A brief review of Stocking and Stand Density Recommendations.

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The NFC committee on Boreal Forest Stocking Standards has been asked to provide plot data to assist the State of Alaska Division of Forestry with development on new stocking recommendations. As head of this committee, I thought it would be helpful to provide a little background information on Forest Stocking and Stand Density estimates.

The term stocking typically reflects an indication of trees per area and for a given stand is commonly expressed as a percentage of that which would be expected for the same site and stand age of a standard or reference stand. Such reference stands, commonly called fully stocked or normal stands, are based upon average values collected from "normal stands" measured throughout the geographic area.

For many years now, there has been an interest in developing better guidelines for estimating boreal forest spruce site full stocking recommendations. Stocking standards assist forest managers with development of silvicultural prescriptions and are commonly the basis for projection of stand yields. Minimum stocking standards are commonly set by law in many states and serve as a basis for the application of forest incentive programs by landowners. It should be emphasized that measures of stand density are features of a stand and are used by silviculturist to describe a stand of trees. Stocking is an analytical tool applied to an existing stand and are commonly used to serve as a basis for growth and yield assessment and for making estimations of stand development in order to meet landowners objectives.

Traditionally, a fully stocked stand represented a stand that produced maximum growth for a given average tree diameter and site class and was considered to be a normal stand, representing normal stocking and was the basis for development of normal yield tables. Normal stand tables serve as a basis for the comparison of stands of similar species, and age and usually exhibit even-aged stand structure (a single cohort).

Reineke (1933) reported that the space occupied by trees in even-aged normal (fully stocked) stands increased exponentially as the trees increase in diameter. This space requirement and subsequent reduction of trees per area as average stand diameter increases was found to follow the -3/2 power function. This relationship was the basis for the Stand Density Index calculation used by Reineke based upon a standard stand diameter of 10 inches. As a stand ages and average stand diameter increases there is a proportional reduction in the number of trees per area which is somewhat species specific but entirely independent of site index or stand age.
However, these relationships become complicated in stands that have a high
degrees of clumpiness, of mixed species composition, or contain multiple age
groups or cohorts, and whether the stands have been fully stocked leading up to
their present condition.

A complications of these features for spruce stands in the boreal forest is that
they commonly don’t develop naturally as fully stocked pure species stands,
commonly developing first in mixed hardwood/spruce stands of varying age class
distributions. Another complication is the narrow crowns with high leaf area
index common with individual spruce trees making it possible to have very high
density stands and a challenge to determine when full site occupancy has been
achieved given site conditions and stand history. Even well stocked white spruce
stands may not exceed 70% crown closure.

There may be a range of stocking for a given spruce site all having closely the
same average diameter but differing in total stand volumes. Relatively older
mature stands of white spruce are more likely influenced by stand histories than
tree physiology and tree volumes more strongly influenced by diameter growth
than height growth.

Wilbur Farr (1967) published results of 99 samples plots he measured in well-
stocked white spruce stands throughout the Interior of Alaska. Data from these
plots was used to calculate stocking and volume tables and an SDI curve for
white spruce well stocked (normal) stands. However, research conducted by
Susan Vogt and reported in her masters thesis (A Characterization of Mixed
Forest Stands in the Tanana Valley, Alaska. 2002) gives a good indication of the
great deal of variability found in mixed species stands in the Interior. Her results
indicate that for the mixed stands sampled that the white spruce component
would not likely reach full site occupancy within a 120 year rotation based upon
Farr’s stocking tables for well-stocked stands. However, when considering all
tree species present, many of the stands possessed near total stocking (based
upon full stocking numbers used by Farr). If we are managing for mixed species
stand composition, it would appear that the spruce component stocking
recommendations could be substantially less that that for pure white spruce
stands.

Full site occupancy by multiple cohorts of spruce developing in a mixed canopy
has raised concern over site productivity as compared to a single cohort stand
structure. Kevin O’Hara (Dynamics and Stocking-Level Relationships of Multi-
Aged Ponderosa Pine Stands. 1996) found for multiple cohort Ponderosa pine
stands that there was no indication of lost productivity comparing a single cohort
to a multiple cohort stand structure. However, this relationship may be
somewhat species specific, given the canopy and stem growth characteristics of
P. pine.
Members of the NFC have been asked by the State Division of Forestry if they could assist in providing plot data to support efforts to develop a new standard for stocking recommendations for white spruce stands. It is my hope that we can be of assistance with this much needed work.