

Is a Tree a Heavy Drinker, or Does It Just Pump Water?

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The awakening of a forest in spring is a marvel to behold. The woods fill with music as birds stake out their territories and advertise these holdings with an impressive variety of songs. Trees clothe themselves with leaves, creating a forest full of subtle shades of green. The process of photosynthesis has started once again.

Of the materials used in photosynthesis — carbon dioxide from the air, water from the soil, and light from the sun — water is taken in the greatest amount. A tree in full leaf may lift a ton of water a day from the soil and carry it through an elaborate system of pipelines to every leaf.

This is where we start to have fun with trees “drinking” versus “pumping” by tossing around all kinds of neat gee-whiz facts and figures.

The best conditions for photosynthesis require wet cells in the leaves in contact with sunlight and air. The tree accomplishes this by running massive amounts of water through its system. A tree uses 55 pounds of water to make 100 pounds of cellulose, the main constituent of wood, but it evaporates more than 90,000 pounds of water in the process.

A medium-sized tree (40-50 feet tall) will take 10,000 gallons (83,000 pounds) of water from the soil in a growing season. Most of this water is transpired through the leaves back into the air. On a hot summer day, a large birch may give off as much as 900 gallons (7,500 pounds of water) through its 200,000 leaves, cooling as much air as half a dozen room-size air conditioners.

A tree's pumping or circulation system is incredibly intricate. Water must travel a distance of nearly 450 feet to get to the topmost leaves of a giant sequoia. In certain species of trees, evaporation of water from the leaves creates such a “pull” that water rises inside the trees at the speed of almost 150 feet per hour.

When rain falls on a forest, what happens? A six-year study of ponderosa pine in California showed that:

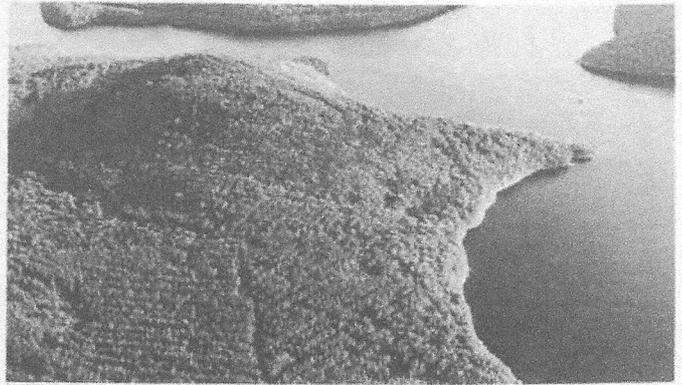
- 4% of the rain ran down the stem of the tree to the ground immediately around the base of the tree;
- 12% of the rain was intercepted by the trees, then eventually evaporated back into the air;
- 84% dripped off the leaves or fell between the leaves directly to the forest floor;
- 15% of the water that made it to the ground ran off as streamflow.

Most of the water on Earth gets run through a tree eventually. Forests play an important part in the natural cycle that cleans, protects, regulates and recycles the closed system of water on this planet. Taking care of our limited supply of water is what watershed management is about.

Many watershed forests are managed to protect a continuing supply of high quality water, as well as to provide wood products, wildlife habitat, recreation and beauty. There are approximately 130 water companies nationally with land in the American Tree Farm System.

Joe Arabski, an area chairman on the New York Tree Farm Committee and a watershed forester for the Albany City Watershed (a Tree Farm), notes that water quality is best in their reservoirs surrounded by forests. The water is cooler and there is less algae growth. But if we want maximum water yield, “we plant areas of grass around the reservoir,” Joe says. “In our forested areas, hardwoods provide better water yield than pine, but we make every effort to keep cottonwoods out — they're tremendous pumpers.”

The Baltimore City Watershed, also a Tree Farm, experimented with converting open areas to young pine forests. The result was a decline in water yield of 283,000 gallons per acre per year. While



Trees protect water supplies. They also use a great deal.

trees protect water by stabilizing soil, they use water as you can see.

If a tree is a pump, the forest is a sponge. Consider:

- The forest floor — to which trees add foliage and decaying wood — acts as a sponge, absorbing, filtering and holding water, releasing it gradually into streams, lakes and ground water aquifers.
- By absorbing rain as it hits the ground, forests reduce the amount of water discharged into streams and rivers immediately after a rainstorm. This reduces the harmful “peak” discharge which causes erosion and sedimentation.
- Forest soil 36 inches deep can absorb and hold as much as 18 inches of rain, or nearly 1/2 million gallons per acre.
- Forest land contributes only 5% of the sediment to rivers and streams that non-forested areas contribute.

Trees are fascinating. On the one hand, they are inefficient — pumping and evaporating inordinate amounts of water for photosynthesis. And on the other hand, they are a protector of the Earth's fresh water supplies.

Leaves that unfurl in all their perfection with hues of green in spring are subjected to insects in summer, and foliage suffers. And then the cool, dry days of autumn trigger a complicated sequence in trees that involves shutting down their huge waterworks. The pumping slows and eventually stops. One marvelous season in the forest ends and another begins.

If you, too, find excitement in everyday things, like the miracle of trees, you'll appreciate what Louis Agassiz, the great scientist once said: “I spent the summer traveling. I got halfway across my backyard.” ▲