CENTRE FOR ENHANCED FOREST MANAGEMENT

ADVANCES IN FORESTRY RESEARCH

DEPARTMENT OF RENEWABLE RESOURCES

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Estimating and managing understory light using aspen density and diameter in central and north-eastern B.C.

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Past studies report strong relationships between understory light levels and the basal area of aspen in boreal forests (Comeau 2001, Lieffers et al. 2002). Based on these relationships, density and diameter can be used to estimate light levels in the understory of aspen stands and in developing stocking tables to guide prescriptions for spacing of aspen to enhance growth of understory spruce. This note summarizes results from a study undertaken to determine whether similar relationships reported by Comeau (2001) from a study conducted near Fort St. John, are applicable to aspen dominated stands west of Prince George. A table to assist with development of tending prescriptions is presented.

Data were collected in the summer of 2000 from two aspen dominated stands (23 and 26 years old) in the Fort St. James vicinity. At both locations, eight 3.99 m or 5.64 m radius sample plots were used characterize aspen density, diameter and basal area. At each plot center, light was measured 1.5 m above the ground using a LiCor LAI-2000 Plant Canopy Analyzer (LiCor Inc., Lincoln Nebraska). Results are compared to those obtained from six aspen stands near Fort St. John in north-eastern B.C.

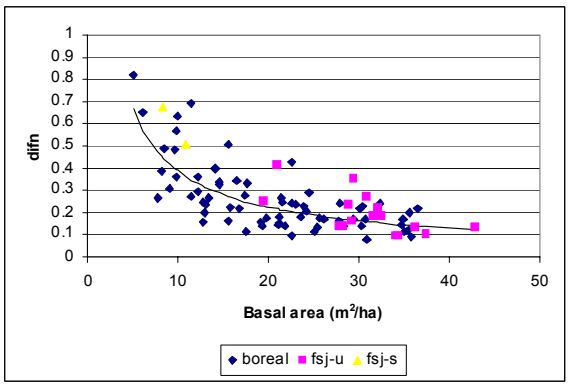

Figure 1. This graph shows the relationship between understory light (*difn*) and basal area (*BA*). The line is described by the equation: $Ln(difn)=0.8583 - 0.7869 \times ln(BA)$ (n=86; R^2=0.5252; RMSE=0.3608). Yellow triangles indicate post-treatment values for two spaced plots.

Analysis indicated that data from Fort St. James could be pooled with data from Fort St. John into a single relationship. In addition, two spaced stands fit on the same curve as un-spaced stands. The primary reason for lower light levels, compared to those in the boreal, is the higher basal area found in the Fort St. James stands.

Table 1 provides a means for estimating transmittance levels based on stand diameter (quadratic mean diameter) and stand density and can be used as a basis for developing prescriptions for spacing of young aspen stands to enhance white spruce growth. Similar tables have been prepared by Pinno and Lieffers (unpubl) for Alberta. These relationships are intended to be used in association with small scale (3.99 m radius or 5.64 m radius) assessment plots.

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Further Information:

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Logan, K.T. 1969. Growth of tree seedlings as affected by light intensity: IV. Black spruce, white spruce, balsam fir, and eastern white cedar. Canadian Forestry Service. Ottawa. Publication No. 1256.

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Table 1. Transmittance values for various combinations of quadratic mean diameter (qmd) and stand density (tph=#/ha) based on the equation shown in figure 1. Survival of white spruce is expected to be reduced substantially when transmittance is below 0.15 (Logan 1969, Kobe and Coates 1997) and growth of white spruce is expected to be approaching maximum values when transmittance exceeds 0.60 (Wright et al. 1998). Values in the range between 0.15 and 0.60 are shown in bold.

	tph																					
qmd (cm)	600	1000	1500	2000	3000	4000	5000	6000	7000	8000	9000	10000	11000	12000	13000	14000	15000	16000	17000	18000	19000	20000
2.5									0.893	0.804	0.733	0.675	0.626	**0.584**	**0.549**	**0.518**	**0.490**	**0.466**	**0.444**	**0.425**	**0.407**	**0.391**
3							0.873	0.757	0.670	0.603	**0.550**	**0.506**	**0.470**	**0.439**	**0.412**	**0.388**	**0.368**	**0.350**	**0.333**	**0.319**	**0.305**	**0.293**
3.5						0.817	0.685	**0.594**	**0.526**	**0.473**	**0.432**	**0.397**	**0.368**	**0.344**	**0.323**	**0.305**	**0.289**	**0.274**	**0.262**	**0.250**	**0.240**	**0.230**
4					0.830	0.662	**0.555**	**0.481**	**0.426**	**0.384**	**0.350**	**0.322**	**0.299**	**0.279**	**0.262**	**0.247**	**0.234**	**0.222**	**0.212**	**0.203**	**0.194**	**0.187**
4.5				0.949	0.690	**0.550**	**0.461**	**0.400**	**0.354**	**0.319**	**0.291**	**0.267**	**0.248**	**0.232**	**0.218**	**0.205**	**0.194**	**0.185**	**0.176**	**0.168**	**0.161**	**0.155**
5				0.804	**0.584**	**0.466**	**0.391**	**0.339**	**0.300**	**0.270**	**0.246**	**0.227**	**0.210**	**0.196**	**0.184**	**0.174**	**0.165**	**0.157**	0.149	0.143	0.137	0.131
5.5			0.868	0.692	**0.503**	**0.401**	**0.336**	**0.291**	**0.258**	**0.232**	**0.212**	**0.195**	**0.181**	**0.169**	**0.159**	**0.150**	0.142	0.135	0.128	0.123	0.118	0.113
6			0.757	0.603	**0.439**	**0.350**	**0.293**	**0.254**	**0.225**	**0.203**	**0.185**	**0.170**	**0.158**	0.147	0.138	0.130	0.124	0.117	0.112	0.107	0.103	0.099
6.5		0.918	0.667	**0.532**	**0.387**	**0.308**	**0.259**	**0.224**	**0.198**	**0.179**	**0.163**	**0.150**	0.139	0.130	0.122	0.115	0.109	0.104	0.099	0.094	0.090	0.087
7		0.817	**0.594**	**0.473**	**0.344**	**0.274**	**0.230**	**0.199**	**0.177**	**0.159**	0.145	0.133	0.124	0.116	0.109	0.102	0.097	0.092	0.088	0.084	0.081	0.077
7.5		0.733	**0.533**	**0.425**	**0.309**	**0.246**	**0.206**	**0.179**	**0.158**	0.143	0.130	0.120	0.111	0.104	0.097	0.092	0.087	0.083	0.079	0.075	0.072	0.069
8		0.662	**0.481**	**0.384**	**0.279**	**0.222**	**0.187**	**0.162**	0.143	0.129	0.117	0.108	0.100	0.094	0.088	0.083	0.079	0.075	0.071	0.068	0.065	0.063
8.5		0.602	**0.437**	**0.349**	**0.253**	**0.202**	**0.170**	0.147	0.130	0.117	0.107	0.098	0.091	0.085	0.080	0.075	0.071	0.068	0.065	0.062	0.059	0.057
9	0.822	**0.550**	**0.400**	**0.319**	**0.232**	**0.185**	**0.155**	0.134	0.119	0.107	0.098	0.090	0.083	0.078	0.073	0.069	0.065	0.062	0.059	0.057	0.054	0.052
9.5	0.755	**0.505**	**0.367**	**0.293**	**0.213**	**0.170**	0.142	0.123	0.109	0.098	0.090	0.082	0.077	0.071	0.067	0.063	0.060	0.057	0.054	0.052	0.050	0.048
10	0.697	**0.466**	**0.339**	**0.270**	**0.196**	**0.157**	0.131	0.114	0.101	0.091	0.083	0.076	0.071	0.066	0.062	0.058	0.055	0.053	0.050	0.048	0.046	0.044
10.5	0.645	**0.432**	**0.314**	**0.250**	**0.182**	0.145	0.122	0.105	0.093	0.084	0.077	0.070	0.065	0.061	0.057	0.054	0.051	0.049	0.046	0.044	0.043	0.041
11	**0.599**	**0.401**	**0.291**	**0.232**	**0.169**	0.135	0.113	0.098	0.087	0.078	0.071	0.065	0.061	0.057	0.053	0.050	0.048	0.045	0.043	0.041	0.040	0.038
11.5	**0.559**	**0.374**	**0.272**	**0.217**	**0.158**	0.126	0.105	0.091	0.081	0.073	0.066	0.061	0.057	0.053	0.050	0.047	0.044	0.042	0.040	0.038	0.037	0.035
12	**0.523**	**0.350**	**0.254**	**0.203**	0.147	0.117	0.099	0.085	0.076	0.068	0.062	0.057	0.053	0.049	0.046	0.044	0.042	0.039	0.038	0.036	0.034	0.033
12.5	**0.490**	**0.328**	**0.238**	**0.190**	0.138	0.110	0.092	0.080	0.071	0.064	0.058	0.054	0.050	0.046	0.044	0.041	0.039	0.037	0.035	0.034	0.032	0.031
13	**0.461**	**0.308**	**0.224**	**0.179**	0.130	0.104	0.087	0.075	0.067	0.060	0.055	0.050	0.047	0.044	0.041	0.039	0.037	0.035	0.033	0.032	0.030	0.029
13.5	**0.434**	**0.291**	**0.211**	**0.168**	0.122	0.098	0.082	0.071	0.063	0.057	0.052	0.047	0.044	0.041	0.039	0.036	0.034	0.033	0.031	0.030	0.029	0.027
14	**0.410**	**0.274**	**0.199**	**0.159**	0.116	0.092	0.077	0.067	0.059	0.053	0.049	0.045	0.042	0.039	0.036	0.034	0.033	0.031	0.030	0.028	0.027	0.026
14.5	**0.388**	**0.260**	**0.189**	**0.150**	0.109	0.087	0.073	0.063	0.056	0.051	0.046	0.042	0.039	0.037	0.034	0.033	0.031	0.029	0.028	0.027	0.026	0.025
15	**0.368**	**0.246**	**0.179**	0.143	0.104	0.083	0.069	0.060	0.053	0.048	0.044	0.040	0.037	0.035	0.033	0.031	0.029	0.028	0.026	0.025	0.024	0.023