The Leaflet

Newsletter of the Morgan Arboretum

Spring 2018

A journey in the life of a tree

Take a moment for magic

By Jim Fyles, Director

It was Winterfest. We were serving up sausages on the Conservation Centre patio. The team across the way was pouring sweet strands of taffy onto packed white snow. The patio was bustling with people coming and going, deciding what to do next. But, in amongst all the knees, my attention was held by a small girl immersed in what I guessed to be her first experience with taffy-on-snow. Her eyes were wide, her tongue outstretched, concentration intense. It was first love. The golden orb of soft heaven was all she saw, even it made its way slowly, slowly down the stick, the hand, the pink snowsuit…it was a moment of magic.

We were almost too late. But if we hurried, we could ski the yellow trail before dark. A good snow day could not be missed. The hemlocks felt close, the beeches cathedral-like in the afterglow of the setting sun. Dusk had settled in as we approached the Sugar Shack. I happened to look up and silhouetted against the sky, just for an instant, a wide pair of outstretched wings appeared and vanished. “Owl” I called in a stage whisper. But where? ‘Tip-toeing’ on our skis, we crept closer. There, high up, a dark shadow with a barred breast, round face and intent eyes regarded us. I put on my best ‘who cooks for you’ barred owl imitation. The eyes didn’t blink. And then the response. Squawk! Not the resounding hoot I had hoped for but recognition nonetheless. For us, in the growing dark, it was a moment of magic.

We were a fascinating crowd, brought together to celebrate the inauguration of the Canada 150 Trail. As would have been expected, there were ‘dignitaries’, the Dean and me, to say a few words. There were many of the volunteers who had put so many hours of hard work into planning, clearing and building. There were members of the Holland family who we thanked for providing funding in memory of a loved one. But there were more who were unexpected. The event recalled the planting of birches from across Canada near the Chalet Pruche 50 years before.

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Barred Owl stretching

A journey in the life of a tree

By **Mitchell McKinnon**, Student Intern from Vanier College

Getting a cents of it all

The Canadian forest industry is far and away the most robust and successful of any country in the world. Traditional forest products like lumber, pulp and paper make up the majority of revenue generated from forests, but new activities like forest management and advanced bioproducts are beginning to provide even more value. In fact, the forest industry alone accounts for approximately seven percent of our total exports – an impressive 34.4 billion dollars in 2016, having increased every year since 2009. Over 200,000 people are employed in forest management or the production of forest products; the importance of this industry to Canada cannot be overstated.

The top 100 forest product companies generated 317 billion US dollars in sales revenue in 2015 alone, and this just begins to scrape the surface of the global forest industry. It is easy to see that forests are of tremendous importance to world trade markets based on their economic value alone. However, there are other aspects of our forests which we still do not entirely understand in value or importance.

Softwood lumber is a major export item

Peter Wohlleben is a German forester and author who has spent decades developing reformed methods of forest management. He has recently published a book, The Hidden Life of Trees, which focuses specifically on tree communities and the surprisingly complex lives which they lead.

Peter Wohlleben in the forest he manages in Hümmel, Germany

Before we look into the complex interactions of trees and other organisms, we first need to understand some tree basics.

How trees work

The living world can be broken down into two categories: autotrophs or heterotrophs. Autotrophs create their own energy, heterotrophs get energy from other organisms. Trees are one of the largest groups of autotrophs on the planet. Collectively, autotrophs are the primary producers of energy in our world, they are the beginning of every food chain there is. Trees have photosynthetic cell components in their leaves, called chloroplasts,

which allow them to convert sunlight into energy and are responsible for the green appearance of most vegetation. They do this by using energy from the sun to cause a reaction that transforms carbon dioxide and water into sugar and oxygen. The sugar produced is essential to plant growth, whereas oxygen is expelled as a byproduct of the reaction, much to the benefit of the breathing world.

These sugars, along with minerals and nutrients absorbed through their root systems, are transported to all parts of the tree by vascular tissues called xylem and phloem. These tissues serve largely the same function as arteries and veins in animals.

How trees communicate

Trees may seem inactive apart from the basic function of producing sugars, minerals and nutrients. What we have come to find out, however, is that assumption could not be further from the truth. While humans and animals have complex systems of communication, be it sound, scent or sight, trees have their own methods of communication as well. The umbrella thorn acacia trees (*Vachellia tortilis*) of the African Savannah communicate so well that they can warn other trees when giraffes are feeding on them. These trees will emit gases (specifically ethylene) to warn their neighbours that danger is imminent. When the other trees receive this signal, they transport toxins to their leaves to deter the large herbivores.

The umbrella thorn acacia Photo: Diana Robinson (Flickr)

So we now know that trees can smell! But what other forms of communication do trees possess? When something bites into a leaf of a tree, an electrical signal is emitted which prompts a response to repair this damage. This should sound familiar because it is exactly the same mechanism animals use to respond to stimuli. These responses occur at vastly different rates, however: the response of an animal occurs in mere milliseconds, the response of a tree occurs at a rate of centimeters per minute.

How trees change their environment

The parallels between humans and trees do not stop simply at communication. Humans alter their environment with houses equipped with furnaces and air-conditioners to live comfortably, but trees do not have these luxuries. Trees create an environment which they thrive in differently. One tree by itself does not have much of a chance of surviving a full life, which can be hundreds or even thousands of years. However, a forest of trees can alter the environmental conditions to their collective benefit. Forests act as a temperature buffer, similar to how oceans and large lakes buffer temperature in coastal regions, so that they can withstand hot summers and cold winters. In climates like Canada, this is particularly important because the variation in temperature between summer and winter is enormous (up to 70 °C). The leaves of deciduous trees reduce the influence of wind throughout a forest and when they fall on the forest floor, they form a natural mulch that also reduces moisture loss. Leaves can also change other environmental factors in a forest. The leaves of the American beech (*Fagus grandifolia*) alter the pH (measure of acidity or alkalinity) of soil such that the soil's ability to hold water is greater. This may seem inconsequential

American beech leaf litter can transform the soil conditions Photo: Nicholas A. Tonelli (Flickr)

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To all of the stars who together provide the sunshine that sustains our activities and make the Arboretum thrive: **thank you!**

In addition to the donors listed below, 48 individuals have contributed donations of less than $50 for a total of $1,219. Every contribution helps.

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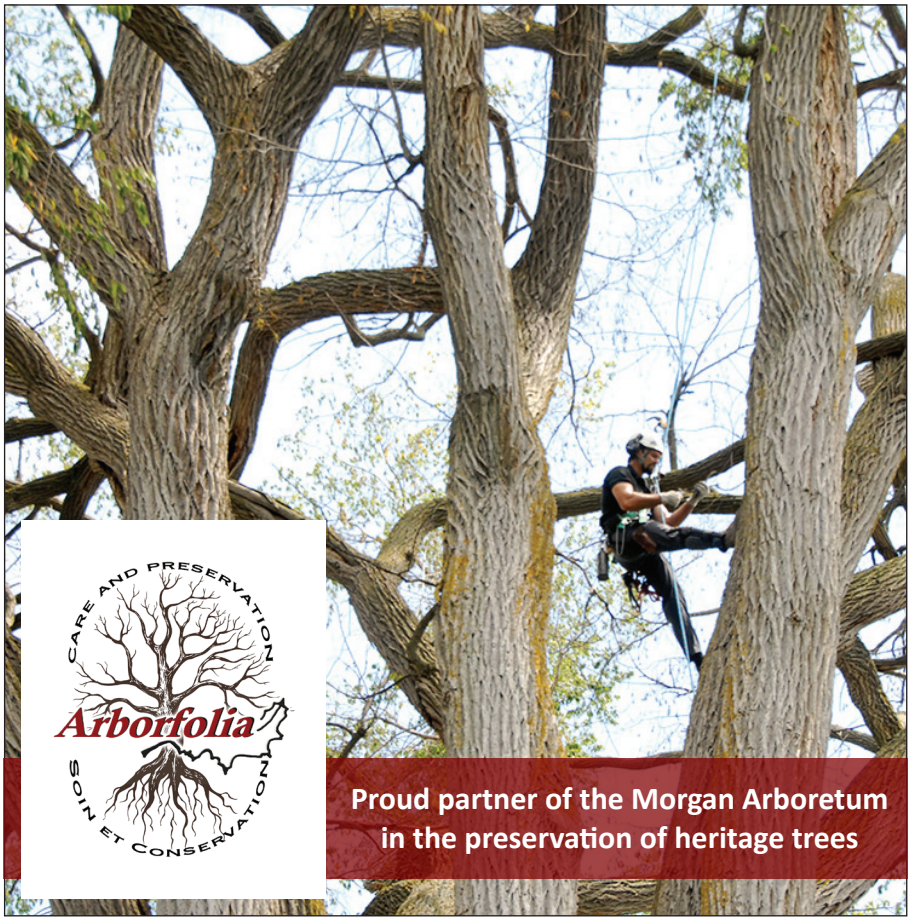
And some in the crowd had participated in the original planting. Some had worked with Dr. Brittain as students in the field and lab to study the birches and prepare for the planting. Some had done research on the resulting plantations. And some of the Jones family were present who recalled Arch and Helen Jones who were so active in the original project and in the Arboretum for years after. We felt the presence of those from the past who had looked forward as they planted the birches, and the presence of those in the future to whom we will pass the Trail. It was a moment of magic.

There has been a lot of buzz in the press lately about shinrin-yoku, the Japanese-Korean practice that translates as 'forest bathing'. Long promoted for its benefits to health and personal wellbeing, this practice of spending mindful time in the forest is emerging as a recognized therapy with at least the start of scientific credibility. Researchers provide evidence of aromas produced by trees that have direct effects on our physiology, and that the ever-changing shapes, colours and lighting provide a welcome contrast to our usual existence of straight lines and square corners. Even when we spend time in nature, we are often driven by purpose. Walk the Orange Trail, run the dog, return in 45 minutes. But at its heart, the discipline of shinrin-yoku is simply to Be. Walk. Sit. Relax. Breathe. Experience the forest with all of your senses. Be in the moment. Be part of the magic. In the Arboretum, it is everywhere.

Thinking back to Winterfest, I am not sure what sort of magic was required to extract that lovely, wee, taffy-coated girl from her snowsuit at the end of the afternoon, but I hope the magic of the moment stays with her. I hope that as she grows she will return often, for taffy in season, and for all of the other moments of magic she can find with a pause, a look and a listen in the Arboretum.



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during spring and summer rain storms, but during the cold, dry winter, it can make all the difference in the world for these trees.

The European beech (*Fagus sylvatica*), which Peter Wohlleben has studied extensively, has a unique relationship with its offspring. All beech species belong to the genus Fagus (a taxonomic division of the classification of organisms), and are considered shade-tolerant. Shade-tolerant means that these trees can continue to grow, albeit extremely slowly, under the canopy of much larger, older trees. The canopies of beech trees are particularly dense and only let three percent of the available light through to the younger, shorter trees. Three percent of the total light energy is simply not enough for young trees to survive. To compensate, mature trees with their extensive root networks, will transport sugars and nutrients to these young trees allowing them sufficient energy to survive until the older trees die and the young have access to more sunlight.

European beech is one of the most widespread tree in Europe
Photo: Michele Zanetti (Flickr)

An ocean of trees

Trees can communicate with each other, they can sense stimuli and react to it in much the same way animals do, they can alter their habitat to better suit their needs, and seemingly nurture their young. While all these abilities are largely self-serving, forests provide an invaluable service to everything around them – rain. The hydrologic cycle, how water moves throughout our planet, is one of the most basic and crucial components to life on Earth. Most of the rain that large landmasses like North America receive comes from the oceans but some places are simply too far from the oceans for the water to reach them (think of the centre of the Eurasian landmass). Despite this colossal distance from any ocean, water somehow still falls all over the Earth, and forests are the reason why. The roots of a tree take in immense amounts of water, literally tons. That water is used to make the energy the tree needs to survive but only a small amount is actually used for growth. Approximately 98% of the water a tree absorbs is lost to the atmosphere again through a process called transpiration. Similarly to how humans have small pores in their skin, trees have small pores in their leaves called stomata. These stomata, when moisture conditions are just right, release the stored water in the tree to the atmosphere. One tree releasing water is unlikely to amount to a lot of rain, but a forest of thousands or millions of trees can create torrential downpours. For life to exist in regions so far from large bodies of water, forests are needed to bridge that gap.

Leaf stomata

Forests' transpiration condensates into clouds

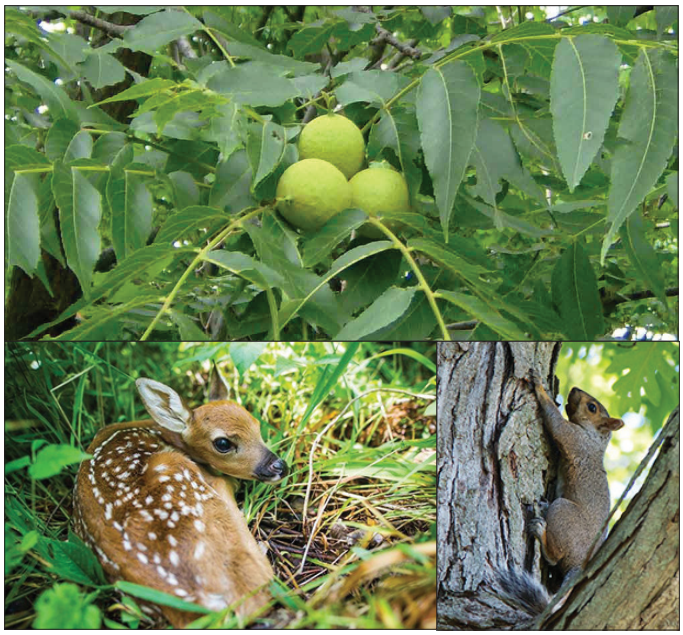
Feeding the forest community

A poplar tree (genus Populus) can produce up to one billion seeds in its relatively short life (many tree species live much longer). Each of these seeds, however, does not survive to become an adult tree, so what happens to the rest?

Poplars produce a ton of tiny fluffy air-borne seeds

The nuts and other fruits that trees produce, which house seeds intended for reproduction, are almost entirely consumed before they even have a chance to become a sapling. The black walnut (*Juglans nigra*) produces walnuts, which are high in fats and coveted by many forest-dwelling animals. The white-tailed deer (*Odocoileus virginianus*), among others, prefers this food source over all others due to its high nutritional value. Deer eating all of the walnuts would be a major problem if that same tree did not produce tens of thousands of nuts every three to five years. While the deer will happily consume every walnut they can find, other animals think more long-term. Some bird species but especially small rodents like the eastern grey squirrel (*Sciurus carolinensis*) will cache these nuts underground to eat after the other animals have eaten all the ones from the forest floor. The squirrels will end up eating most of these cached nuts, but some will be forgotten and become the next generation of walnut trees. While this may seem coincidental, it is actually a reproductive strategy called predator satiation used by many highly consumed plants and animals.

The black walnut was introduced in a specific area of the Arboretum in 1950. It is now sprouting in many parts of the Arboretum as an illustration of the squirrels' contribution to the long term success of an important source of food and habitat.



Top *The black walnut fruit looks and smells like a citrus fruit but within the husk, there is a delicious and nutricious walnut. Photo: sambenvie1 (Flickr)*

Left *A young white-tailed deer.*

Right *The Eastern grey squirrel plays a important role in the propagation of many nut tree species. Photo: Richard Gregson*

The tree community

When saplings, leaves, branches, and even mature trees inevitably die, they will fall to the moist forest floor they have so diligently created and begin to decompose. During this process, in which dead wood turns into a substance called humus, the trees support an immense ecosystem on and beneath the forest floor. Insects and fungi that you can only see with a microscope flourish in decaying tree parts. The insects, which live and thrive in these conditions, are crucial parts of forest food webs. The fungi and trees have an even more intimate relationship, though. A symbiotic relationship is where both members of the relationship (the fungi and the trees) benefit from their close association. The trees provide the fungi with habitat and sugars, the fungi provide the trees with nitrogen which the trees struggle to obtain on their own. As a consequence of the trees dying, they support a deceptively large food web.

In fact, Dr. Suzanne Simard of the University of British Columbia has conducted ground-breaking research into what we now call tree communities. In her native British Columbia rain forests, Dr. Simard ran an

Old growth coastal Douglas fir forest at Cathedral Grove on Vancouver Island. Photo: George Draskóy (Flickr)

experiment involving paper birch (*Betula papyrifera*) and Douglas fir (*Pseudotsuga menziesii*). Her findings were extraordinary: the birch and the fir communicated about what they needed. In the summer, when the birch was producing more than the fir, it sent carbon to the fir. In the winter, when the birch had lost its leaves, the opposite happened. Further studies have found that the fungi, which trees live in close association with, allow the trees to communicate with each other. The threads which the fungi create, called mycelium, are so dense that there can be hundreds of kilometres in a handful of soil.

The more we research trees, the more we realize that these organisms are amazingly complex. We are only starting to dig into the absurdly complex social life that takes place within tree communities. **Peter Wohlleben** has dedicated decades to developing progressive forest management practices which will help forests weather their biggest challenge ever – humans. In his new book, **The Hidden Life of Trees**, he provides insight into how paramount forests are to the world as a whole.

Trees are linked through an underground network of fungi mycelium. →

Morgan Arboretum Association

Established in 1952

Dedicated to forest conservation and environmental education

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