

Science for Environment Policy

Research provides insight into the impacts of droughts in dry Alpine forests

The impacts of drought on European trees are of high concern, especially under a changing climate. New research has indicated that, if summers become continually drier, sensitive species, such as larch and spruce, will suffer reduced growth in some Alpine areas. This could potentially compromise ecosystem services provided by forests in these areas.

Drought can have major impacts on the growth and survival of [trees](#). An increase in drought frequency has already been observed in the Alps and lowlands of Central Europe and [climate](#) projections suggest even drier summers for these regions in the future.

This research was conducted on five conifer species: European larch, Norway spruce, Scots pine, black pine and Douglas-fir. The impact of drought on these species from 1961 to 2009 was investigated at two contrasting sites: in the dry inner Alps and in the wetter Swiss lowlands.

Using data on [soil](#) water holding capacity, temperature and precipitation, the researchers calculated a soil water deficit index at the two sites to represent the effects of drought. This index was then related to tree-ring width and the presence of stable carbon and oxygen isotopes in tree rings. Analysis of the concentration of these stable isotopes in the wood belonging to particular tree rings can provide information on the degree of drought experienced by trees over time.

The results showed that trees in the dry Alpine site are mainly affected by droughts of long duration (11–12 months) and depend essentially on water availability prior to the growing season. In contrast, summer droughts and even a shorter drought duration (less than 8 months) impede growth and physiology of trees in the wetter lowlands.

The isotope analysis indicated that trees in dry Alpine areas can adapt to drought conditions in the short term by reducing water loss. This is aided by their smaller canopy and shorter needles. Prolonged drought conditions and a change in the seasonality of precipitation will probably reduce soil water replenishment, resulting in severe effects on growth. Therefore favourable conditions in spring, autumn and winter are becoming critical for tree survival in inner-Alpine dry forests.

In the wetter lowlands, trees do not normally experience the same level of drought but they tend to have larger canopies leading to increased water loss by evapotranspiration (the process by which water is transferred from the land to the atmosphere by evaporation from the soil and transpiration from plants). This may make them more sensitive to short-term droughts as they cannot use the same adaptation strategy as trees in dry Alpine areas.

Norway spruce and European larch were found to be highly sensitive to long-term drought in the dry Alpine region, indicating they are particularly dependent on water stored during the previous year. Both of these species, the researchers suggest, are at their physiological limits in this area.

Although the study is based on only two sites, and more extensive research is needed, the results indicate that if the frequency, duration and intensity of droughts worsen in the dry-inner Alps, all five species will suffer. In particular, European larch and Norway spruce, which are already at their physiological limits in these areas, could be at risk of dieback. In the wetter lowlands, the impacts are not as severe, but longer and more intense summer droughts are expected to lead to severe growth reductions.



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Contact:
mathieu.levesque@wsl.ch

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