

Biodiversity does not always improve resistance of forest ecosystems to drought

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Protection forest consisting of about ten tree species above the lake of Brienz.
Credit: Canton of Berne, Switzerland

Due to climate change, parts of the world will face droughts that will affect forest health. Scientists from INRA, in collaboration with the Swiss Federal Institute for Forest, Snow and Landscape Research WSL

and European colleagues, studied the resistance of forests to drought according to the diversity of tree species. Contrary to what was commonly accepted by scientists, species diversity does not systematically improve tree resistance to drought in forest ecosystems. This result is published in the *PNAS* on 29 September 2014.

The extreme events induced by climate change will have drastic consequences on [forest](#) functions and services and may bring about important drought-induced die-off events. It is, however, known that biodiversity can promote forest ecosystem performance and resistance to insect pests and diseases, but whether or not diverse forests are also better adapted to deal with drought stress remains unknown.

To shed more light on the effects of biodiversity on the resistance of European forests to drought, scientists from INRA, in collaboration with WSL and European colleagues, studied 160 forest stands with a variety of tree [diversity](#) levels from monocultures to five species mixtures across Europe (Spain, Italy, Romania, Poland, Germany). "For every region, we compared monocultures to mixed forests (up to 5 tree species) and looked at their respective capacity to resist to drought", explains Damien Bonal who led the research at INRA. "The results of this project are generally important for our forests, in Switzerland as well. Because of the [climate change](#) we have to anticipate more summer droughts in Central Europe", Arthur Gessler from WSL, co-author of the study, emphasizes.

This study shows that mixed species forests are more resistant to drought stress than monocultures in some regions only: tree diversity may afford resistance to drought stress only in drought-prone areas, i.e. in regions where the frequency and severity of drought during the growing season is high. Therefore, managing [forest ecosystems](#) for high tree [species diversity](#) alone does not necessarily ensure forest adaptability to possible future severe drought events. "Forest ecosystems containing tree species

which are particularly not adapted to frequent droughts rarely benefit from prevention which is being provided by higher diversity. This is the case in large parts of Switzerland", says Arthur Gessler.

Bonal concludes: "It might be of great importance to consider species identities and local climatic conditions, and not solely the degree of diversity in the mixtures, to obtain complementary use of resources and thus maintain ecosystem functions under [drought stress](#)". "Our research illustrates which [tree species](#) help to make a mixed forest more stable and resistant against extreme natural events like droughts or storms. Forests are better able to cope with dry periods, if the root systems of different species are spreading in different soil depths. This helps to use the water in the soil as efficiently as possible, and no species is competing with the other", Arthur Gessler explains.

More information: Grossiord, C.; Granier, A.; Ratcliffe, S.; Bouriaud, O.; Bruelheide, H.; Checko, E.; Forrester, D.I.; Dawud, S.M.; Finér, L.; Pollastrini, M.; Scherer-Lorenzen, M.; Valladares, F.; Bonal, D.; Gessler, A.: "Tree diversity does not always improve resistance of forest ecosystems to drought." *PNAS*, 29 septembre 2014. [DOI: 10.1073/pnas.1411970111](#)

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