Loss of hemlocks will affect water dynamics in southern Appalachian forests

July 9 2007

Hemlock woolly adelgids attach at the base of the needles. Credit: Chris Evans, River to River CWMA, Bugwood.org

Forest Service (FS) research has provided the first estimates on the impact the loss of eastern hemlock will have on the water dynamics of the southern Appalachian mountains. In the June 2007 issue of Ecological Applications, researchers Chelcy Ford and Jim Vose from the FS Southern Research Station (SRS) Coweeta Hydrologic Laboratory present findings on eastern hemlock rates of transpiration (the amount of soil water taken up by trees) from a 2-year study in western North Carolina.

Eastern hemlock, a keystone species in the streamside forests in the southern Appalachian region, is already experiencing widespread decline

and mortality and may be decimated by the hemlock woolly adelgid (a tiny nonnative insect) within the next 10 years. As a native evergreen capable of maintaining year-round transpiration rates, eastern hemlock plays an important role in the ecology and hydrology of mountain ecosystems. Hemlocks provide critical habitat for birds and other animals; their shade helps maintain the cool water temperatures required by trout and other aquatic organisms in mountain streams.

“No other native evergreen in the southern Appalachians will likely fill the ecohydrological role of eastern hemlock if widespread mortality occurs,” says Ford, ecologist with the Otto, NC unit where Vose is project leader. “With the loss of this species, we predict changes to streamflow, streamside forest structure, and soil moisture that will have to be addressed by land managers.”

Hemlock woolly adelgids attach themselves to the base of the needles of the eastern hemlock, feeding on carbon fixed by the trees, slowing growth and causing the needles to drop. Needle loss causes the crown of the tree to thin and dieback in branches; in a surprisingly short time—usually 5 to 10 years—the tree fades away and dies.

To estimate the impact the loss of hemlock will have on the water balance, the researchers measured transpiration rates over a range of tree sizes for 2 years. “We found quite substantial transpiration rates for individual hemlocks, with large trees transpiring as much as 49 gallons of water a day.” says Ford.

The study showed that eastern hemlock plays two distinct ecohydrological roles in the southern Appalachian region: one as an evergreen tree with relatively stable water use throughout the year; the other as a streamside tree with high rates of water use in the spring. If hemlock is lost, there is probably no other native tree species that can fill these roles.

“As hemlock woolly adelgid infestations increase, we expect to see at least short term reductions in forest transpiration rates,” says Ford. “For southern Appalachian forests specifically, we estimate that eastern hemlock mortality could reduce annual forest transpiration by 10 percent, and winter and spring transpiration by 30 percent. We expect this will increase soil moisture and alter both the amount and timing of stream flow. The duration of these changes will depend on how other vegetation responds to the loss of hemlock.”

Source: Southern Research Station - USDA Forest Service