

April 2011 Tornado Outbreak Timber Damage Summary

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On April 16, 2011 a front passed across the state spawning tornados across much of the piedmont and coastal plain. This outbreak of tornados was reported to be the largest in the state's history, with 28-30 tornadoes. An additional storm system, on April 27, 2011, caused widespread damage to states to our south and west and spawned at least one confirmed tornado in western North Carolina. In addition to the devastation these storms caused to the people of North Carolina, significant damage to the forest resources in the impacted areas was also observed.

Requests for tornado timber damage assessments were received from Division of Forest Resources District and County personnel across the state. Three aerial survey teams took part in the damage surveys, one from District 2 (Lenoir), one from District 13 (Fairfield), and one from Griffith's Forestry Center. Damage from the April 16 storms was surveyed over the course of three days, April 19, April 25, and April 29 and damage from the April 27 storm was surveyed May 13.

Due to the expansive extent of the storm damage a ground survey could not be completed in a timely and safe manner. Instead, the damage appraisal to determine the amount of forest damage caused by the storms was completed using acreages mapped during the aerial survey.

Methods – An aerial survey was completed over the course of four days in April and May by personnel from the Division of Forest Resources Fairfield District, Lenoir District, Aviation Branch staff, and Pest Control Branch staff. An initial attempt was made to fly the damage surveys on a grid but due to the nature of the damage flights parallel to the tornado tracks proved much more efficient. All major tornado tracks reported by the National Weather Service were flown with damage mapped as polygons with various attributes. Based on observation of recently windthrown (or toppled) trees, broken main stems, and severely

damaged crowns, each point was assigned to a damage class (Light - 1-25%, Moderate - 25-50%, Heavy - 50-75%, and Severe - more than 75% of timber damaged). A total of 240 timber damage polygons were mapped in 22 counties, for a total of 4,749 acres. Damage was fairly evenly distributed amongst the four damage classes with no single damage class holding a majority. After obtaining the number of acres damaged, the average value of timber was calculated. This was done by factoring *Timber Mart-South* (Harris, 2010) published values of standing timber for the affected area of North Carolina with volumes obtained from U. S. Forest Service survey information (Brown, 2002). Timber values used were \$158 per thousand board feet (MBF) International rule for pine sawtimber, \$107 per MBF for hardwood sawtimber, \$17.69 per cord for pine pulpwood and \$12.45 per cord for hardwood pulpwood.

The average values per acre were multiplied by midpoint damage levels for each damage class and the resultant figures were multiplied by the acreage in that damage class to obtain volume and value of damage for that class. Midpoint damage levels used in the “Light Damage” class was 13 percent, in the “Moderate Damage” class damage 37.5 percent, in the “Heavy Damage” class 62.5 percent, and in the “Severe Damage” class 87.5 percent. Damages obtained for each damage class were then totaled to obtain total county and district-wide losses.

Results - A total of 4,749 acres of timber (See Table 1) sustained some level of damage. The value of the timber damaged across all affected counties was estimated at \$4,053,716 (See Table 2). Visual observations from the survey concluded that almost 75 percent of the damage occurred in mixed pine/hardwood stands. The damage occurred across all topographic positions on the landscape, though nearly half of the mapped damage occurred in bottomland forests. A map of the damaged areas follows the summary tables (Figure 1).

TABLE 1
Acreege of Timberland Damaged in North Carolina
By Percentage Class and County
April 2011 Tornadoes
4/16/2011 & 4/27/2011

County	Damage Class (% Timberland Acres Damaged)				Total
	1-25	26-50	51-75	76-100	
Alamance	3	15	-	-	18
Alexander	1	10	28	-	39
Bertie	55	51	86	140	332
Bladen	22	46	119	41	228
Caldwell	-	33	42	-	76
Caswell	2	-	-	-	2
Chatham	-	-	-	113	113
Craven	52	-	-	121	173
Cumberland	33	30	222	144	429
Greene	45	14	38	189	286
Halifax	-	1	-	-	1
Harnett	87	-	81	17	185
Hertford	5	15	-	1	21
Johnston	319	263	184	187	953
Jones	-	-	11	-	11
Lee	-	83	164	225	471
Person	6	18	-	-	24
Pitt	-	16	-	-	16
Robeson	-	25	13	-	38
Sampson	104	63	306	67	540
Tyrrell	311	-	337	-	648
Wake	6	50	58	32	145
Total	1,051	733	1,689	1,276	4,749

Numbers in rows and columns may not sum to totals due to rounding

A dash (-) indicates no observations were made in county using this sampling method

TABLE 2
Volume and Value of Timber Damaged in North Carolina
By County
April 2011 TORNADOS
4/16/2011 & 4/27/2011

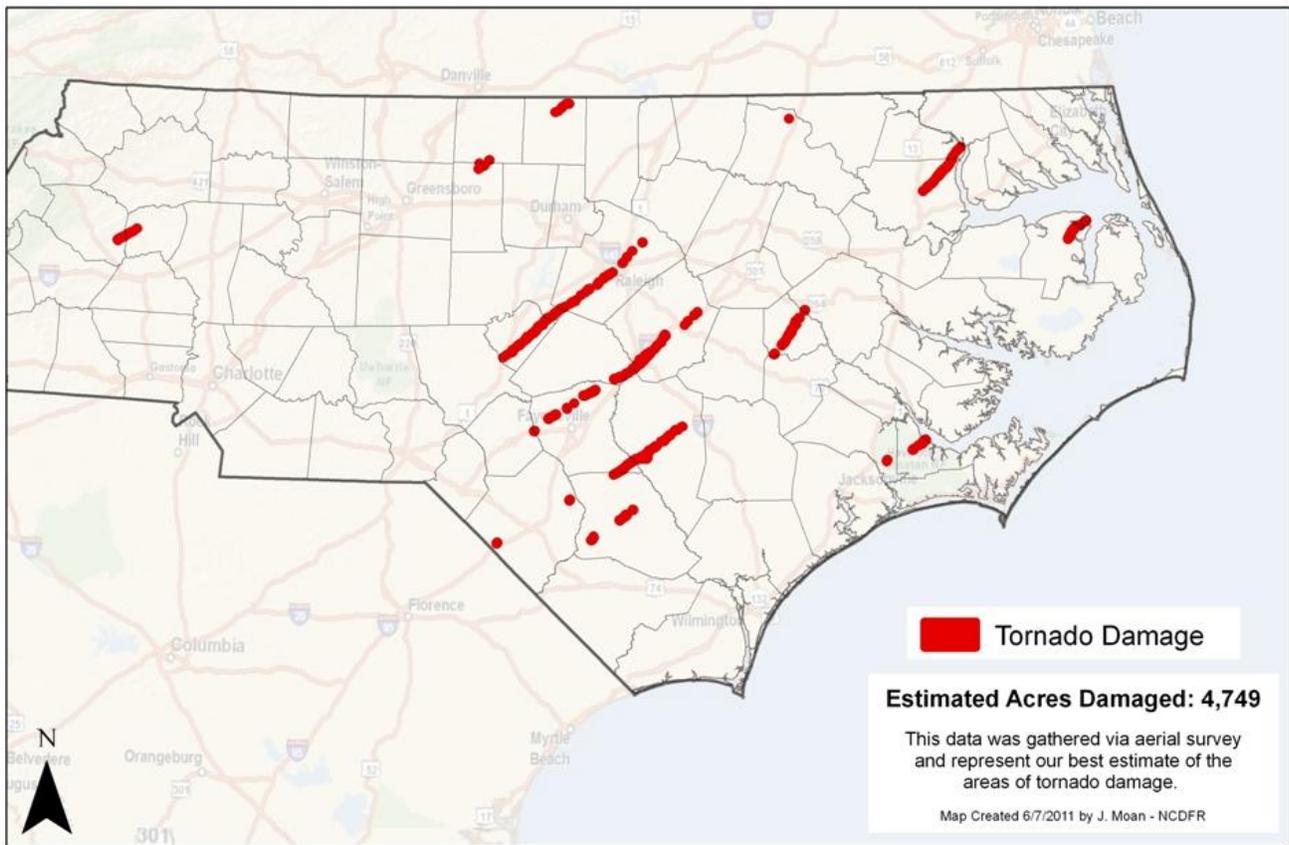
County	Pulpwood Volume Cords	Sawtimber Volume MBF (Int. Rule)	Value Dollars
Alamance	78	59	\$ 8,223
Alexander	297	149	\$ 20,854
Bertie	3,329	2,014	\$ 335,120
Bladen	2,093	891	\$ 172,679
Caldwell	559	344	\$ 48,280
Caswell	4	2	\$ 300
Chatham	1,941	1,066	\$ 183,225
Craven	1,519	1,340	\$ 237,286
Cumberland	4,309	2,959	\$ 542,208
Greene	3,270	1,143	\$ 209,612
Halifax	8	4	\$ 732
Harnett	1,060	678	\$ 122,190
Hertford	126	66	\$ 11,346
Johnston	5,708	3,602	\$ 599,735
Jones	109	61	\$ 11,853
Lee	5,353	3,278	\$ 561,124
Person	104	52	\$ 8,234
Pitt	71	68	\$ 10,471
Robeson	258	202	\$ 33,598
Sampson	4,215	2,261	\$ 366,589
Tyrrell	3,405	2,412	\$ 447,513
Wake	871	761	\$ 122,546
Total	38,683	23,412	\$ 4,053,716

FIGURE 1

The observed damage polygons are shown on the map below. Note that the boundaries of the polygons have been exaggerated to enhance visibility at a statewide scale. The nature of tornado activity made it difficult to follow the storm paths in some areas. It is possible that additional damage may be found in the areas not surveyed.



Forest Damage
April 16th and 27th Tornado Events



Limitations

Survey Method. At the start of the survey, it was quickly determined that the most efficient method for the survey was to fly the reported tornado tracks rather than use a grid-based approach. This method was based on the assumption that the tornado tracks would be continuous enough that they could easily be located and followed. It turned out that keeping the surveys along the storm tracks was a challenge. In the areas with the most significant damage, the assumptions held true but in areas where the damage was light to moderate, tracks were often difficult to follow. In areas of lighter damage, being just 1-2 miles to either side of the storm track could make these damaged stands virtually invisible. Additionally, the areas along the storm tracks where the tornados actually touched down were often separated by many miles. Based on these limitations, our damage acreages and timber value estimates represent our best estimate of the damaged areas. It is possible that other damage may exist outside of our surveyed areas.

Usually, storm damage surveys are completed with a combination of aerial reconnaissance and ground survey plots. Completing this survey using only aerial sampling can lead to a some variability due to flight conditions (turbulence, visibility, flight speed and altitude) affecting observer interpretation of ground occurrences. Every effort was made to keep sampling as systematic as possible to minimize biases and variability.

Acreage, Volume and Value. The acreage and volume figures used in this were calculated using assumptions and data from Forest Inventory and Analysis sources. Use of this data to determine acre, volume, and value estimates can lead to unacceptably high sampling error at the county level.

Literature Cited

Brown, Mark, 2002. Forest statistics for North Carolina, 2002. USDA Forest Service, Southern Research Station. Resource Bulletin SRS-88. 78 pages.

Harris, Thomas G., Jr., 2010. Timber Mart South. Fourth Quarter, 2010. Daniel B. Warnell School of Forestry, Univ. Of Ga., Athens, Ga.

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