Nominal Diameter-at-Breast Height and Tree Height Values for Canadian Forest Fire Behavior Prediction (FBP) System Fuel Types for use in Albini's Maximum Spotting Distance Model

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In an earlier document[1] I had suggested that "Nominal or representative DBH and Tree Height values need to be assigned to each of the FBP System the coniferous (C) and mixedwood (M) fuel types" in implementing Albini's (1979)[2] model for predicting maximum spotting distances for single or group tree torching firebrand sources into the *PROMETHEUS* wildland fire growth model. Of course, a user should probably still have the option to input specific tree parameters in addition to relying on default values.

I recently received a request from Judi Beck (Leader-Fire Sciences, Protection Program, B.C. Ministry of Forests, Victoria) for this kind of information for use in a fire planning application. This document will serve a two-fold purpose: one to address this request and secondly, provide a vehicle for subsequent discussion and revisions.

Most of the fuel types in the Canadian Forest Fire Behavior Prediction (FBP) System are reflections of different experimental fire datasets. However, certain FBP System fuel types are often dominated by a particular study. Thus, the relevant publications were consulted in deriving the values for diameter-at-breast height (DBH) and tree height (TH) contained in Table 1.

Table 1

FBP System Fuel Type(s)	DBH (cm)	TH (m)	Source(s)
C-1 Spruce-Lichen Woodland	7[a]	10	Alexander et al. (1991)
C-2 Boreal Spruce	4[a]	7	Alexander (unpublished)
C-3 Mature Jack or Lodgepole Pine	18	18	Stocks (1989)
C-4 Immature Jack or Lodgepole Pine	5	10	Stocks (1987a)
C-5 Red and White Pine	33	25	Van Wagner (1963, 1972)
C-6 Conifer Plantation	15	14	Van Wagner (1968, 1977)
C-7 Ponderosa Pine/Douglas-fir	25	20	Author estimate (MEA)
M-1/M-2 Boreal Mixedwood-Leafless/Green	11	13	Author estimate (MEA)
M-3/M-4 Dead Balsam Fir/Mixedwood-Leafless/Green	10	8	Stocks (1987b)

[a] Represents the mean DBH.

[1] Alexander, M.E. Some Initial Thoughts on Possibly Incorporating Albini's Maximum Spot Fire Distance Models into *PROMETHEUS.* FERIC Wildland Fire Operations Research Group. Dated February 9, 2004.
[2] Albini, F.A. 1979. Spot fire distance from burning trees – a predictive model. USDA For. Serv. General Technical Report INT-56.

In deriving these nominal DBH and HT values, due consideration had to be given to the nominal crown base height values that have been assigned to the FBP System fuel types that are susceptible to crowning[3]. In most cases (C-3, C-4, C-5, C-6, M-3, M-4) this was a relatively straight forward task because the fuel types for practical purposes involved a single stand cohort.

Structurally, FBP System fuel types C-1 and C-2 are comprised of multi-tiered stems with continuous vertical fuel continuity. For these two fuel types it was felt that the average stem DBH was valid for the present application but that the mean height should be increase by 2.58 of the standard deviation (i.e., thereby encompassing 99% of a normally distributed population).

FBP System fuel type C-7 is also a structurally complex fuel type with a distinctly two-storied stand structure in most situations (i.e., a tall overstory with the possibility of dense understory thickets). In this particular case, there wasn't a single experimental fire study that dominated the development of the C-7 models contained in the FBP System. Although some spot stand measurements exist for C-7 (e.g., McAlpine et al. 1990), the values presented in Table 1 are a reflection of the ponderosa pine and Douglas-fir overstory. Assuming a 20 m TH, the DBH was in turn inferred from available stem data (e.g., Brown 1978).

The M-1 and M-2 FBP System fuel types are not based on specific field studies but rather outputs from C-2 and D-1 (leafless aspen) coupled with an assumption regarding fire spread during the summer months for the latter fuel type. As the member of the CFS Fire Danger Group at the time who penned the descriptions for these two fuel types in the mid 80s, I imagined that they would applied to stands some 10-15 m in height or so. So the values proposed in Table 1 are based on this general assumption coupled with stem data in the literature (e.g., Stelfox 1995).

[3]As outlined in the publication Development and Structure of the Canadian Forest Fire Behavior Prediction System (For. Can. Inf. Rep. ST-X-3, p. 35), "Crown base height is a critical factor in the crowning criterion; however, the theory on which the crown fire criterion is based was itself dependent on empirical data for its final quantitative form. The crown base height assigned to each fuel type is therefore the result of some trial. While the independent fuel type description incorporates some indication of the crown base height, the assigned value for each fuel type had to match the general pattern of crown involvement. The final assigned crown base height values represent the real forest structure as well as possible."

Reference Sources in Table 1

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