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SLASH WEIGHT AND SIZE DISTRIBUTION OF WHITE SPRUCE AND LODGEPOLE PINE

(Project A-601)

by

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Calgary, Alberta
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ABSTRACT

A simple and practical method is described for predicting slash weight and proportion of fine fuels. Sixty white spruce and 101 lodgepole pine trees differing in site and stand conditions were felled, measured and the unmerchantable stem and all branchwood weighed in west-central Alberta. A graphical analysis showed that the slash weight-merchantable cubic foot ratios for both species varied inversely with tree diameter for the range of diameters sampled. White spruce has a higher slash weight-merchantable cubic foot ratio and a higher proportion of fine fuels than lodgepole pine.

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A. D. Kiil[2]

INTRODUCTION

Forest managers interested in the application of prescribed fire as a hazard reduction and a silvicultural tool are hindered by a lack of quantitative measures of fuels. This paper presents a simple method of predicting slash weight and proportion of fine fuels from tree diameter for white spruce and lodgepole pine.

Slash weight and size are two important factors influencing the degree of forest fire hazard on logged-over areas. An objective evaluation of slash in terms of its burning potential requires that these factors be known. Several workers have developed methods of estimating foliage and branchwood weight from certain stem and crown characteristics (Kittredge 1944, Storey, Fons and Sauer 1955, Brown 1963 and Muraro 1964), while others (Fahnestock 1960 and Chandler 1960) have prepared crown weight tables.

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Slash weight is defined as the oven-dry weight of the entire crown and unmerchantable stem less than 4 inches in diameter. Crown weight is the oven-dry weight of the entire crown, including bridge fuels (dead branches). Fine fuels include all parts of the stem and crown less than $\frac{1}{2}$ inch in diameter.

METHODS

The data for this report were collected in 1963-64 on the lease limits of North Western Pulp and Power Limited near Hinton, Alberta in conjunction with an extensive study of stem and crown parameters. The study area is located in the transition zone between the Upper and Lower Foothills Sections of the Boreal Forest Region (Rowe). White spruce (Picea glauca) and lodgepole pine (Pinus contorta var. latifolia) are the two important commercial species.

Sixty white spruce and 101 lodgepole pine trees were felled, measured and their crowns and unmerchantable stems weighed. Each tree was selected on the basis of a full symmetrical crown and every effort was made to sample over a wide range of site and stand conditions. Measurements of each tree included diameter at breast height to the nearest 1/10 inch, and total height, crown length and crown width to the nearest 1/10 foot. The stem was divided into four sections of equal length. The proportion of fine fuels was determined from three sample branches taken from the top, middle and bottom third of each section supporting green branches. The material was then separated into three size-classes, namely

(1) up to ½" (i.e. fine fuels), (2) ½" - 2" and (3) 2" and over. All remaining crown and unmerchantable stem components less than 4 inches in diameter were weighed by sections and sampled for moisture content. The fuel samples were oven-dried in the field laboratory for 24 - 36 hours at about 212° F. Oven-dry weights of all fuel components were calculated using the per cent of oven-dry weight represented by the samples taken from each tree.

A height-diameter curve was drawn for each species. Merchantable cubic foot volumes were calculated using curve heights and Alberta form class volume tables (Alberta Department of Lands and Forests, 1962). The slash weight - merchantable volume ratios and the mean weights of fine fuels were plotted by 2-inch diameter classes and fitted with free-hand curves.

RESULTS AND APPLICATION

From Figure 1 the ratios of slash weight per merchantable cubic foot for both white spruce and lodgepole pine vary inversely with diameter at breast height, and within the range of diameters sampled, white spruce has a higher ratio than lodgepole pine. White spruce slash contains a higher proportion of fine fuels than lodgepole pine within the range of diameters sampled, with the maximum for both species occurring in the 8 to 12 inch diameter range (Figure 2). The relatively low proportion of fine fuels in the low diameter classes is due to the relatively heavy unmerchantable stem.

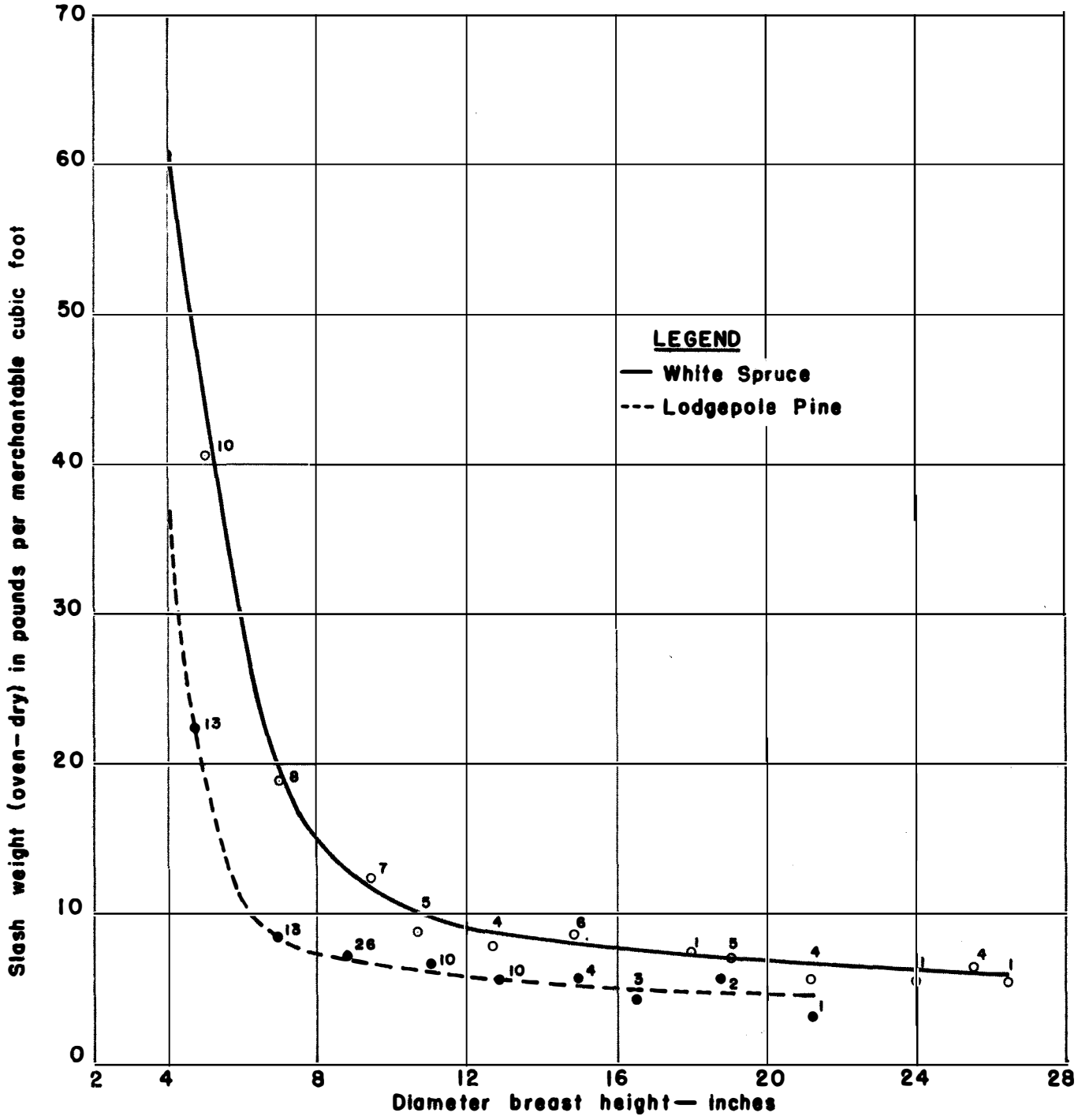

Figure I. Relation of Slash Weight per Merchantable Cubic Foot by d.b.h. Classes

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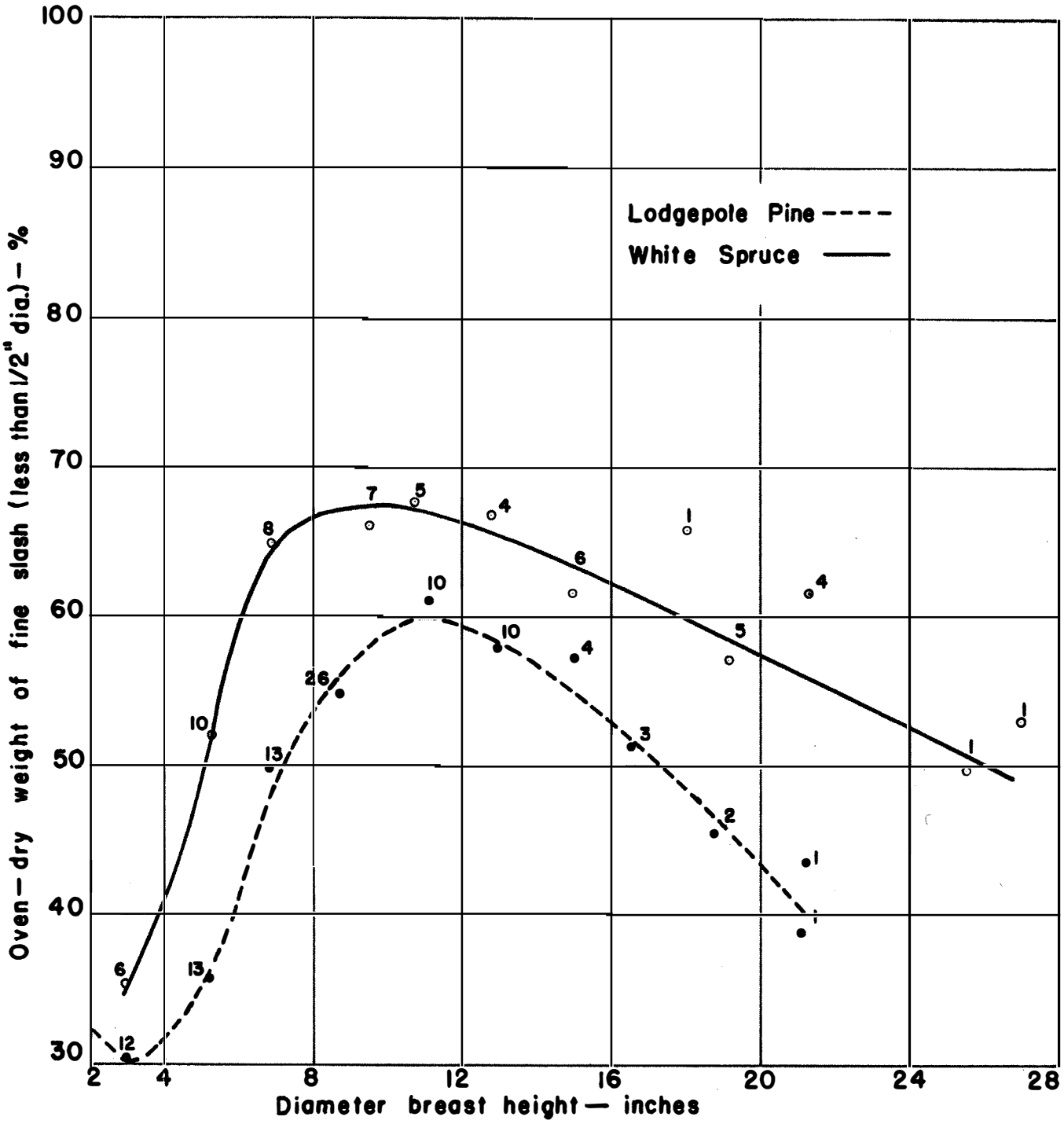

Figure 2. Relation of Fine Fuels to Total Slash Weight of White Spruce and Lodgepole Pine by d.b.h. Classes

GRL

Table 1 shows the method of calculating total slash weight and weight of fine fuels for a hypothetical white spruce stand. The merchantable cubic foot volume for each diameter class is obtained from merchantable cubic foot volume tables (4 inch top diameter). Slash weight-merchantable volume ratios and proportional weights of fine fuels are obtained from Figures 1 and 2 respectively. All calculation have been carried out on a per acre basis.

Table 1. A procedure for calculating slash weight and size distribution of a hypothetical white spruce stand.

Dbh Class	No. of Trees	Merch. vol. (a)	Slash Weight Per Merch. Cu. Ft. Vol. (b)	Slash Weight (axb)	Weight of Fine Slash (c)	Weight of Fine Slash $\frac{(axb)(c)}{(100)}$
		cu.ft.	lbs.	lbs.	per cent	lbs.
6	10	30	24.8	744	59	439
8	15	100	14.8	1,480	67	992
10	20	240	10.9	2,616	68	1,779
12	25	480	9.0	4,320	67	2,894
14	30	900	8.3	7,470	65	4,856
16	25	900	7.8	7,020	63	4,423
18	15	800	7.2	5,760	60	3,456
20	10	700	6.9	4,830	58	2,801
Totals	150	4,150		34,240		21,640

Total slash weight is 34,200 pounds per acre, or 17.2 tons, of which 21,600 pounds, or 10.8 tons, is fine slash.

When the diameter distribution of a stand is unknown, average stand diameter and total merchantable cubic foot volume per acre can be used to obtain an approximate estimate of slash weight and size distribution. For example, the average stand diameter of the hypothetical white spruce stand is 13.1 inches, yielding 4,150 merchantable cubic feet of wood per acre. Referring to Figure 1, a tree 13.1 inches in diameter yields about 8.7 pounds of slash per merchantable cubic foot and the resulting slash weight per acre is 8.7 x 4,150 = 35,690, or 17.8 tons. From Figure 2, the proportional weight of fine fuels is 65 per cent of the total slash weight, or 11.6 tons.

While average stand diameter can be used to determine approximate slash weight a more reliable estimate is probable, particularly for uneven-aged stands, from the sum of the products of the merchantable cubic foot volumes and the corresponding slash weight - merchantable cubic foot volume ratios for each diameter class.

The results of this study are based on sample trees supporting full symmetrical crowns. Therefore, an overestimate of slash weight by the method described is likely for very densely growing trees with short and often irregular crowns. Open-growing trees, on the other hand, usually support long and symmetrical crowns and an underestimate is probable. The error of estimate should be least in merchantable stands as most data collected reflect stem and crown characteristics commonly found in these stands.

It is recognized that while the slash weight - merchantable volume ratios vary inversely with d.b.h., they are influenced also by other stem and crown characteristics, including crown length and width, tree height, and age. Fahnestock (1960) and Brown (1964) have tested the relationships between crown weight and various stem and crown characteristics and have developed crown weight prediction equations. From a cursory examination of the data it appears that crown length and width account for most of the variation in slash weight for the range of diameters sampled.

The limitations of predicting slash weight and weight of fine fuels from tree diameter are recognized. While the accuracy of the method has not been tested in practice, the procedure is simple and according to Fahnestock (1960), "any objective method of calculating slash quantity is vastly superior to the guesswork used heretofore".

The results of this study are based on the slash weight-merchantable volume ratios and proportional weights of fine fuels in relation to d.b.h. for white spruce and lodgepole pine. Additional work is in progress to determine the effects of several stem and crown variables, including crown length and width, on slash weight and size distribution.

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