Forest Health Evaluation of Hurricane Katrina Tree Damage: De Soto National Forest, Mississippi

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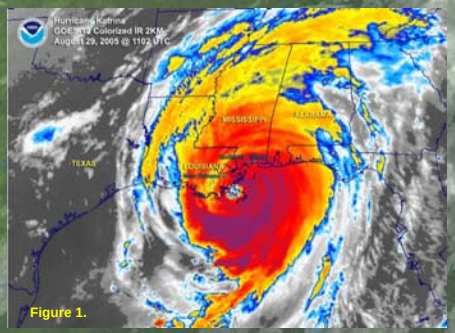


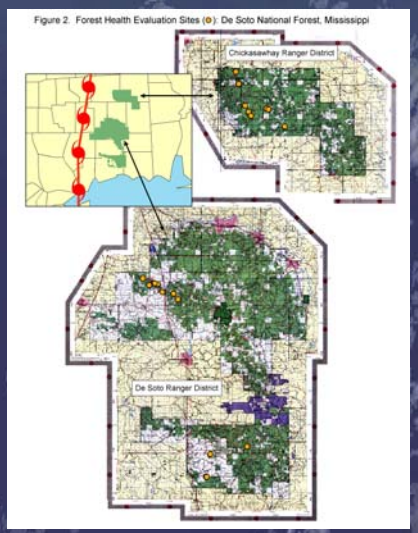
Figure 1.

Introduction

Hurricane Katrina, a category four storm, made landfall on August 29, 2005 (Figure 1), impacting both Districts of the De Soto National Forest in Mississippi. Initial estimates of the affected areas on the De Soto Ranger District, in broad damage classes, included 142,000 acres of heavy damage, 108,000 acres of moderate damage and 132,000 acres of light damage. Similar estimates for the Chickasawhay District consisted of 39,000 acres of heavy damage and 116,000 acres of light damage. Due to forest health concerns regarding potential increases in insect, disease and non-native invasive plant activity in the aftermath of the hurricane, a general field assessment of the nature and extent of tree damage was conducted on the Districts during October 3-7, 2005.

Methods

A total of 18 separate stands were examined (Figure 2) utilizing three, 1/10 ac plots per stand (56 plots). These stands were selected based on resource concerns of the District and FHP, and represented both a variety of stand conditions and range of hurricane damage (i.e., light, moderate and heavy). Within each plot, all trees greater than 2" dbh were measured and the predominant damage type recorded for each. The fourteen different types of tree damage were subsequently grouped into classes of severe, moderate, light, and none, for analysis and projections of mortality and future health risks. Plots/trees were also examined for the presence and type of insect activity, rot and stain fungi, and non-native invasive plants.



Damage Types:

Windthrow (WT): entire tree blown over and laying on ground, only a few attached roots still in ground (Figures 6 and 8)
Snapped (SP): tree with entire crown completely snapped off, usually 2-15 meters of bole still standing (Figure 3)
Root-sprung Horizontal (RH): tree leaning at 46-75° from vertical, most roots exposed
Root-sprung Vertical (RV): tree leaning at 20-45° from vertical, some roots exposed
Broken Top (BT): upper portion of the crown broken off
Bent Bole > 30° (B+30): bole bent more than 30° from vertical (Figure 4)
Slightly Leaning (SL): tree leaning less than 20° from vertical
Bent Bole < 30° (B-30): bole bent less than 30° from vertical
Twisted Trunk (TT): twisting and separation/splitting of bark and/or wood within bole
Severe Limb Breakage (SLB): >40% of large limbs (>3" dia.) broken
Moderate Limb Breakage (MLB): 20-40% of large limbs (>3" dia.) broken
Light Limb Breakage (LLB): < 20% of large limbs (>3" dia.) broken
Minor Wounding (MW): minor wounds to bole/limbs from falling/flying/whipping objects
Undamaged (UN): no visible sign of storm damage to the tree

Tree Damage Classes:

Severe - trees directly killed by storm damage and those likely to die in the short–term (i.e., 2 years) as a result thereof; including trees categorized by the following damage types: **WT**; **SP**; **RH**; **RV**; **BT**; and/or **B+30**

Moderate – trees that may survive, but with lasting or long-term impacts on growth and/or wood products, and are also temporarily at in increased risk of attack or infection from insects or pathogens; including trees categorized by the following damage types: **SL**; **B-30**; **TT**; and/or **SLB**

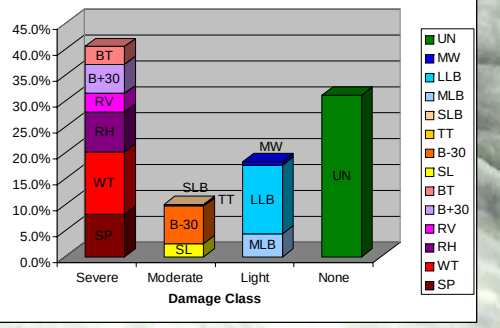
Light – trees that are temporarily at an increased risk of attack or infection by insects or pathogens, but otherwise should survive with little or no lasting impairment to growth, form, products, etc.; including trees categorized by the following damage types: **MLB**; **LLB**; and or **MW**

None – trees that outwardly exhibited no significant damage from the storm; including trees categorized as **UN**


Figure 3. Examples of snapped (SP) damage type


Figure 4. Examples of bent bole >30° (B+30) damage type

Figure 5. Percent Tree Damage by Type and Class for All Trees (N=585)



Results and Discussion

The following results are for plot trees ≥ 5" dbh (n=585). Overall, approximately 70% of the trees exhibited some type of evident damage from the hurricane, most of which was classified as severe (40.5% of all trees) and likely to result in tree mortality. Most of the severe damage was attributed to windthrow (12.0% of all trees), followed by snapped trunks (8.2%), producing direct and immediate mortality (or nearly so) to 20% of all trees evaluated. Half of all severely damaged trees remained viable, but most likely will die over the course of 2006-07. The most abundant damage type observed was light limb breakage (Figure 5).

On a stand level basis, severe tree damage likely to result in tree mortality, ranged from a low of 6% of the trees per acre (TPA), and 5% of the basal area per acre (BA), to a high of 83% of the TPA and 98% of the BA. Eleven of the 18 stands exhibited 30% or more severe tree damage on a TPA basis; ten of which showed greater than 40% of the BA as being severely damaged and likely to die in the near future (within two years). In contrast, light plus no evident tree damage ranged from a low of 17% of the TPA and 2% of the BA, to a high of 94% of the TPA and 95% of the BA (Table 1).

In mature sawtimber stands, the most severe damage appeared to occur in those stands of reduced or low density/stocking (e.g., recently thinned pine sawtimber, seed tree and shelterwood harvests, and open grown stands), (Figure 7); and this damage was primarily due to snapped trunks and windthrow (Figures 3, 6, and 8). However, absolute amounts of severe damage were virtually identical, on average, between the dense and open sawtimber stands examined, for both trees per acre (54 vs. 47, respectively) and basal area per acre (54 vs. 51, respectively). In the young pine plantation, the severe damage was almost entirely due to root-springing and severe bole bending (Figure 4).

Bark beetle and woodborer activity was extremely limited in early October, and primarily confined to the downed tops of some of the snapped, broken-topped and windthrown trees. By January 2006 virtually all of the originally downed material had been infested, and bark beetles (*Ips* engravers) had begun to infest and kill root-sprung trees. Japanese climbing fern (*Lygodium japonicum*) was the only non-native invasive plant detected in plots, but only appeared in one of the 18 stands examined. Cogon grass (*Imperata cylindrica*), already recognized as a relatively widespread problem plant on the Forest, was also observed outside of the plots in another stand.


Figure 6. Windthrow (WT) in thinned longleaf stand

Fig. 7A. Trees Damaged per Acre

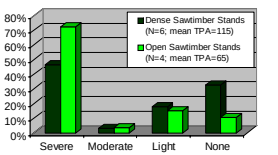
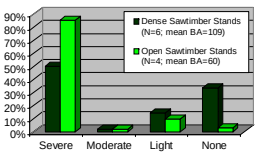


Fig. 7B. Basal Area Damaged per Acre



Conclusions

The widespread and abundant supply of attractive and highly susceptible host material for pine-infesting insects (e.g., bark beetles, weevils, and borers) suggests that populations of these potential pests will increase and possibly cause additional and undesirable tree mortality in the future. Recommendations for preventing and otherwise mitigating future tree mortality and weed problems in the aftermath of the hurricane are discussed in Forest Health Evaluation Report No. 2006-02-02. These permanent plots will be periodically re-inventoried, and the results thereof reported on in future Forest Health Evaluations. This tree/plot data is also currently being used by others to interpret and analyze remotely sensed imagery following the hurricane.

Table 1. Summary statistics from Forest Health Evaluation plots (1/10ac), De Soto National Forest, October 3-7, 2005.

Dist.	Comp.[a]	Stand[a]	For. Type[a]	Cond. Class[a]	Site	# of Plots	Initial Damage Class	Pine Avg. Dbh (in.)	Pine Avg. Ht. (ft.)	Pine Avg. Age (yrs.)	Trees per Acre All Trees	% Pine	Damage by Severity Class (All Trees) Severe	Moderate	Light	None	Basal Area (sq. ft.) per Acre All Trees	% Pine	Damage by Severity Class (All Trees) Severe	Moderate	Light	None
Sawtimber Stands in Floodplains/Drains																						
2	297	8	31	10	3	3	Heavy	14.6	103	68	100	80%	63%	0%	27%	10%	109	91%	65%	0%	24%	11%
5	369	5	21	12	4	3	Heavy	20.7		80[b]	140	31%	32%	0%	5%	64%	150	68%	15%	0%	9%	75%
5	378	18	31	13	5	3	Heavy	11.7	113	67	110	24%	30%	3%	6%	61%	94	51%	40%	2%	5%	54%
Average						*9*		*15.7*	*108*	*68*	*117*	*45%*	*42%*	*1%*	*12%*	*45%*	*118*	*70%*	*40%*	*1%*	*13%*	*47%*
Pine Sawtimber Stands																						
2	296	13	32	12	1	3	Heavy	14.2	100	58	140	43%	43%	10%	36%	12%	109	69%	53%	6%	32%	10%
2	295	5	31	16	9	3	Heavy	19.3	98	61	110	54%	52%	3%	33%	12%	101	84%	69%	4%	17%	11%
5	378	27	21	12	6	3	Heavy	13.3	92	61	90	86%	59%	4%	0%	37%	90	94%	59%	1%	0%	39%
2	587	2	21	6	10	3	Heavy	11.4	85	50	90	100%	71%	4%	27%	4%	68	100%	77%	2%	18%	3%
Average						*12*		*14.6*	*94*	*58*	*108*	*71%*	*56%*	*5%*	*24%*	*16%*	*92*	*87%*	*65%*	*3%*	*17%*	*16%*
Recently Thinned Pine Sawtimber Stand																						
2	281	3	21		5	3	Heavy	14.5		80[b]	100	83%	71%	3%	26%	0%	103	94%	78%	3%	19%	0%
Sparse Pine Sawtimber																						
2	295	13	31	13	2	3	Heavy	22.1	107	61	50	53%	64%	7%	7%	21%	42	72%	68%	3%	2%	6%
2	277	22	21	13	4	3	Heavy	15.2	83	67	20	100%	83%	0%	0%	17%	25	100%	68%	0%	0%	2%
Average						*9*		*18.7*	*95*	*64*	*35*	*77%*	*74%*	*4%*	*4%*	*19%*	*34*	*86%*	*93%*	*1%*	*1%*	*4%*
Red-cockaded Woodpecker Stand																						
2	613	12	21	10	12	3	Moderate	17.0	75	68[b]	40	100%	18%	27%	55%	0%	60	100%	28%	23%	51%	0%
Pine Sawtimber Stands																						
2	591	12	21	10	11	3	Light	12.3	79	63	80	100%	30%	0%	61%	9%	72	100%	42%	0%	51%	7%
5	365	16	21	12	3	3	Light	16.4	79	70	40	94%	9%	0%	0%	91%	47	99%	13%	0%	0%	87%
5	365	1	21	12	2	3	Light	15.9	89	60	60	94%	12%	0%	0%	88%	78	99%	12%	0%	0%	88%
5	354	5	21	12	8	3	Light	15.9	76		60	100%	6%	0%	12%	82%	81	100%	5%	0%	8%	87%
Average						*12*		*15.1*	*81*	*64*	*60*	*97%*	*14%*	*0%*	*18%*	*68%*	*70*	*100%*	*18%*	*0%*	*15%*	*67%*
Recently Thinned Pine Poletimber Stands																						
2	283	4	22	11	6	3	Light	9.3	58	31	160	87%	21%	9%	57%	13%	69	95%	23%	7%	56%	14%
5	343	8	21	11	1	3	Light	9.8	65	30	110	97%	9%	3%	3%	84%	57	97%	9%	5%	2%	84%
Average						*6*		*9.5*	*62*	*31*	*135*	*92%*	*15%*	*6%*	*30%*	*49%*	*63*	*96%*	*16%*	*6%*	*29%*	*49%*
Recent Precommercially Thinned Pine Stand																						
5	417	8	21	13	7	3	Light	3.8	34	11[b]	480	90%	46%	29%	2%	24%	57	74%	63%	18%	1%	18%

Footnote: [a] = taken from CISC data set.


Figure 8. Windthrow (WT) in "open" longleaf stand