Rapid Assessment of Wildfire Damage Using Forest Inventory Data: A Case in Georgia

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Abstract: *The rapid assessment of damage caused by natural disasters is essential for planning the appropriate amount of disaster relief funds and public communication. Annual Forest Inventory and Analysis (FIA) data provided initial estimates of damage to timberland in a timely manner to State leaders during the 2007 Georgia Bay Complex Wildfire in southeast Georgia. FIA plots were selected from within the shape file (a polygon outline of the fire perimeter) of the burn area and processed with the National Information Management System. Forest area and total volume by stumpage products were compiled for the wildfire area. A mortality factor determined by the Georgia Forestry Commission was used to estimate the volume of damaged timber, and the value of damaged timber was assessed using Timber Mart-South stumpage prices.*

Keywords: FIA, forest disturbance, inventory, Mapmaker, stratification, wildfire.

Introduction

Large wildfires have been documented in southeast Georgia for more than 100 years. Climatic conditions create droughts that foster conditions for large wildfires in and around the Okefenokee National Wildlife Refuge and Wilderness Area. Wildfires, associated with droughts, were documented in 1844, 1860, 1910, 1932, 1954-1955, and 2007. The fire of 1932 began when a young boy started a fire to warm his hands. The intensity of the fire created gale force winds that worsened the damage. The drought occurring in the 1950s was severe, and the fires of 1954-1955 were peat fires that burned underground and therefore impossible to control. Analysis of peat samples back in the 1890s found it to be 85 percent combustible (Izlar 2007). In 2007, 9,500 wildfires burned about 504,000 acres in Georgia. Of particular note was the Georgia Bay Complex Wildfire which

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In: McWilliams, Will; Moisen, Gretchen; Czaplewski, Ray, comps. 2009. 2008 Forest Inventory and Analysis (FIA) Symposium; October 21-23, 2008: Park City, UT. Proc. RMRS-P-56CD. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 1 CD.

burned 441,705 acres in southeast Georgia and destroyed nine homes (Georgia Forestry Commission 2007a). This fire started when a tree fell on a power line creating sparks that ignited dry, woody fuels.

The Forest Inventory and Analysis (FIA) program plays an important role in quantifying losses from broad-scale disturbances, and FIA personnel have several options available to perform rapid assessments of these disturbances. The options include Mapmaker analysis, analysis based on FIA database (the FIA public database), and analysis based on the National Information Management Systems (NIMS)—using estimation procedures documented in Bechtold and Patterson (2005). Each of these analytical methods requires different levels of effort and requires different turn-times. The key to rapid assessment is to provide required information for disaster relief in a timely fashion, which helps quantify losses and aid in recovery decisions.

The objective of this paper is to describe the assessment techniques used to quantify potential timber losses from the Georgia Bay Complex Wildfire.

Methods

On Memorial Day weekend 2007, the Georgia Forestry Commission (GFC) requested help in assessing damage from what was discovered to be the largest recorded wildfire in Georgia history (and the Southeastern United States). The GFC needed this information to respond to inquires from the media, State and Congressional representatives, and there were reports that the President of the United States would visit Georgia to view the damage. The first option was to use Mapmaker (Miles 2007), the FIA online database retrieval system tool, which would provide first-line estimate of the timber resource within the known burn area. GFC needed some assurance that their initial estimates were reasonable. A shape file was sent via email from the USDA Forest Service, Region 8, Southern Area Coordination Center, a key player in the National Incident Management System. The shape file had been constructed by firefighters through global positioning system (GPS) receivers. From the shape file, coordinates outlining the burn area were digitized using Arc Map and copied into the Mapmaker custom table retrieval polygon window. The polygon captured the plots from the Georgia 2004 annual inventory and provided the first estimate of total timber volume within the early extent of the burn area (fig 1).

Mapmaker queries separated volume into the major species groups of softwood and hardwood, sawtimber and poletimber, ownership class, age class, and stand origin. From these queries, tables were developed for forest stumpage products by softwood and hardwood. From young age classes, a table was developed to estimate the area of precommercial stands. Assumptions were made that precommercial planted pine stands ranged from 1 to 10 years old and precommercial natural stands ranged from 1 to 15 years old.

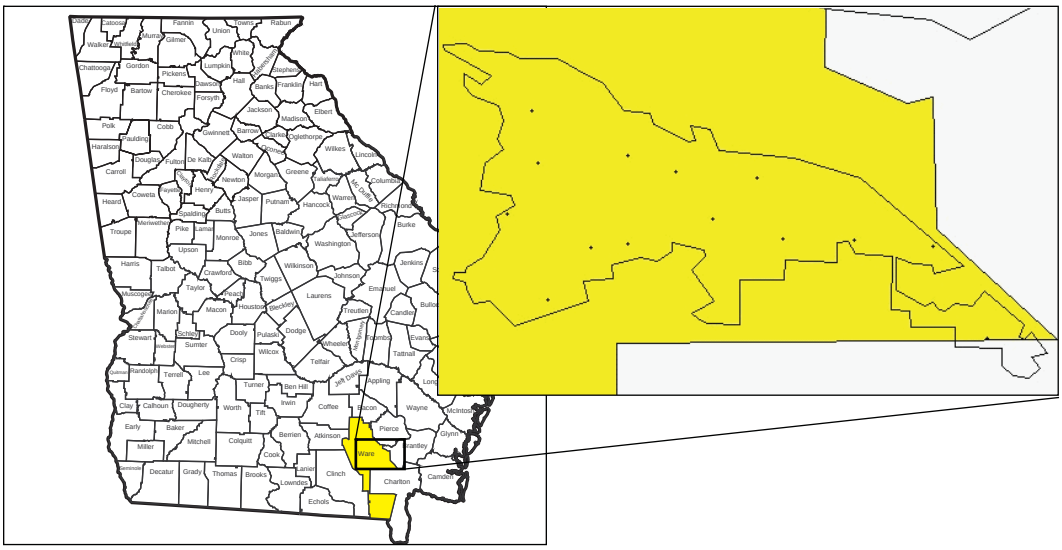

Figure 1: One of the first shape files received from the USDA Forest Service, Region 8, Southern Area Coordination Center of the burn area. Coordinates were imported into Mapmaker to select plots (small dots within the polygon) used to calculate volume and create a map.

Once these tables were developed, a value by stumpage product was incorporated to assess timber value. These values were derived from Timber Mart-South, 1st Quarter 2007 average stumpage value estimates for south Georgia. Stumpage products assessed were pine sawtimber, mixed hardwood sawtimber, and pulpwood for both softwood and hardwood. Total volume by product was multiplied by the timber value for each product to compute values by product and total value. While stumpage values cannot be applied to precommercial timber, a per-acre value was estimated based on general establishment costs. This is the allowable value that may be recorded on a landowner's tax return regarding investment loss. Federal lands contained the majority of precommercial natural stands, while private and State lands contained mostly precommercial planted stands.

Large area wildfires create a mosaic of burn intensities across the landscape intermixed with areas that did not burn (fig. 2). It is difficult to assess the degree of tree damage and mortality percent in a timely manner. Because time was of the essence, the GFC conducted a ground survey along travel corridors to estimate the level of mortality supported by aerial reconnaissance (Georgia Forestry Commission 2007b). Mortality was expressed in percent. Development of the tables using FIA data provided the total volume and value of timber within the burn area. The GFC applied the assessment of tree mortality within the burn area to reduce the total volume, and applied Timber Mart-South values for timber stumpage products to produce an estimate of timber losses. The FIA data assessment was compared to ground estimates by GFC, as well as landowner estimates reporting damage.

Figure 2: Aerial views showing the mosaic pattern of burn intensities across the landscape helped estimate areas of mortality. (Courtesy of the Georgia Forestry Commission).

It should be noted that this method assumes that timber was valued at "pre-fire" stumpage prices to estimate market value loss. However, post-fire stumpage value is discounted because of fire-caused timber damage, and due to increased volume introduced to the market (increased supply), which required salvage in a timely manner—regardless of fluctuating markets. It also is difficult for local industry to manufacture and market a dramatically increased supply.

The assessment using Mapmaker complemented the initial estimate of losses caused by the wildfire. The actual area of wildfire-affected stands grew beyond initial estimates, and because more time was available, a refined estimate was provided based on the expanded boundary and using the NIMS compilation system. Working with the raw data allowed flexibility needed to produce the best assessment with FIA plot data. The final shape file of the burn area was used to select actual plots from the Southern Research Station database (not fuzzed and swapped plots as is the normal procedure to comply with privacy laws) within the boundary of the burn area. The area estimation unit was established to the shape file allowing the expansion factors to directly represent the burn area. National Land Cover Data were used to stratify the FIA plots by forest/nonforest and the Okefenokee area to allow further refinement of the estimation unit and expansion factors for the area of interest. The data were compiled in NIMS to calculate forest volume of softwood and hardwood by ownerships, forest products categories, and precommercial forest area.

Results

Softwood and hardwood tables were developed by ownership classes and types of forest products. The detailed private ownership could be developed to compare with estimates reported by forest industry and individuals. The unadjusted value for all forest land within the burn area was estimated to be $284 million (table 1). Because the Okefenokee is by statute reserved forest land (not available for timber harvest), the timber volume and value were removed from the estimate leaving a

Table 1: Detailed breakout of total volume and value by ownership and forest products

Pulpwood	Volume	Unit value[a]	Total value
	cords	- - - - - - - - - - *dollars* - - - - - - -	
Softwood			
Okefenokee	1,302,821	$ 19.40	$ 25,274,731
Other federal	181,783	$ 19.40	$ 3,526,590
State	14,781	$ 19.40	$ 286,753
Industry	779,542	$ 19.40	$ 15,123,113
NIPF	166,750	$ 19.40	$ 3,234,948
Total	2,445,677	$ 19.40	$ 47,446,134
Hardwood			
Okefenokee	1,686,307	$ 21.07	$ 35,530,487
Other federal	370,864	$ 21.07	$ 7,814,105
State	7,179	$ 21.07	$ 151,271
Industry	88,451	$ 21.07	$ 1,863,659
NIPF	852	$ 21.07	$ 17,957
Total	2,153,654	$ 21.07	$ 45,377,479

Sawtimber	Volume	Unit value[a]	Total value
	million board feet[b]	- - - - - - - - - - *dollars* - - - - - - -	
Softwood			
Okefenokee	493,968	$ 262.00	$ 129,419,512
Other federal	93,015	$ 262.00	$ 24,369,861
State	9,887	$ 262.00	$ 2,590,488
Industry	83,864	$ 262.00	$ 21,972,402
NIPF	9,994	$ 262.00	$ 2,618,329
Total	690,727	$ 262.00	$ 180,970,592
Hardwood			
Okefenokee	37,902	$ 131.00	$ 4,965,221
Other federal	30,258	$ 131.00	$ 3,963,735
State	940	$ 131.00	$ 123,096
Industry	6,367	$ 131.00	$ 834,054
NIPF	—	$ 131.00	$ —
Total	75,466	$ 131.00	$ 9,886,107
Georgia Total			$ 283,680,312

[a] Timber Mart-South (2007).

[b] Thousand board feet, International log rule.

total value of $88 million. Softwood sawtimber made up the largest component ($52 million). Forest industry and other Federal lands had the largest total value, each totaling almost $40 million. GFC considered these total values and adjusted them based on estimated mortality factors to report the value of timber lost from fire damage. After the final analysis of the Georgia Bay Complex Wildfire, GFC reported the timber loss at $54 million.

Discussion

The initial assessment using Mapmaker had limits in the estimation. A large portion of the burn area was in the Okefenokee National Wildlife Refuge and Wilderness Area. By statute, the Okefenokee is reserved forest land and has no commercial timber value, i.e., it is not available for timber harvesting. Because of the hazards to field crews penetrating the Okefenokee area during recent data collection, there were a limited number of plots that accurately would facilitate a true assessment of timber volume within its boundary. The Okefenokee reserved forest land area was separated from other ownerships to allow flexibility in assessing damage for reporting.

The area estimation unit used to develop plot expansion factors by Mapmaker was the Southeast Survey Unit for Georgia. This somewhat skewed expansion factors for plots within the burn area. Because privacy laws require plots to be "fuzzed and swapped," there were possibilities that plots on the edge of the burn area do not represent the timber resource within the burn area—an introduced bias. Most timberland outside the Okefenokee is private ownership, and there could be no stratification of ownership types within the private group (privacy laws) using Mapmaker.

Conclusion

The initial response to the Georgia Bay Complex Wildfire using Mapmaker gave a quick comparison to on-the-ground estimates before reporting to policy makers and the media. As the wildfire continued to expand, FIA staff was able to refine estimates, and use plot data directly from the NIMS compilation system. Area stratification allowed segregation of tree volume estimates within the Okefenokee National Wildlife Refuge and Wilderness Area, where limited plot data were available, therefore, limiting the focus of the study to commercial timberland and a break-out of private ownerships. Even though some estimates had high sampling errors, the data offered a comparison to general volume per acre ground estimates.

Responses to the Georgia Bay Complex Wildfire provided insight for improvement of future rapid response to catastrophic events. Flexibility of annual FIA data compilation coupled with online tools, continue to improve and

provide better assessment of rapid response, which are suitable in a variety of applications. As awareness gains momentum among the growing and diverse FIA user groups and more public tools are developed, the FIA data offer opportunities for a variety of assessments that deal with the complexity of forest resources and their management.

Acknowledgments

The authors greatly appreciate suggestions made by Frank Green and James Johnson with the Georgia Forestry Commission. Their peer reviews were of substantial use. Firefighters, in addition to controlling the blaze, gathered the GPS coordinates surrounding the burn area; and the USDA Forest Service, Region 8, Southern Area Coordination Center compiled the shape file. The Georgia Forestry Commission and forest landowners worked together to assess mortality. Timber Mart-South, Frank W. Norris Foundation—at the University of Georgia—provided the 1st Quarter 2007 stumpage prices for Georgia. FIA field crews with GFC and the USDA Forest Service collected plot data. FIA staff responded during a holiday weekend to answer the call for assistance. This team of dedicated professionals are all part of this rapid response forest resource assessment.

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