Big Storms have Big Benefits

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Only a few weeks ago a huge storm hit the Ottawa Valley. Some were without power for more than a week. Roads and power lines were blocked with fallen trees. And, on land trust properties, trees were felled across many of our trails. It would be easy to assume that our properties in particular, and our forests in general, were harmed. Actually, it is not so. I have been asked to say something about the role of natural events like storms in forest ecology.

Natural disturbances are, well natural. Common examples are fires, hurricanes, landslides, volcanoes, and larger than normal spring flood pulses. These events are usually short-lived. Too often news stories report such events as 'catastrophes.' If, however, we are trying to protect natural areas, it is important for us to understand that extreme events are part of nature. The task of scientists is not to provide emotional judgements for newspapers, but rather to understand the effects of these extreme events on natural systems. This article is a summary, dealing with storms and forests ecology.

Even bigger disturbances happen, including collisions with asteroids, such as the one that destroyed the dinosaurs. However, this is a topic for another day. In this short contribution, I want to focus more narrowly. First, let us focus upon damage from storms. And, second, let us focus upon forests. Rather a lot is known about the impacts of storms upon forests.

Probably the most visible damage from storms is fallen trees. The fallen tree trunks remain in place and slowly decay. As they decay, they provide many kinds of wildlife habitat, as well as often providing germination sites for tree seedlings. Let us look at germination first. In our part of the world, trees like Yellow Birch and Hemlock are classic examples of trees that will germinate on the top of fallen logs. Often, they cannot germinate on the ground because it has a thick layer of leaves, while a rotten log provides a moist leaf-free germination site. Sometimes you can find situations where the log has rotted away entirely, leaving an adult Yellow Birch tree apparently standing on stilts. The next time you are hiking in the forest, pay attention to fallen logs that are many years old, and see how many kinds of tree seedlings you can find growing on the dead wood. The fallen trees and branches on a forest floor are known in forest ecology as coarse woody debris. This debris provides vital habitat for ground-dwelling invertebrates and amphibians. Salamanders are particularly well known to benefit from fallen trees, so when Cathy and I see a fallen tree, we remind ourselves that the debris will make the forest even better habitat for salamanders. Other organisms, however, such as frogs, giant millipedes (*Narceus americanus*) and many kinds of fungi also make use of decaying logs. In the winter you may see footprints that reveal how mice, weasels, and squirrels use fallen logs as highways.

There is another important impact of fallen trees. The roots are often tipped upward when the tree falls, sometimes creating a vertical wall of roots that will even lift boulders into the air. Right next to this tip-up is a depression, which sometimes reaches down to the water table, making a small wet pool. In ancient forests that have not been logged, the ground is actually quite uneven from this process; it is common to see many tip-up mounds next to shallow pits. This is called pit and mound topography and it is a diagnostic feature of old-growth forests. This topography creates many kinds of habitat patches for plants and animals. The photos below show a huge maple that fell in the storm, and me standing in one new pit with the roots that will create a new mound. Notice that the tree roots have lifted a boulder well above my head; over time, this too will become part of the new mound. The formation of this mound may take decades as the roots

slowly rot. If you see pits and mounds, pay attention to particular species of plants and animals that may be making use of them.

Left: Large Sugar Maple trees were felled in the storm that hit eastern Ontario in 2022;

Right: Paul standing in the pit created by the upheaval of a large root network. The roots in this tip-up will decay over several decades, leaving a mound of soil. Note the small boulder that has been lifted by the roots. The pit is deep enough to have several centimeters of water.

Some trees are damaged, but remain standing. Many descriptions of storm damage will count up trees that have been damaged when large branches are broken, or trees that are bent at an angle. Many reports—alas some even written by scientists—report dead and damaged trees as a problem. In fact, dead, leaning, and damaged trees may become snags (“wildlife trees”) which provide habitat for many kinds of animals including cavity-nesting birds. Again, these trees enrich habitat diversity in a forest.

Storms have one other very important consequence for forests: gap regeneration. If you look carefully at most forests, there are thousands, indeed hundreds of thousands of young trees about knee height covering the forest floor. Sugar Maple is particularly capable of forming dense stands of seedling trees. Over time, most of these young trees die from lack of light and water and are replaced by newly-germinated seedlings. They are all simply waiting for a rare event that will kill the adult trees that are shading them. When this happens, the sudden availability of light (as well as water and nutrients) allows these small trees to grow vigorously. Hundreds or thousands of young trees will race to fill the gap, but only one or two will win, and they will become the next adult tree. So, the next time you see a fallen tree, pay attention to the sun-lit gap. You will notice that the young trees in this gap are growing quickly. If you return in a few years, you will be able to see which young trees are in the lead to fill the gap. There are some tree species that cannot reproduce at all or very poorly in the shade. Common examples in Lanark County are White Pine and Yellow Birch. The only time these species can germinate and grow into adults is if a large enough gap is formed. Both of these species therefore benefit from storms (and from forest fires, but that is another story). There are many papers written by scientists that describe how gap dynamics lead to increased tree and wildlife diversity.

Overall, then, storms and fallen trees have many consequences for forests. I have listed four positive consequences above. Since our objective is to protect natural areas for future

generations, it is important for us to remind ourselves that natural disturbances are a positive part of natural systems. Of course, being human, we become attached to our surroundings, and sometimes find it difficult to accept it when a large, old tree falls to the ground. We feel like we have lost something. However, what we are really seeing is just one stage in gap regeneration, and pit and mound formation. These events ensure that our grandchildren will inherit forests with a natural mix of tree species, and many kinds of wildlife that are dependent upon fallen trees.

If you want to read more about the role of natural disturbance in forests, here are four well known examples:

Botkin, D.B. 1990. *Discordant Harmonies: A New Ecology for the Twenty-first Century*. Oxford University Press, New York. (written for a general audience)

Keddy, P.A. 2017. Disturbance. Chapter 5 in *Plant Ecology: Origins, Processes, Consequences*. Cambridge University Press, Cambridge. (written for students; download a pdf of this chapter here https://drpaulkeddy.files.wordpress.com/2022/06/chapter-5-disturbance-from-plant-ecology-2017.pdf)

Tubbs, C.H., R.M. DeGraff, M. Yamasaki and W.M. Healy. 1987. *Guide to Wildlife Tree Management in New England Northern Hardwoods*. United States Department of Agriculture and Forestry Service General Technical Report NE-118. (a great reference for the beneficial effects of dead trees and dead wood overall; download as a pdf here https://www.fs.fed.us/nrs/pubs/gtr/gtr118.pdf)

Connell, J.H. 1978. Diversity in tropical rain forests and coral reefs. *Science* 199: 1302–1310. (a general discussion of gap dynamics and diversity in a technical journal)