

Windthrow as an Agent of Tree Death

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[For the series of articles on agents of tree death, we will make a distinction between the wind blowing an entire tree down, from the roots, and the wind doing other damage to trees such as breaking limbs and roots. This article addresses the first of these.]

Most people familiar with the streets of Halifax will have seen whole trees blown over as a consequence of a windstorm, perhaps even a hurricane (like Juan in September 2003 or Dorian in September 2019). If the winds are strong enough, it doesn't matter where the trees are, or really even how big they are.

On that first point, no tree is ever fully protected from the wind (although I'll present an example later where trees have been tethered together to prevent wind from toppling individual trees). Whether it's a park tree, woodland tree, yard tree, or street tree, it is susceptible to windthrow (or blowdown, we sometimes call it) if the winds are strong enough and from the right direction. Some forest ecologists in Nova Scotia - me included - consider wind to be a really important agent of tree mortality in the forests of the province.

What factors predispose a tree to be susceptible to windthrow? There are quite a few:

- (a) shallow or otherwise restricted soil;
- (b) wetness of the soil - roots slide easier through wet soil;
- (C) slope and aspect of the land - if a hill faces into the wind, the trees will be buffeted more than the trees on the lee side of the hill;
- (D) rooting habit of the tree - some species are by nature shallow-rooted, some are more deeply rooted;
- (E) leaf habit of the tree - trees that are leafless from November to May are much more apt to stay standing through a winter windstorm than trees with full foliage (like most of our conifers);
- (F) previous exposures of the tree to wind - if a tree has grown up in a windy environment, it will have developed a stronger trunk and roots as a consequence of the wind; if it has been sheltered from the wind, by other trees for example, it is less able to withstand those same winds; this is what happens when woodland trees that have grown in a dense stand all of a sudden find themselves with no tree neighbours on account of a timber-harvest operation;
- (G) pruning history of the tree - a tree that has had recent crown-reduction pruning, for whatever reason (power-line conflicts, health improvement), is more likely to stay up during a wind event than the tree in its pre-pruning condition.

Doubtless the list is longer, but you get the picture - it's complicated. Let me address the issue of soil for a moment. Under "normal" circumstances - say, in a woodland setting - trees send their roots as far down as they can and as far horizontally as they can. This means, of course, that trees close together have root systems (and crowns as well) that are intertwined with those of other trees. From a wind-firmness perspective, one would want one's trees to be as firmly rooted as possible. Unfortunately, in the city environment, we do our trees, particularly street trees, a great disservice by hampering their root developments with our hardscape structures. It's bad enough that the soils of Halifax are, in so many places, naturally shallow. Our contemporary construction practices make matters so much worse when, first of all, we compact the subsurface gravels under concrete and asphalt to an incredible hardness, and second, we build a tree lawn (the space between curb and sidewalk) that brings the concrete borders to within a metre of each other. If you want to predispose a tree to windthrow through construction practices, that's exactly what you would do!!

Fortunately, in so many of our older residential neighbourhoods, the tree lawns are wide (often two metres, sometimes more) and the subsurface under the sidewalks and streets is not so highly compacted. This situation allows most of our street trees to become firmly rooted and, even if they are towering elms of more than 25 metres, they still have a good chance not to fall over in the next wind event.

I mentioned above that trees of all sizes can be blown down. Of course, as a general rule, the taller the tree, the more top-heavy it is and the easier it is for a wind event to blow it down compared to shorter trees. However, when we get the occasional large wind event, like the two hurricanes I mentioned, even smaller trees can be susceptible. At the really small end of the spectrum are the balled-and-burlapped trees we customarily plant streetside. It takes several years for these new trees to establish their rooting system and get the roots well extending in the surrounding soils. That's the main reason the new trees are staked and tethered. If the tethers are left on too long (say, five or ten years or, heaven forbid, never removed!!), the trees are not motivated to develop wood and root strength by responding to non-lethal winds. If no tethers are used at all, a strong wind event could easily push the young trees over because they have had insufficient time for the roots to penetrate the surrounding undisturbed soil.

I have even seen examples where streetside trees planted just after Hurricane Juan (i.e., 2004) were blown down during Hurricane Dorian (2019)! One was a linden on the edge of the North Common opposite William St., a tree that displayed a graceful arc in its main branches, so unlike its immediate neighbour - an oak - the branches of which come out of the trunk at a right angle and run horizontally. Another was a super-tree - Freeman maple - that was planted right where a big one had come down onto the adjacent house during Juan. The tree grew a huge crown and trunk, amazingly quickly, which I think were not adequately supported by root development and it fell right on the same house! (see photo).

So, how do we make our urban forests more resistant to windthrow, given that we live in a somewhat windy city on the Atlantic coast and we can expect an even windier environment in the future due to climatic change? My first demand on this is to provide every street tree with abundant soil - we know what to do in this regard, we just don't seem to want to spend the

money to make it happen. My second plea is for a rapid transition to a full program of cyclical pruning where every street tree gets a frequent visit from a municipal arborist who will prune the tree for health and structural integrity. I do not favour the oft-cited remedy of growing only trees that are small at maturity. The broad reduction in ecosystem services that this would precipitate is not welcome, at least not in *my* Halifax!

After encountering the naturalized woodland ecosystem established in a courtyard of the National Library of France in Paris, I have been pondering the potential merits of tethering mature trees loosely to each other so that weakly rooted trees might be able to depend on strongly rooted trees during a wind event. In the photo of this interesting pine-dominated “forest garden”, you might be able to see the tether points on many of the pine trees. I believe this had been done to prevent the windthrow of any specific tree, especially since the large trees were all transported to this location as large trees! Of course, if the wind is strong enough, I suppose it could take the whole tree population down, but in such a case I don’t think it matters one way or the other whether the trees were tethered together or not!

Wind is certainly a major mortality factor for trees in Halifax. Through my own count, I estimate that about 5% of the street trees in my central-peninsula neighbourhood blew over during Juan (and I’ve heard other estimates as high as ten percent). As many Haligonians know, Hurricane Juan laid down, in a matter of an hour or two, about three-quarters of all the mature trees in Point Pleasant Park. We need to take wind seriously in the future management of the Halifax urban forest.

Finally, as a matter of interest, just because a tree is totally blown over does not necessarily mean that it will die. In the built-up areas of the city, as soon as a tree blows down, we remove it. In the woods, though, we often don’t. Wandering through older stands of trees often brings to sight trees that, while laid horizontal from the roots to the tip, still manage to cling to life using the few roots that did not break when the trees fell. That makes for a fascinating treescape, especially when such trees continue to live for a long time.

Picture captions

Street trees felled by Hurricanes Juan and Dorian [TreeFelledByJuan_01; TreeFelledByDorian_01; TreeFelledByDorian_02] (all photos by P. Duinker)

Sixteen years after planting, this Freeman maple was felled by Hurricane Dorian onto the same house as its predecessor fell during Hurricane Juan [FreemanMapleDownByDorian_VernonSt_190908]

A human-made pine ecosystem in the courtyard of the National Library of France in Paris [Paris_National_Library_01]



Street trees felled by Hurricanes Juan. Photo Source: P. Duinker



Street trees felled by Hurricanes Dorian. Photo Source: P. Duinker



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