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LIVING

Trickery and deceit

Trees vary the quantities of seeds they produce in order to keep predators under control

If you have taken a close look at your cedar trees or maples lately, you've probably noticed an especially heavy crop of seeds this year. In fact, the cone crop on white cedars is so heavy that from a distance the trees appear almost entirely yellow, the colour of the cones. The branches of sugar and Manitoba maples, too, are bowing heavy with an enormous load of keys, now ready to spin gracefully to the ground. What we are seeing here is not simply a response to particularly good growing conditions. Rather, it is nothing less than a fascinating adaptation employed by trees to assure that their progeny does not all end up in some animal's gullet.

OUR CHANGING SEASONS
Drew Monkman

The extraordinary amount of seed around right now was completely predictable last spring. You may recall that in May, maple trees everywhere were draped in an unusually heavy cloak of yellow flowers. I don't remember every seeing so many flowers on the trees, spending so much time sweeping fallen flowers from our driveway or removing them from the eaves troughs.

Once pollinated, tree flowers develop into seed, be it in the form of keys, nuts, fleshy fruit or cones. The seed crop on the silver maples in our neighbourhood was so heavy that when they came showering down in June, the spectacle resembled a cloud of twirling locusts. A few days later, when all of the keys had fallen, the trees looked practically bare. Obviously, silver maples at least had put much more energy into producing seed than making leaves.

A year in which trees produce an abnormal abundance of flowers and seed is referred to as a mast year. The term comes from the Old English "maest," a word used to describe nuts such as acorns and beechnuts that have accumulated on the ground. Masting within a given species of tree occurs over huge areas, many thousands of square kilometres in size. Quite often, a number of different types of trees will undergo masting at the same time. Interestingly enough, however, many tree species produce little or no seed in the year following a mast year. Although masting follows somewhat cyclical patterns, there are no fail-safe predictors yet of when it will occur.

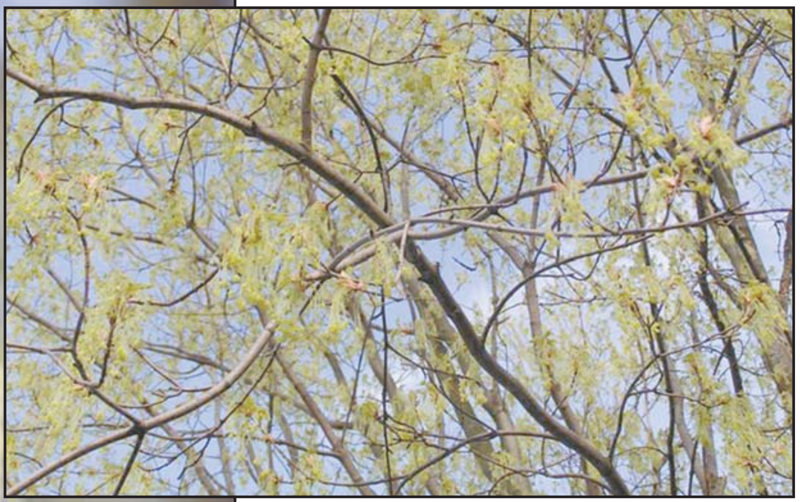
For masting to be such a widespread phenomenon — it is also noted in tropical species — it must be of some evolutionary benefit. Otherwise, trees would simply produce more or less the same quantity of seed each year, something most species do not do. Biologists believe that masting is indeed an adaptation or "evolutionary response" to a challenge from the environment. For a tree, the challenge in question is how to best avoid having all of its seeds eaten by predators. Therefore, any adaptation that minimizes such predation of the seeds will be favoured by natural selection.

As it turns out, the benefit of masting lies in "predator satiation." The idea is that a bumper crop will be more than seed eaters could ever consume, and a significant percentage of seeds will therefore go uneaten and be able to germinate. If trees were to produce more or less the same amount of seed each year, seed eater populations would remain pretty much the same and practically all of the seeds would be consumed.

Predator satiation is reinforced in the year following masting, when most trees produce few if any seeds. Just when animals thought they had it made and produced much larger than usual families, the food dries up. Talk about trickery and deceit. The relative famine usually results in large numbers of seed eaters starving to death or being forced to move elsewhere. This phenomenon is well documented in many bird populations. An abundance of spruce or pine seeds, for example, allows species such as crossbills to lay more eggs than usual and fledge more young successfully. However, in a low-seed year following masting, the birds must migrate elsewhere in search of food. Because masting and the following poor crop year occur over such far-flung areas, the population of a given species may decrease substantially. When masting reoccurs, the population is too low to eat all of the seeds available.

Small mammals such as voles, mice and lemmings also have cyclic population fluctuations, themselves related to the masting years. Deer mice cycles, for example, are closely tied to seed production in sugar maples. As the seed production of maples goes up and down so wildly from one year to the next, the mouse population follows suit. Since a number of larger birds and mammals depend on mice as a major source of food, the fluctuations in sugar maple seed production have a major ecological ripple effect through the wildlife community.

Oak and beech trees, too, are well-known for masting. Variable acorn crops are an important determinant of increases and decreases in bird populations such as acorn woodpeckers, a western species. Large acorn crops in eastern North America also lead to increases in populations of bears and deer, two major predators of acorns. The acorns from red oaks are among the most nutritious fall foods available to wildlife. Acorns are especially important to bears as they fatten up for hibernation. They will even go right up the trees after them, breaking off branches to bring the acorns within reach. The tangled piles of broken branches are sometimes called "bear's nests." Similar heaps of branches can often be seen in beech trees. Like acorns, beechnuts are big and nutritious and therefore a favourite of bears. The bark of beech trees is often riddled with claw marks from bears climbing the tree for the delicious nuts.



Drew Monkman, special to The Examiner
Close-up of flowers of sugar maple (left), and a sugar maple tree draped in flowers (above).

Because masting is a group phenomenon taking place over a huge area, the question that comes immediately to mind is how do far-flung trees of the same species suddenly decide to produce a bumper crop of seeds the same year? Some conifers, for example, are able to synchronize their seed production at sites as far as 2,500 kilometres apart. One may think that exceptionally good growing conditions such as ample rainfall and sunshine the year before might provide trees with the resources to grow more seeds than usual. This, however, does not appear to be the case. The annual fluctuations in rainfall and temperature are smaller in magnitude than the fluctuations of crop sizes of masting species. The most likely explanation for the synchronicity of masting is that an environmental factor such as temperature signals to the trees whether it's best to direct energy towards growth or seed production. This is known as the "Moran effect" from work done in the 1950s by Patrick Moran, an Australian statistician. He was able to show that an external factor such as weather could actually synchronize population cycles so that, in the case of trees, they all undergo masting at the same time. The Moran effect has been shown to apply to a wide variety of organisms, from human viral pathogens to lynx. In the case of trees, the synchronizing cue is probably temperature at the time the trees flower, which in turn influences the number of flowers that get fertilized.

It is speculated that climate change may result in unusually high spring temperatures becoming the norm. This may end up decreasing the year-to-year variation in flowering success of many tree species and essentially put an end to masting. The end result could be that fluctuations in seed-predator populations will be less pronounced. How this will effect ecosystems as a whole is unknown.

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