CHAPTER 11.

A Test of the Forest Inventory and Analysis Program's Down Woody Material Indicator for Regional Fuel Estimation in the Southern Appalachian Mountains

(PROJECT SO-F-06-01)

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INTRODUCTION

Both the National Fire Plan (http://199.134.225.50/nwcc/t2_wa4/pdf/RuralAssistance.pdf) and the Healthy Forest Initiative (http://www.fs.fed.us/projects/hfi/2003/august/documents/hfi-fact-sheet.pdf) call for reduction of hazardous fuels. Consequently, estimations of forest fuel loading at various scales become necessary. The Forest Inventory and Analysis (FIA) Program of the Forest Service, U.S. Department of Agriculture, is currently sampling down woody materials (DWM) at its phase 3 plots at the intensity of one plot every 96,000 acres. In this study, DWM is defined as a collection of fine woody material (FWM) (i.e., 1-hour, 10-hour, and 100-hour fuels), coarse woody material (CWM) (i.e., 1,000-hour fuel), litter, and duff. Because multiple fuel complexes may exist at a much smaller scale (fig. 11.1), it is not clear if the FIA's program current DWM sampling intensity would produce reasonable estimations of regional fuel loading.

OBJECTIVES

The objective of our study was to test whether the fuel estimations derived from the FIA phase 3 plots capture multiple and distinct fuel complexes in the Southern Appalachian Mountains. Based on the test, the minimum sampling intensity for obtaining an adequate regional DWM estimation was suggested for the Southern Appalachian Mountains.

METHODS

The study area in the Southern Appalachian Mountains involved three national forests (Chattahoochee National Forest in northeastern Georgia, Nantahala National Forest in western North Carolina, and Sumter National Forest in northwestern South Carolina) and one national park (Great Smoky Mountains National Park in southeastern Tennessee).

Data were collected from three different sources: FIA phase 3 data, data collected by Intensive Sampling Data (Brudnak and others 2007), and new data collected in this study (New Data). The most recent FIA phase 3 plots in the studied national forests/park were acquired, with the year of sampling ranging from 2001 to 2005. Using a stratified random sampling method, Brudnak and others (2007) intensively sampled one subjectively selected 10-square-mile area at each studied national forest/park by installing 193 to 297 plots (50 × 44 feet in size) and referencing slope location and aspect. In addition to the two sources of available data described above, we conducted additional sampling in fall 2007, with 20 plots in each national forest/park. Those plots were randomly selected within each forest and park, but subject to restriction of road access. CWM, FWM, litter, duff, and shrub and herb loadings were measured in all plots using the FIA phase 3 method. Estimates of various DWM components were calculated using the equations in Chojnacky and others (2004).

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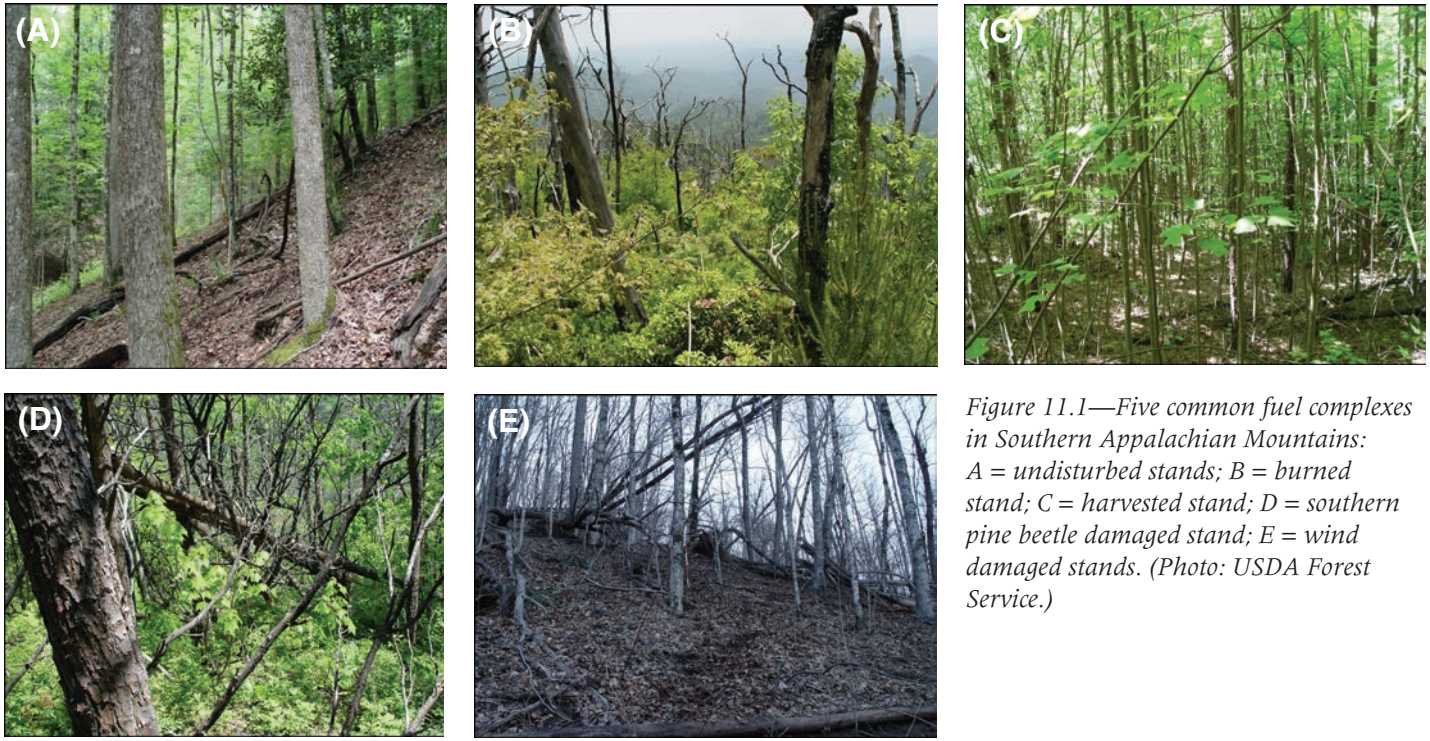

Figure 11.1—Five common fuel complexes in Southern Appalachian Mountains: A = undisturbed stands; B = burned stand; C = harvested stand; D = southern pine beetle damaged stand; E = wind damaged stands. (Photo: USDA Forest Service.)

Biomass of DWM components is summarized using descriptive statistics. In order to determine an adequate sampling density, we calculated running averages of DWM estimates from plots that were sampled in the study. The change of DWM estimates with the increase of sampling size was visually inspected and a minimum sample size was interpreted when the estimates approached a stable value.

RESULTS AND DISCUSSION

The amounts of total DWM estimated using the FIA phase 3 data were generally much less, by 47 to 73 percent depending on study area, than those estimated using the intensively sampled data (table 11.1). When individual DWM components were compared, 1,000-hour fuel was estimated consistently and considerably lower, by 81 to 98 percent, based on the FIA phase 3 data when compared to the intensively sampled data. These discrepancies in 1,000-hour fuel or CWD appeared extremely large, which was the main reason why the intensively sampled data resulted in much higher estimates of total DWM in each forest/park. The large discrepancies in CWM, however, could not be simply attributed to low sampling intensity of FIA phase 3 plots.

Table 11.1—A comparison of the down woody material (DWM) estimates derived from Forest Inventory and Analysis phase 3 plots and the intensive sampling plots

Sampled area[a]	Method	N	1-hr	10-hr	100-hr	1000-hr	Litter	Duff	Total
			tons per acre						
Georgia	FIA[b]	6	0.22	0.79	1.50	1.08	2.06	2.17	7.81
	Intensive[c]	297	0.27	0.92	3.78	14.80	2.76	6.40	28.93
	Percent[d]		-19.99	-14.78	-60.20	-92.69	-25.54	-66.11	-73.00
North Carolina	FIA	7	0.14	0.97	1.91	5.37	4.02	7.04	19.45
	Intensive	250	0.34	0.95	3.65	28.52	2.92	6.23	42.63
	Percent		-59.45	1.37	-47.58	-81.18	37.49	12.96	-54.38
South Carolina	FIA	1	0.55	3.88	5.63	0.32	0.90	2.03	13.30
	Intensive	275	0.24	1.05	3.95	13.86	2.63	3.54	25.27
	Percent		130.55	268.64	42.54	-97.66	-65.83	-42.70	-47.35
Tennessee	FIA	9	0.28	0.86	1.48	2.16	2.45	4.18	11.41
	Intensive	193	0.38	0.90	3.77	19.48	3.20	5.05	32.78
	Percent		-26.32	-4.14	-60.78	-88.90	-23.56	-17.24	-65.20

[a] Sampled area indicates the national forest/park found in these States.
[b] FIA method can be found in Woodall and Williams (2005).
[c] Intensive sampled method can be found in Waldrop and others (2007).
[d] Percent = 100 x (FIA-Intensive)/Intensive, where the estimates using intensive data are assumed as criteria.

We could not find other apparent reasons responsible for these discrepancies. However, it is possible that each 10 square mile area selected for intensive sampling may have higher CWM than each forest/park.

In each national forest/park, the change of the running average of the total DWM with the number of plots diminished and approached a stable value before sampling size reached about 12 plots (fig. 11.2A). When considered over a large area (i.e., with the three national forests and the one national park combined), the running average of the total DWM approached a stable value with the number of sampling plots increased to about 30 plots (fig. 11.2B).

CONCLUSIONS

We found a large discrepancy between the FIA phase 3 estimates and those derived using the intensive sampling data of Brudnak and others (2007). These discrepancies are attributed to the extremely large difference in CWM estimates between the two methods, which could not be explained satisfactorily. FIA phase 3 sampling intensity (approximately one plot per

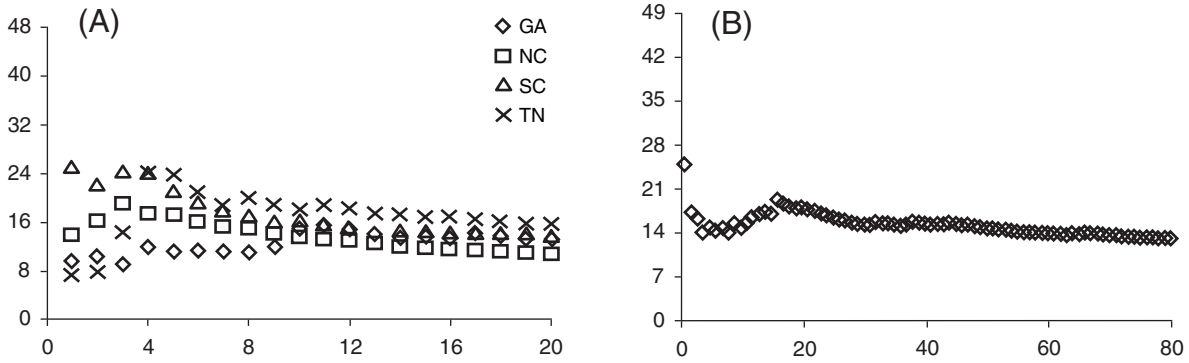

Figure 11.2—The changes in mean down woody material (DWM) weight (y-axes) with increasing number of sampling plots (x-axes) in each national forest/park (A) (diamond = Chattahooche National Forest; square = Nantahala National Forest; triangle = Sumter National Forest; cross = Great Smoky National Park) or four areas combined (B).

96,000 acres) is appropriate at a regional scale when fuel loading is averaged over a large area (>2 million acres). At a smaller scale (i.e., at individual county or individual national forest/park scale), the FIA phase 3 sampling intensity would likely be too sparse to generate reliable fuel loading estimates.

ACKNOWLEDGMENTS

This study was funded by the Forest Service, U.S. Department of Agriculture. We thank Jim Brown and Dale Starkey, Forester/Forest Health Monitoring Program Coordinators (Region 8), for their assistance. We express our great gratitude to Forest Inventory and Analysis, Southern Research Station in Knoxville, TN, for providing the FIA phase 3 data.

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