Question about Taper

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A cruise sample was collected from a single stand. It included 15 plots using a 27.78 basal area factor (Baf) expansion for sample trees. Every tree was measured for both Dbh and total height. The Dbh measurements were to the nearest 0.1-inch. Every tree also had a Girard Form Class measurement taken at 17-foot height. These Form Class values were in the range 69 to 87 as whole values across all species in the cruise. This taper observation was loaded to the FPS Cruise Compiler as a diameter at 17-foot height by multiplying the Form Class times Dbh.

This cruise was then compiled four times in FPS resulting in the following table of cubic volumes per acre:

	With field Form Class	**Without Form Class**
FPS Version 7.31	3,703	3,980
FPS Version 7.51	3,053	3,400

The volumes go up without the field measured form class. It appears in Figure 1 that the field measurements are too low.

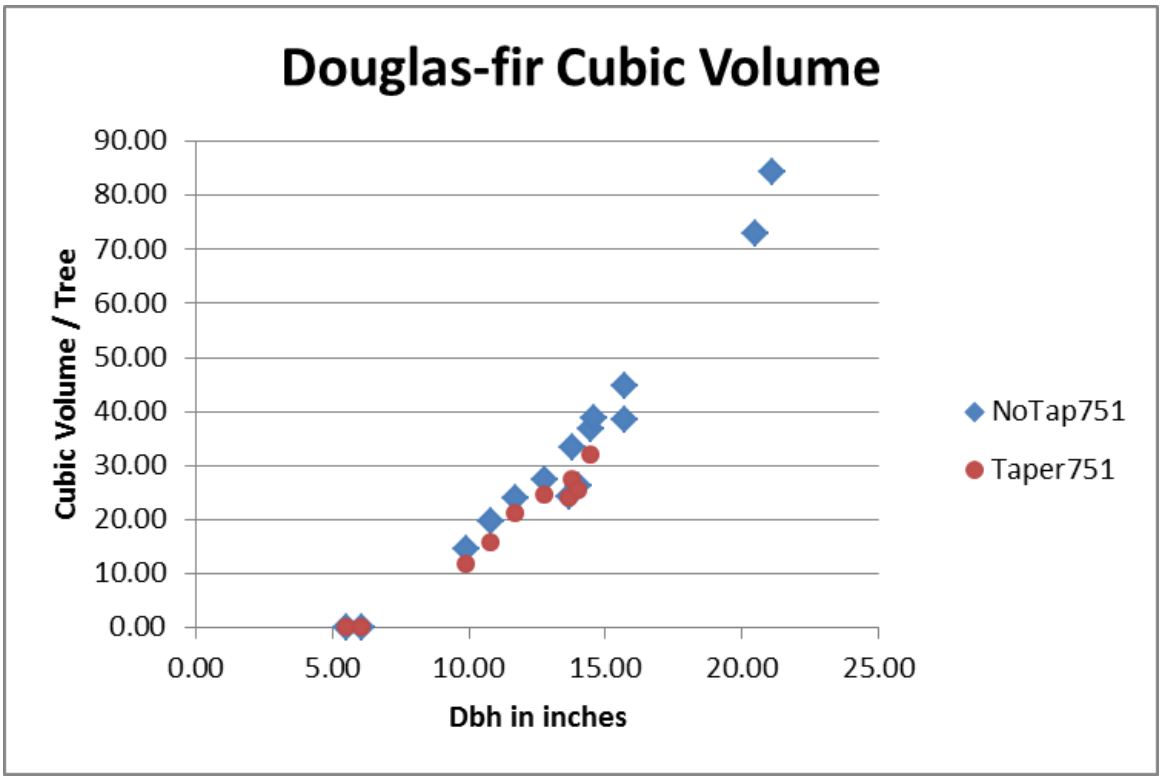

Figure 1. Comparison with and without field measured taper in FPS Version 7.51.

It also appears that FPS Version 7.51 is more sensitive to field measured taper than was FPS Version 7.31 (Figure 2).

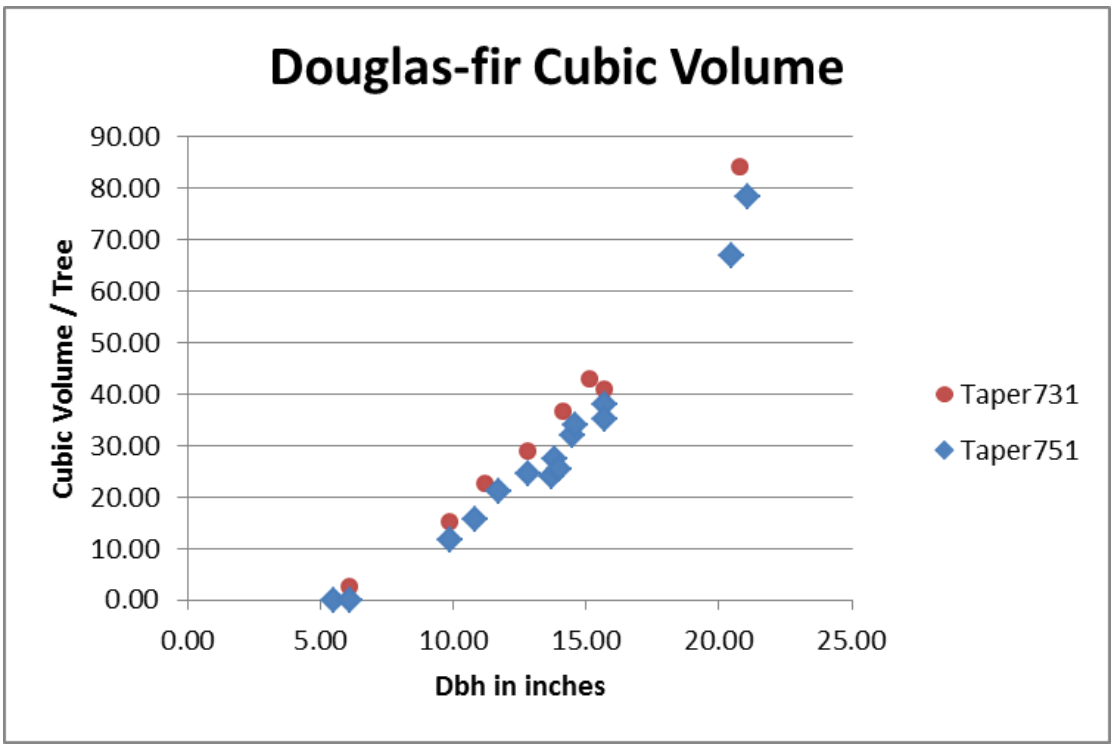

Figure 2. Comparison of sensitivity to field measured taper by FPS Version.

However, when field measured taper is removed, the Douglas-fir taper results in the same volume estimates (Figure 3).

The question becomes one of the reliability of field-measured taper when cruising forest inventory stands. In this case, as has been tradition, the field technique has been to use Girard Form Class as the preferred method. The common point of measurement is at the 17-foot height. The diameter of the tree is then estimated to the nearest 0.1-inch precision. Form Class is determined by dividing this observed diameter by the diameter at breast height (Dbh). The standard definition for Girard Form Class is that the upper measurement is inside bark and the Dbh measurement is outside bark.

However, field instruments do not exist which have the ability while standing on the ground to measure diameter inside bark at 17-feet to the nearest 0.1-inch. A ladder and bark gauge must be included for each tree to attempt this measurement with any reliability. Therefore, many cruisers make an estimate of the Girard Form Class number and then multiply by Dbh to estimate the inside bark diameter. In other words, this is a guesstimate, at best.

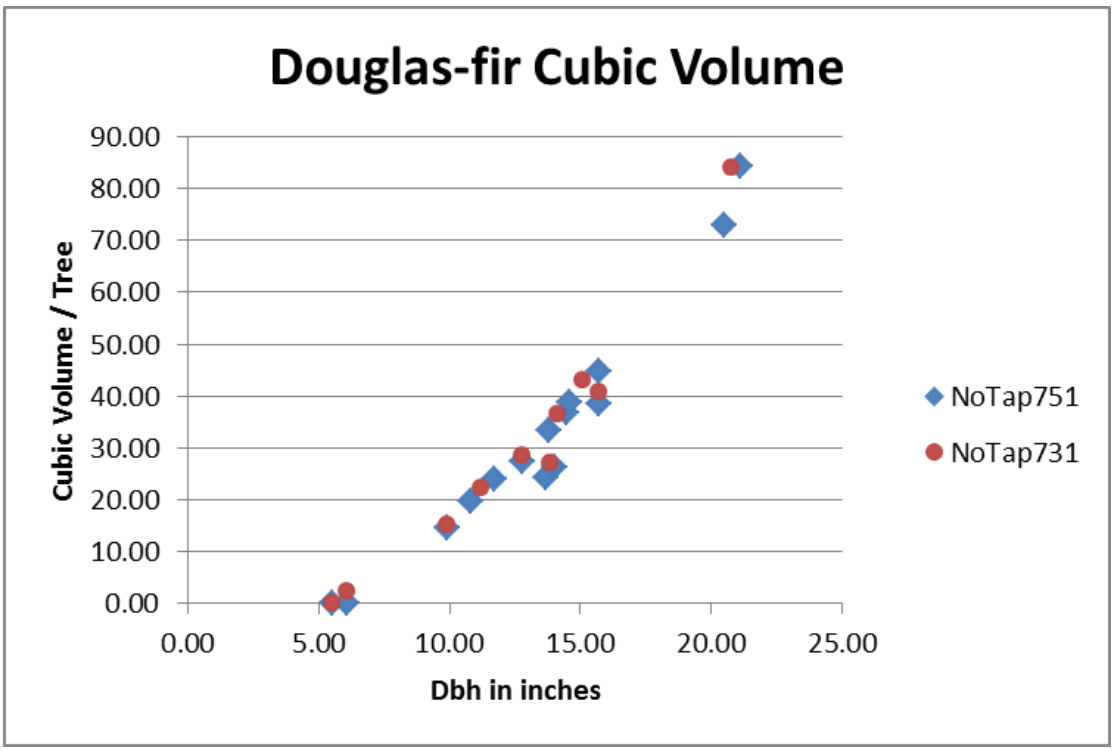

Figure 3. Comparison of default FPS Taper Library parameters for volume.

The trees in this cruise were in the range of 5 – 24 inches Dbh with cruiser-called Form Classes for Douglas-fir of 81 to 87. Table 1 provides a display of the resulting diameters inside bark which are required for these combinations of Dbh and Form Class.

	Diameter inside bark at 17-feet by Girard Form Class								
DBH	81	82	83	84	85	86	87	88	89
5	4.05	4.10	4.15	4.20	4.25	4.30	4.35	4.40	4.45
6	4.86	4.92	4.98	5.04	5.10	5.16	5.22	5.28	5.34
7	5.67	5.74	5.81	5.88	5.95	6.02	6.09	6.16	6.23
8	6.48	6.56	6.64	6.72	6.80	6.88	6.96	7.04	7.12
9	7.29	7.38	7.47	7.56	7.65	7.74	7.83	7.92	8.01
10	8.10	8.20	8.30	8.40	8.50	8.60	8.70	8.80	8.90
11	8.91	9.02	9.13	9.24	9.35	9.46	9.57	9.68	9.79
12	9.72	9.84	9.96	10.08	10.20	10.32	10.44	10.56	10.68
13	10.53	10.66	10.79	10.92	11.05	11.18	11.31	11.44	11.57
14	11.34	11.48	11.62	11.76	11.90	12.04	12.18	12.32	12.46
15	12.15	12.30	12.45	12.60	12.75	12.90	13.05	13.20	13.35
16	12.96	13.12	13.28	13.44	13.60	13.76	13.92	14.08	14.24
17	13.77	13.94	14.11	14.28	14.45	14.62	14.79	14.96	15.13
18	14.58	14.76	14.94	15.12	15.30	15.48	15.66	15.84	16.02
19	15.39	15.58	15.77	15.96	16.15	16.34	16.53	16.72	16.91
20	16.20	16.40	16.60	16.80	17.00	17.20	17.40	17.60	17.80
Average	9.72	9.84	9.96	10.08	10.20	10.32	10.44	10.56	10.68

Table 1. Diameter inside bark for combinations of Dbh and Form Class.

Table 2 provides a display of the differences between Form Class levels which must be observed and measured to assign the correct Girard Form Class. From this table for this forest stand, the cruiser must be able to reliably and repeatedly distinguish diameters inside bark to within 0.05 to 0.20 inches while standing on the ground without a ladder. Obviously, this approach using Girard Form Class is not a workable or repeatable field procedure to localize tree taper.

	Difference in Diameter at 17-feet per Form Class Interval								
DBH	81	82	83	84	85	86	87	88	89
5	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
6	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06
7	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07
8	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08
9	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09
10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11
12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12
13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13
14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14
15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16
17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17
18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18
19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19
20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20
Average	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12

Table 2. Display of differences in diameter at 17-feet between Form Class levels.

Versions of FPS

Going back to Figure 3, there is still a question about the compiled total stand volume when there is no significant difference in the Douglas-fir between V7.31 and V7.51. This stand is primarily Western Hemlock with a major component of Western Red Cedar. Figures 4 and 5 provide displays of the estimated volumes between versions by species.

In this stand with a major component of Western Red Cedar, the FPS Version 7.51 Species Library has a much enhanced felled-tree database for tree taper profiles. This results in the total stand volumes to shift with the update in the FPS Library. Both Douglas-fir and Western Hemlock remain very stable between versions.

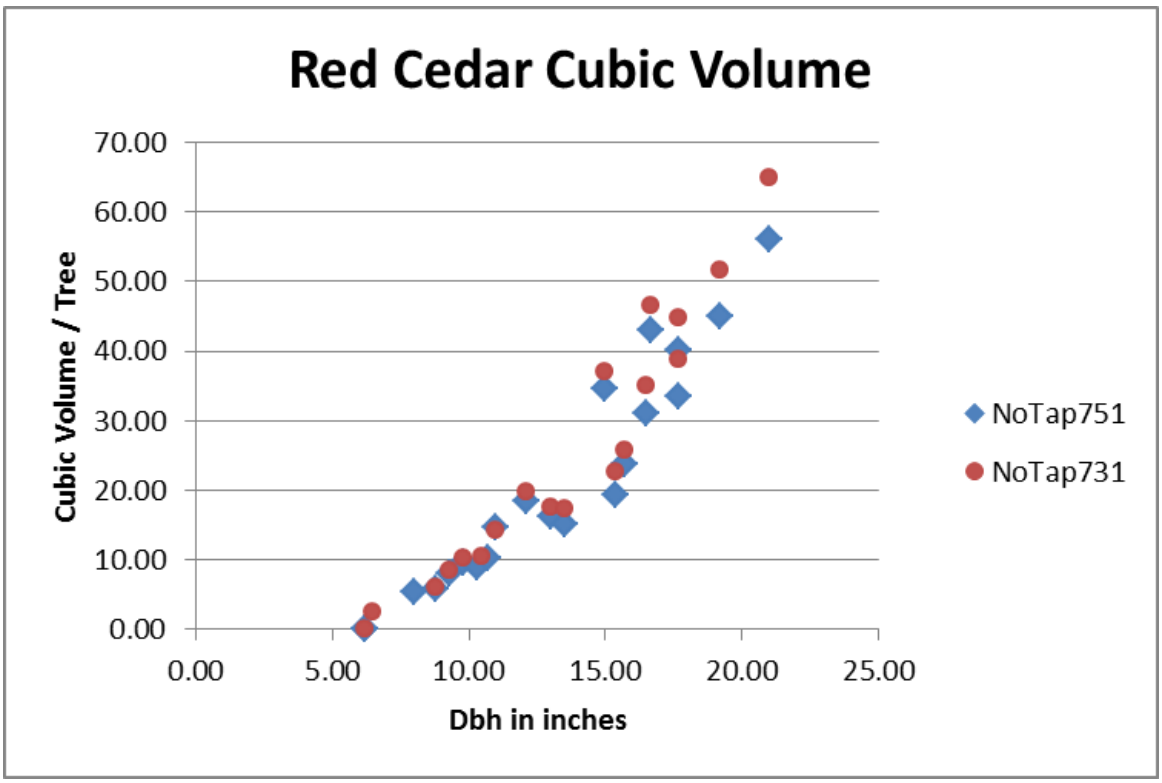

Figure 4. Comparison of Red Cedar Taper Library defaults between FPS Versions.

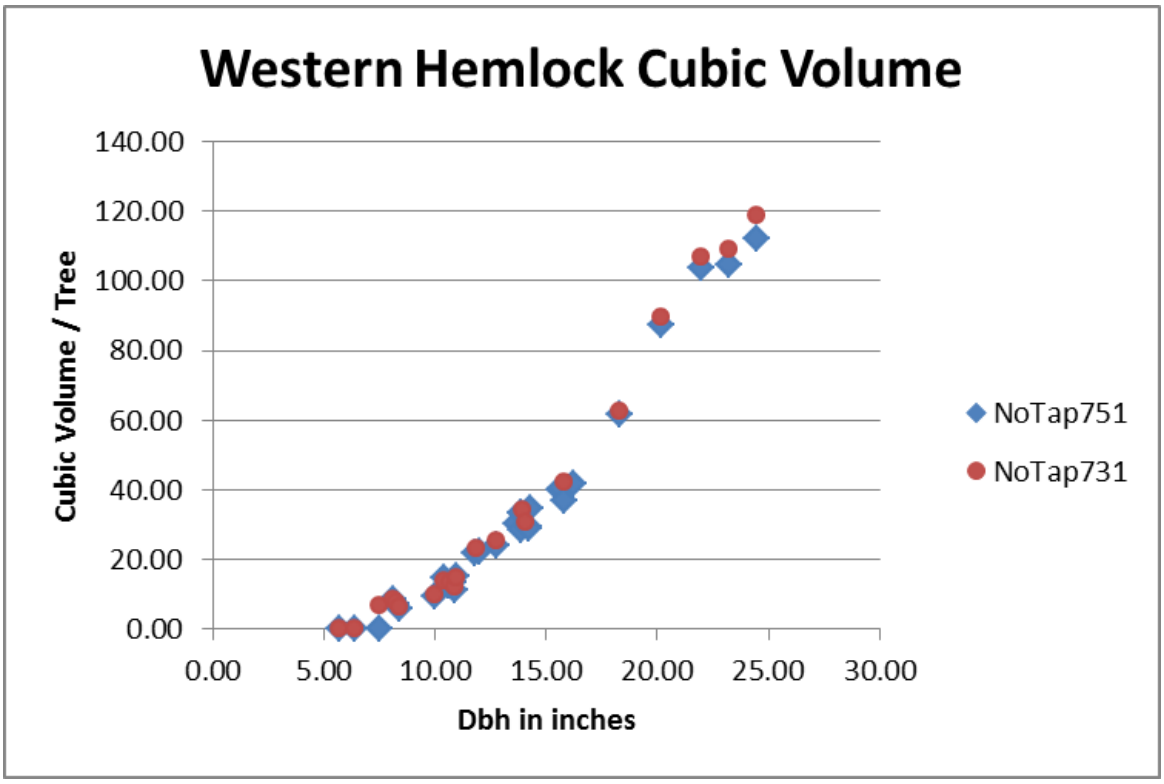

Figure 5. Comparison of Western Hemlock Taper Library defaults between FPS Versions.