Upton Tornado Study by Tom Dodd

On July 26, 2018 a tornado went through the towns of East Douglas, Uxbridge, Northbridge and then came whirling back down into Upton. Both tornadoes were rated as EF1, with maximum winds of 110 mph. The Douglas tornado went for 4.4 miles with a width of 200 yards. The Upton tornado, which caused a power outage at 2:47AM, went for 1 mile with a width of 100 yards. Starting at 142 Main St (losing a roof), it went on to Nathaniel Way, Ephraim's Way, crossing Warren St, and continued into the Upton State Forest (USF). Fortunately, there were no injuries reported and property damage was restricted to a few homes and yards.

Later that morning, Cathy and I decided to check out the damage along Warren Street. The road had been made passable by the Upton Public Works, but it was still littered with leaves and small branches and some trees alongside the road were snapped and uprooted. Being so close to home and within the Upton State Forest, this tornado was of great interest to me, so I made many visits to the site over the following two months to study its effects.

I posed a few questions to myself:

1) What was the path of the tornado?
2) How are tornadoes rated?
3) What does the damage look like?
4) What rotational evidence could be seen?
5) How were plants and animals affected?

Tornado Path

The tornado path was determined by taking GPS points within the Upton State Forest (USF) and also using newspaper accounts of street addresses. The path was estimated from Main Street to Warren Street with my study focused on the tornado affects within the USF. Even keeping GPS points accurate was problematic, because it was difficult to cross over the path with all of the trees down. Future aerial maps may provide a better mapping of the tornado's path. The tornado crossed over Warren Street at the gated entrance to the USF (Pratt Hill Rd or Hurley Trail). Here, it snapped at least 70-year-old White Pine trees, typically at the 50-foot height and uprooted many other trees. There were many deciduous and pine trees that needed to be cleared to make the access road passable. Crossing over the gas line, there are two adjacent sections where I noted the heaviest damage. Here most trees were toppled in a large area with uprooted trees being the most visible. The dirt road leading from the top of Pratt Hill to the power line had a number of trees downed that have since been cleared by DCR. As the hill flattened out at the top, the tornado seemed to hop-scotch over sections, leaving some intact, and dropping back down to take out a few more trees. The last noticeable damaged spot was where an USF trail crosses on the north side of Pratt Hill. As the grade drops down, the tornado damage subsided.

Upton Tornado Path

*Note that the line used in the map is not the full width of the tornado path.

Tornado scale

The Enhanced Fujita Scale (EF scale) is used to rate tornado intensity. Upton experienced an EF1, which has 86-110mph winds and causes moderate damage. The highest intensity is an EF5 where wind speed is greater than 200 mph where some cars, trucks, and train cars can be thrown 1 mile!

There are 28 damage indicators that may be used in calculating the intensity. Most of these rate damage to different types of structures such as: one or two-family homes, barns, motels, strip malls, power lines, light poles, and another two are based on trees. Each of these indicators have degrees of damage that can be identified with a lower, expected, and upper wind speed. As an example, uplift of a roof deck has an expected wind speed of 97 mph, with lower and upper values providing a typical range. The two damage indicators for trees, one for hardwood and another for softwood, each have 5 degrees of damage. The area of the USF that I did a transect through were primarily pine trees that were uprooted and had trunks snapped (most near or above a 50-foot height) with hardwood trees showing somewhat

less damage. This damage indicates an expected wind speed of 87-104mph, which corresponds to an EF1 tornado. Note that hardwood trees (hickory, oak) require a little higher wind speed than softwood trees (pine) for the same degree of damage.

Degree of Damage	Description	Expected Wind Speed (mph)	
		Hardwood	Softwood
1	Small limbs broken (up to 1" diameter)	60	60
2	Large branches broken (1-3" diameter)	74	75
3	Trees uprooted	91	87
4	Trunks snapped	110	104
5	Trees debarked with only stubs of largest branches remaining	143	131

Enhanced Fujita scale

EF0	65–85 mph	Light damage
EF1	86–110 mph	Moderate damage
EF2	111–135 mph	Considerable damage
EF3	136–165 mph	Severe damage
EF4	166–200 mph	Devastating damage
EF5	>200 mph	Incredible damage

As a comparison, the tornado that hit western Massachusetts on June 1, 2011 was characterized as an EF3 tornado having winds of 136-165 mph. It was 39 miles long and 1/2mile across in places. It was severe, with homes heavily damaged and no trees left standing in its path. We found a Christmas postcard in our yard that day. Bill Taylor also found someone's financial form in the USF some days later. Both of these items showed Monson addresses, some 37 miles away!

Transect

A transect line about 250 feet long was created to map the living trees, trees that were snapped or uprooted, and the direction of some fallen trees within about 50 feet of this line. This area was predominately White Pine, with some Hickory, Oak and nearby Ash and Red Maple in the canopy layer. The understory was mainly young Hickory and Maples, with some Oaks and Witch-hazel. The forest floor has wood ferns and partridgeberry.

There were many White Pine trees that had been snapped at about the 50-foot height along with others that had been uprooted. A large oak seemed to be untouched, all of its leaves and branches intact while possibly affording protection to a few pines from the strongest winds. One hickory was killed, but did not just snap like the pines, it was wrenched apart, with strands of interior wood fibers peeling apart in an ordered appearance. The understory hickories and maples showed damage from the upper tree trunks that had fallen on them, with the young tree tops bent to the ground in an arched manner. The forest floor plants showed no damage except from fallen trunks and branches that now covered them.

On some of the Pine trees still intact in the path, the remaining upper branches seemed to be permanently bent – no longer coming straight out from the tree, but partially curling back around the tree away from the wind.

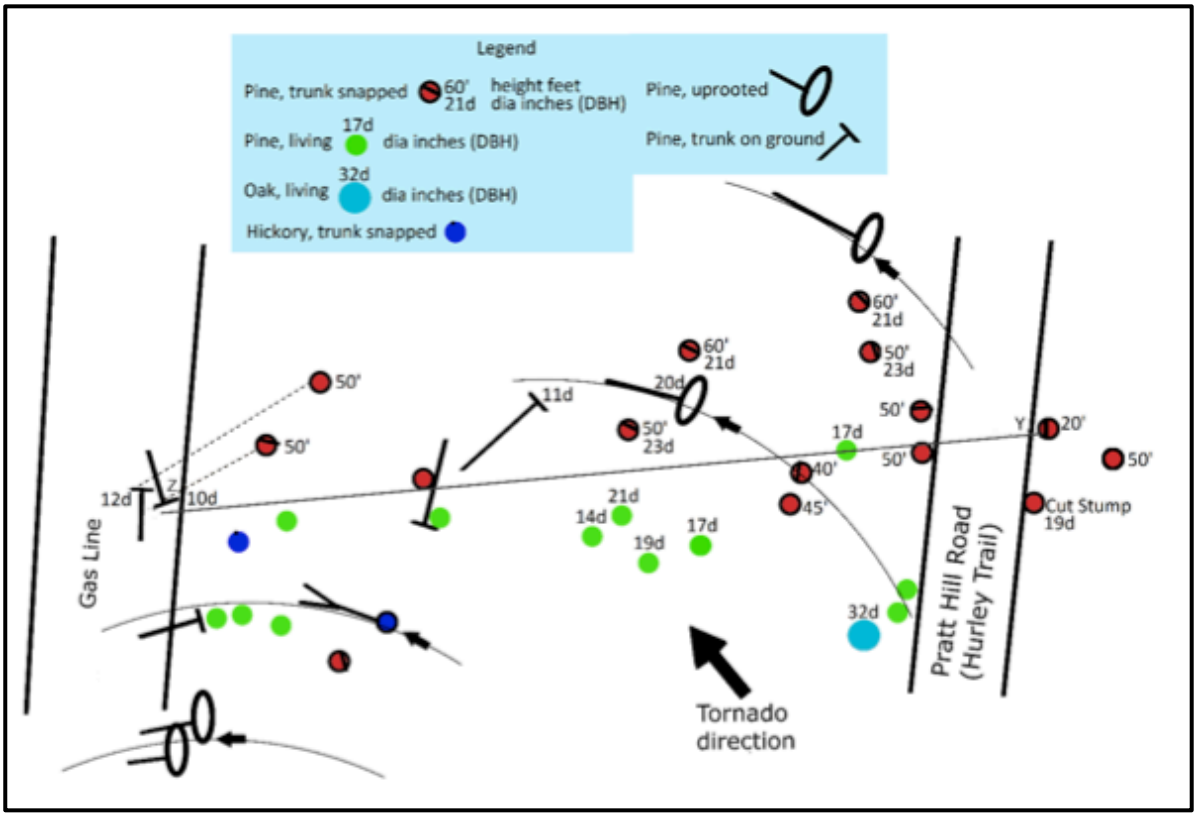
Since there were many trees that had been snapped at about 50 feet, I was expecting to find some evidence of rotation on the remaining trunk, with maybe the bark stripped off in a spiral pattern, but did not find that. Maybe the fallen tree tops that had been torn off would help determine the rotational

wind direction – but their direction seemed altered by how they land. The uprooted trees seemed to provide the best indicator of rotational wind direction. Compass bearings were taken on 10 uprooted trees at various points along the tornado's path. All of the trees had fallen in the direction of the tornado's forward motion or up to 90 degrees to the left as shown below.

Two pine trunks that had been snapped off and blown onto the gas line were also mapped. A dashed line to the probable tree they originated from is shown on the map with them landing at least 50' away.

The map below shows the transect line through the tornado path and provides some perspective as to the damage that was inflicted. There are areas north of the gas line that sustained much heavier damage than this section. However, this section was more accessible and visible from Pratt Hill Road and probably easier to maneuver among the fallen trees.

Note1: Distance was measured by pacing, being difficult to maintain accuracy when trees are down. Heights were grossly measured using a ratio of a 5' stick at base of tree and my thumb at arm's length and counting the number of thumbs high. I took 2 GPS points: y=N42°10'54.0" W71°37'05.9", z=N42°10'56.1" W71°37'07.0"
Note2: DBH (diameter breast height) – tree diameter at 4.5 feet high



Damage along transect line

Spotty damage near top of Pratt Hill

Hickory Tree damage – wrenched apart

Pine trees snapped off at about 50’. Dying branches along ground.

Most damaged section just north of gas line – Many pine trees have been uprooted – all trees down

Plants and Animals Affected

How were the plants and animals affected by the tornado?

A few days after the tornado, I heard an Eastern Wood Peewee singing “pee a wee” from the understory of the damaged area. Was it still nesting? According to Birds of Massachusetts, their egg-dates are from June 10 to July 25, suggesting they may have had young in the nest when the tornado hit. Their nest and young likely would not have survived the winds.

Just over 3 weeks after the tornado had blown through, a deer snorted - not happy with my presence. A small buck and another deer walked through the tornado damaged area heading toward the gas line. Were they eating the more tender leaves at the top of the trees that were downed? Or was this a safe spot from coyotes? This past winter, I noticed that deer were browsing on the top of a Maple tree that had been toppled by beavers earlier in the year. So, maybe the deer were browsing on these fallen tree tops as well. A month later, I did find that deer were browsing on both Maple and Hickory that had re-sprouted from bent over trunks as well as the top of a knocked down living Hickory tree.

Insect-like sounds were heard coming from a few of the downed pine tree trunks. They sounded something like the slow, creaking of a rocking chair that becomes louder and then stops, lasting about 2 seconds, and then repeated. Searching insect sounds on-line, a possible match was Pine Sawyer beetles. A small conical (2” diameter x ½” high) pile of rice-like pieces, but smaller, was found along the ground

beneath an entrance hole on the underside of the trunk. The entrance hole looked to be the size of a pencil lead. There were no sounds heard coming from any live trees. These insects are taking advantage of the tornado's destruction. Soon to follow may be woodpeckers that are after these insects' larvae.

So, with Maple and Hickory trees re-sprouting, deer browsing, and insects going to work to recycle the downed wood, nature recovers from such destruction. Tornadoes can be devastating, but can cause disruptions in the ongoing natural cycles, allowing other plants and animals to colonize anew.

References:

Metro West Daily News – posted: July 26, 2018; updated: July 27, 2018, 10AM
https://en.wikipedia.org/wiki/Enhanced_Fujita_scale
https://en.wikipedia.org/wiki/2011_New_England_tornado_outbreak
Birds of Massachusetts, R. Veit, W Petersen, 1993