CLIMATE CHANGE IN ALPINE FORESTS

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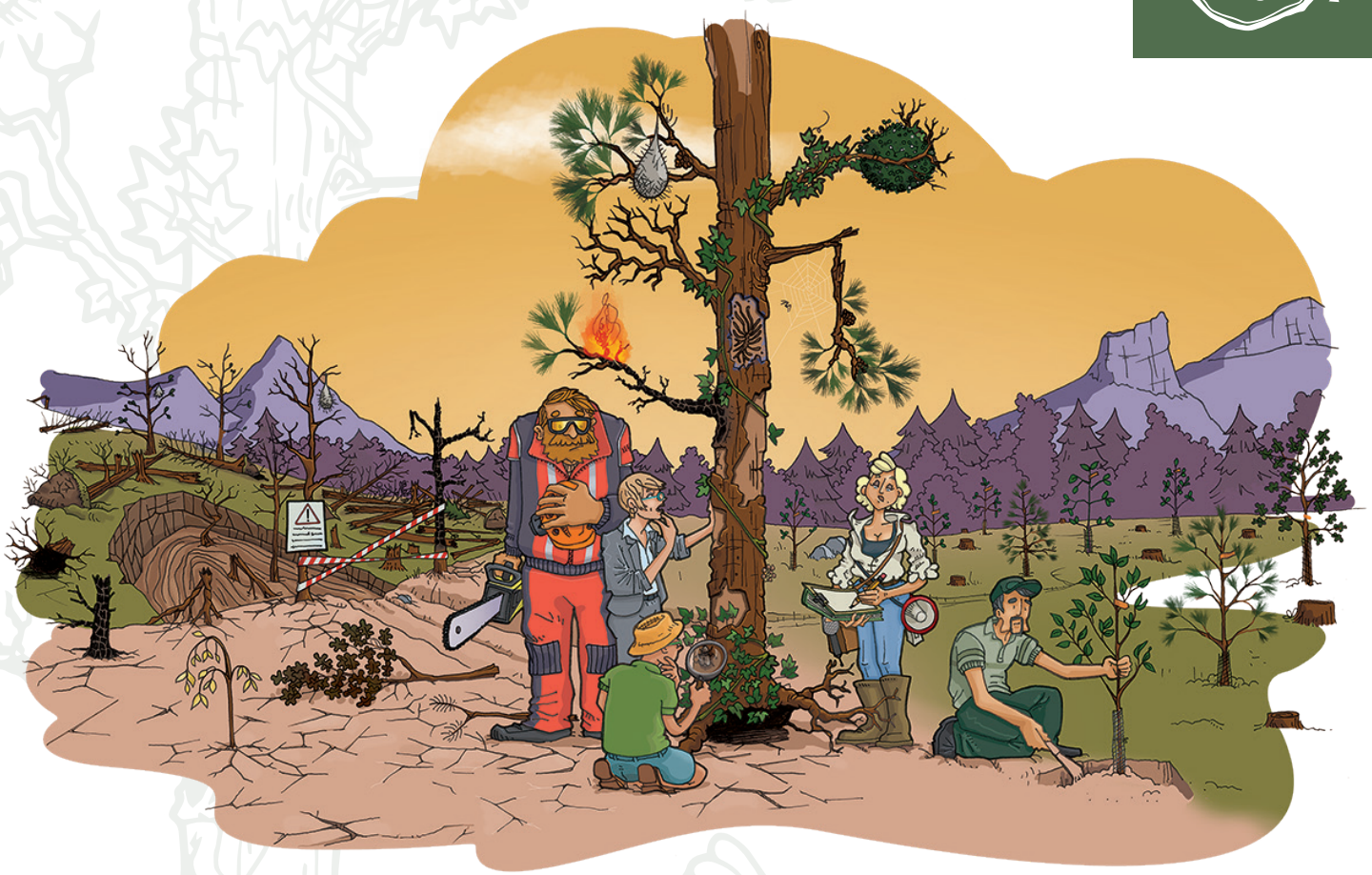


Temperatures in the Alps have risen by around +2 °C since 1950, twice the global average. The effects of global warming in the Alps are more intense, more visible, and already irreversible (melting glaciers). And humans are increasingly exploiting this environment (development of tourist and transport infrastructures, unsustainable urban and agricultural practices). **The Alpine forest cannot escape these disruptions.** By 2050, forests are expected to become even more vulnerable[1], which will likely have a permanent impact on the many services they provide. Meanwhile, society is expecting more and more from these forests.

Spruces, firs, larches, and pines are still the most common species in mountain forests, although deciduous trees (oaks, beeches) are also very present in lower elevations. But for how much longer? Changes in temperature and precipitation have led to changes in the life cycles of tree species (growth, mortality, reproduction in both time and space. **The entire forest ecosystem equilibrium is shifting.**

Species are migrating, with distributions at different altitudes and latitudes

Drought is the main cause of disruption for forests lower than 1,000 m in altitude[2]. Some species can no longer reproduce naturally, while others perish. The repetition of these periods of drought at shorter intervals weakens forest stands since trees' sensitivity to water stress seems to reduce their ability to resist insect pathogen attacks.

The general trend is that the least drought-tolerant species **are moving north and to higher elevations** and risk being replaced by deciduous trees.

Human actions have also influenced species movement at times, such as abandoned pastures that are overtaken by certain species. Beech trees are also moving to higher altitudes because foresters have gradually stopped replacing them with conifers (better valued).[3]

SPECIES DECLINE

*The **white fir** at foothill level is threatened*

***Spruces** are already dying out at the montane level (~ 1,500 m)*

*The **Scots pine** could progress starting at 1,000 m in altitude*

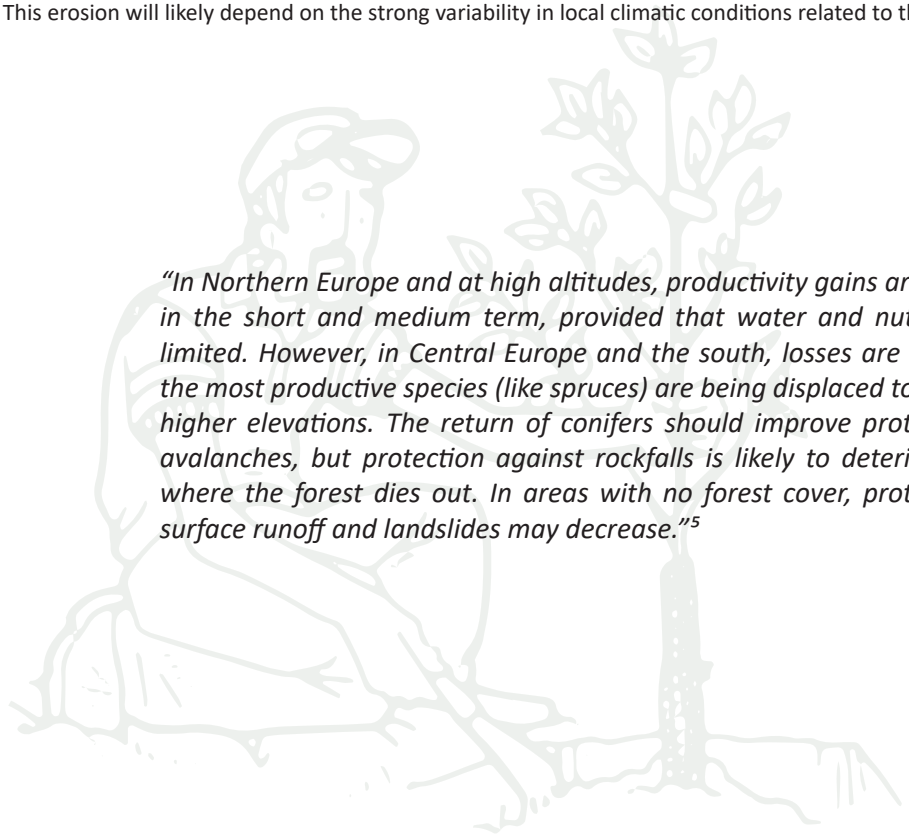
***Sessile oaks** could replace beeches at lower altitudes*

The relationship between species and natural cycles is affected

Native forest species are migrating, and neighbouring or foreign species are replacing them. These new species are followed by a range of associated species, which can lead to a loss of biodiversity and conversely a risk of colonisation. In addition to the new combination of species that occur, vegetation cycles change. The availability of this food resource for wildlife varies in quantity and over time, which can affect animal reproduction. Warmer temperatures increase the number of reproductive cycles among insects such as bark beetles. Pathogens can then disperse even further.

Services provided by the forest: Significant effects at low altitudes and in regions that are already hot and dry

Researchers estimate that mountain forests will experience significant, but hard-to-quantify direct effects[4]. An increase in extreme events could have very negative consequences on the economic sector, protection against natural risks, and biodiversity. This erosion will likely depend on the strong variability in local climatic conditions related to the mountain.



"In Northern Europe and at high altitudes, productivity gains are still expected in the short and medium term, provided that water and nutrients are not limited. However, in Central Europe and the south, losses are expected since the most productive species (like spruces) are being displaced to the north and higher elevations. The return of conifers should improve protection against avalanches, but protection against rockfalls is likely to deteriorate in areas where the forest dies out. In areas with no forest cover, protection against surface runoff and landslides may decrease."[5]

SOURCES :

[1] [2] [3] Journal of Alpine Research | Revue de géographie alpine. 98-4 | 2010. Mountains, the climate change laboratory. Quel futur pour les services écosystémiques de la forêt alpine dans un contexte de changement climatique? Benoît Courbaud, Georges Kunstler, Xavier Morin, and Thomas Cordonnier

[4] [5] Sciences Eaux & Territoires, la revue d'Irstea Article hors-série numéro 48 – 2018 Forêts de montagne et changement climatique: impacts et adaptation – Sophie Labonne, Thomas Cordonnier, Georges Kunstler, and Marc Fuhr

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