WHAT DOES A TAPHOLE DO TO A TREE?

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When we tap our maple trees, we make a wound for the sap to flow out, and we cause some minor (we assume) damage to the interior of the tree. Since trees can remain healthy and grow vigorously for many years even though tapped, within proper guidelines, it is valid to assume that the taphole does not cause serious damage. But just what does a taphole do to the tree?

To better understand the long-term impact of a taphole, it's best to consider what we drilled through in making that hole. First, the drill cut through the bark, which includes not just the outer rough layer that we are familiar with, but also a layer of transport cells that carries carbohydrates manufactured in the leaves to living cells throughout the tree. Just inside the bark is a thin sheet of cells called the vascular cambium, which is where the diameter expansion of the tree takes place. Dividing cells in the vascular cambium create the annual rings of wood we see in a stump, with the newest wood in the outermost part of the outermost ring. The wood inside the cambium consists mostly of long and thin cells, oriented up and down. Most cells in the wood are dead, however they are still quite functional. A large percentage are fibers, thick-walled support cells that give the wood its strength. Interspersed within the fibers are the vessels, the plumbing system that delivers water from the roots to the leaves and the rest of the tree. When our drill cuts into these vessels the sap can flow into the taphole. Vessels in maple are not long pipes running from root to crown—instead they are often only about an inch long, and extremely narrow. Millions of these small vessels connect to each other in ways that allows sap to not only flow up and down but laterally across the trunk. Finally, interspersed among these dead cells are living cells that store starch made in the leaves and used throughout the year for the tree's growth and respiration. At certain temperatures, this starch is converted to sucrose, and some of it enters the sap—to our benefit as sugarmakers who then collect this sweet sap.

So—what has our drill done to all these tissues? If we had cut away the bark from around the tree (girdling), it would eventually die, because destruction of the food transport system will cause living cells to starve—but we merely punched a small hole in the bark, which does not seriously damage the system. The vascular cambium typically dies back for a short distance above and below the hole, but new growth initiated soon after the end of the sugaring season begins to cover the hole with callus (wood repair) tissue—this is assuming the spout was pulled. Below the vascular cambium, the hole in the wood is permanent, although in a healthy tree it will be covered up in a few years. Also permanent is a stain column above and below the taphole. What is this stain and what does it represent? Stain resulting from wounds in maple has been variously described as the interaction between substances from fungi that entered the wound, and substances created by the tree to limit the extent of the wound. Within the stained area the vessels are now plugged, and the living storage cells have been killed. Stained wood around the taphole is still mechanically sound and not decayed—although the former use of the paraformaldehyde pill in some sugarbushes often resulted in significant decay around tapholes. The maple tree has somehow walled off—"compartmentalized"—the damaged area. The common interpretation of this stained portion is that the extent of the stain represents all the wood that is damaged, and that damage does not extend beyond the stain.

A few years ago I conducted an experiment to test the hypothesis that the unstained wood around a taphole was still functional. I was helped by John Bennick from the USDA forest service, with advice from Dr Mel Tyree, former head of the Proctor Center and noted tree physiologist. Sections of trunks that contained a 6 month old taphole in a small tree were brought to the lab, and very finely filtered dye was pushed under pressure through these sections. Presumably, the dye would only pass through portions of the wood that were undamaged—where the vessels were not plugged and the wood was not compartmentalized. Results were interesting—and reassuring to sugarmakers. Indeed, the dye colored most of the trunk section, with the exception of the stained area and wood a small distance (1/4 inch or less) from the stain. Other portions of the stem that were not dyed were associated with things like branch stubs buried in the stem. The area of un-dyed wood could be followed up the trunk some distance from the taphole, just as is true with the stain column, where it narrowed and disappeared about 12 inches above the taphole. We concluded that the stain was indeed a reliable indicator of the area of non-functional wood created by the taphole.

For sugaring to be a viable industry, the process of sap collecting must be sustainable, and not lead to the decline of our trees. Drilling a taphole does make a wound, but with proper tapping procedure and sensible tapping guidelines (as can be found in the new North American Maple Syrup Producers Manual) we can be assured that these wounds are minor and that the tree will repair itself, or can function well without the small volume of wood with non-functional vessels. With proper care in sap collecting, as well as in many other aspects of forest management, our maple trees can last for many generations of future sugarmakers.

Two sections of a tapped maple that were perfused with dye after the tree was cut down to determine which part of the wood was blocked to sapflow. Both the right section, with the taphole, and the left section, with wound stain, show a small area of additional wood that was blocked to the flow of dye—and sap.