Plant roots shaped by river fluctuations

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Changing flow rates in rivers can be disruptive to bushes and trees that grow on riverbanks. Now, researchers from EPFL have developed a way to predict how fluctuations in the water table impact the roots that nourish them.

Whether due to climate change or changes in power production, rivers may soon see significant changes in the amount of water they carry. But

how these changes trickle down to impact trees that grow on the riverbanks is still unclear. Now, researchers have shown how the roots of certain tree species are shaped by fluctuations in the depth of the water table that they draw their water from. Their work could help predict the ecological impact of changes to river flow regimes and contribute to improving the success of river restoration projects. They published their work in the journal *Geophysical Research Letters*.

"It is one thing to estimate how changing rainfall patterns, a warmer climate, or hydropower production change the depth of the water table around a river," says Stefania Tron, the lead author of the study and model developer. "But to date it is difficult to predict the repercussions of these changes on plants that grow on riverbeds and banks," she says. And that despite the fact that trees play a fundamental role in river ecosystems by stabilizing riverbeds and providing habitats for animals.

"Our goal was to develop a way to predict how the roots of certain types of trees, such as birches, willows and poplars that draw most of the water from ground water, respond to changes in the depth of the water table," she explains. "Just above the water table, there is a layer of soil that is kept humid by capillary forces. When the depth of the water table fluctuates, roots that are within this humid layer grow, while those in the dry soil above it and those immersed in ground water below it may die off."

The researchers developed a mathematical model that combines information on plant species, soil properties, and water table fluctuations to estimate the distribution of their roots underground. They validated their model against the roots of actual trees that they dug out from the banks of the Rhone River in Valais and the Thur River in St. Gallen, and with trees grown in an outdoor laboratory.

A case study close to home

Using her model, Tron studied how a 70-centimeter drop of the water table would impact the roots of on birches and poplars growing on the banks of the Rhone River. Her results showed how deep soil layers impact the trees' resilience. When, for example, they grow above a draining soil layer at a shallow depth, a drop in the water table can be detrimental by cutting them from their deep groundwater source.

Besides studying the effect of natural and manmade changes to river flow rate on tree root density, Paolo Perona, the project's supervisor, says that it could also provide valuable information for river restoration projects. "If you know the depth of the water table and the type of soil, our model can provide information on how deep the roots will grow, allowing to quantify to what extent they reinforce they soil of the riverbanks," he says.

More information: Stefania Tron et al. The signature of randomness in riparian plant root distributions, *Geophysical Research Letters* (2015). DOI: 10.1002/2015GL064857

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