frontline EXPRESS
Canadian Forest Service, Great Lakes Forestry Centre

Bulletin No. 10

STAND DENSITY MANAGEMENT DIAGRAMS AND THEIR UTILITY IN BLACK SPRUCE MANAGEMENT

INTRODUCTION:

Stand density management is the process of controlling the level of growing stock through density manipulation to realize specified management objectives (Newton 1997a). Density manipulation involves regulating the number and arrangement of individual stems per unit are a through initial spacing or a temporal sequence of thinning events. Stand density management diagrams (SDMDs) graphically represent the relationship between yield, density and mortality at various stages of stand development. These diagrams provide resource managers with an objective method of determining density control schedules, and determining initial spacing and/or thinning densities necessary for specific forest, vegetation or wildlife management objectives.

LOCATION/SITE:

An SDMD for black spruce (*Picea mariana*) was developed from a database consisting of 49 0.081-ha permanent sample plots (PSPs) and 257 open-grown sample trees located in naturally regenerated black spruce stands (>90% black spruce by basal area). This study area is located in the boreal forest region of central Newfoundland. An SDMD for managed black spruce standswas developed using data derived from 37 variable-size temporary and permanent sample plots, and 257 open-grown sample trees. The plots were located within 15 plantations and 4 precommercially thinned stands situated throughout central and western Newfoundland, northwestern New Brunswick and northern Ontario.

RESULTS:

A stand density management diagram graphically illustrates the following relationships: 1) approximate crown closure line at a relative density, 2) size-density condition at which maximum stand production is achieved, 3) lower limit of the zone of imminent competition-mortality, 4) maximum size-density relationship, 5) isolines for mean dominant height, quadratic mean diameter and merchantability ratio. Initial plantation densities can be superimposed on the diagram and their expected size-density trajectories derived. Future estimates of mean volume, densities, quadratic mean diameters, merchantable and total volumes, and total basal areas can be obtained using the dominant height isolines in combination with the appropriate site index curve. The relationships represent the cumulative effect of various underlying competition process on tree and stand yeild parameters..

CONCLUSIONS:

The SDMS developed for black spruce graphically illustrates the relationships between yield, density and mortality at various stages of stand development. Subject stands can be superimposed on the diagram and their expected natural thinning trajectories derived (Newton and Weetman 1993). Also, future estimates of mean volumes, densities, quadratic mean diameters, merchantable and total volumes, and total basal areas can be obtained by using the dominant height isolines. The diagram can be used to illustrate the dynamics of managed black spruce stands using the dominant height isolines in combination with the appropriate site index curve. To reduce the likelihood of graphical interpolation error and to increase the usage of SDMDs in silvicultural decision making, algorithmic versions (software) of the SDMDs have been developed. Furthermore, these PC-based software programs are available for download via the World Wide Web. See Newton (1997b; 1998) for specific instructions on acquiring the programs via the Internet.

MANAGEMENT INTERPRETATIONS:

SDMDs are biologically based models that allow forest managers to formulate results of various density manipulations. These diagrams are useful in situations where density management decisions must be made in the absence of long-term response information on managed stands. A forester would be able to determine the heights and diameters of which black spruce stands start to close and incur mortality. SDMDs provide sustainable forest resource managers with an analytical tool to optimize the usage of the productive forest land base at the stand-level by selecting an approximate density regulation regime that maximizes forest production throughout the entire rotation. For example, the diagrams can be used to determine and subsequently maintain site occupancy levels which yield the greatest returns in total volume per unit area and individual tree size via a series of thinning events. SDMDs can be used for forest management objectives including wildlife management, carbon management, biodiversity maintenance and vegetation management.

SOURCES OF RELEVANT INFORMATION:

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ISSN 1496-7847

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