stressed populations showed asymmetrical size distributions in which mean tree size decreased with increasing density. Increased density stress favoured the partitioning of dry matter to foliage at the expense of stem and branch components. Decreased partitioning of resources to stem and branch components with increasing density stress is a result of a hierarchical carbon allocation pattern, in which stem and branch production has a lower priority than foliage, root, and storage requirements.

MANAGEMENT INTERPRETATIONS:

Historical tree reconstruction techniques can be used for both jack pine and black spruce. After establishing high initial population densities on recently disturbed sites, juvenile spacing is implemented to increase merchantable yields and attain early stand operability. One of the objectives of this study is to quantitatively assess the long-term effect of different juvenile spacing regimes on partitioning patterns among above-ground modular components using sequential competition analysis. The other objective is to develop a spatially explicit stand density management model. The results obtained from this study will assist in the development of operational tools for use in sustainable forest management in addition to extending competition theory.

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SOURCES OF RELEVANT INFORMATION:

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