Plant species indicative of cold screes at low altitudes in the French Alps

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Abstract

This study deals with cold screes in the French Alps. Vegetation is used as indicator of morpho-dynamic changes. 10 sites are monitored. 12 species appear as "characteristics".

Keywords: cold screes; bio-indicator; climate change; monitoring.

Introduction

Below the timberline, some North Slope forests shelter special periglacial formations: abyssal ecosystems on cold scree. These openwork block formations are characterized by the presence of a negative thermal anomaly in summer in the lower part and a positive thermal anomaly in winter in the upper part (Delaloye *et al.*, 2003). The openwork system provides an internal air circulation mechanism. The presence of perennial ice lenses at the bottom of scree slopes is the only occurrence of patchy sporadic permafrost at low altitude (900-1300 m above sea level) (Gude *et al.*, 2003). We observe abyssal plant species and dwarf trees on the cold areas representing original paleo refuges (Růžička *et al.*, 2012). This natural habitat is a European priority under the term "Pine communities with *Pinus mugo subsp. uncinata* and *Picea abies* on frozen scree" (code 9430). In the context of climate change, we wonder about this environment: resilient or sentinel system? We know that plant species can be used to indicate dynamics and evolutions (Huc, 2008).

To assess the evolution of vegetation in time and space in relation to possible modification in air circulation due to climate change, we propose two goals: 1- To identify the characteristic plant species in the cold zone and the margins and 2- To test a simple monitoring protocol in the coldest zone and in the control area.

To appreciate the potential changes, this ecological study makes the connection with the study of humus (Meynier & Brun 2017) and microclimatic monitoring (Schoeneich, 2017). Finally, 10 cold screes are studied along a latitudinal gradient at the scale of the French Alps.

Methods

From the vegetation surveys carried out in the cold screes of the Alps (Database Flora (version 2), 2017), we have selected species that meet 3 criteria: a frequency of occurrence >30%, a vegetation cover >15% and an altitudinal shift (their natural range is generally located at a higher altitude) or a possible dwarfism of trees. Identified species are then monitored in time and space. The protocol consists in identifying the presence of characteristic species in 30 plots of 1 on 0.5 m (Fig. 1) along transects in the cold zone and in the control area for temporal monitoring and along a transverse transect that cuts the cold zone and the control area for spatial monitoring.

Figure 1. Sampling with 30 plots of 1 on 0.5 m along transect.

Results

With the first results obtained in 2016 and 2017 we test the validity of the species chosen for monitoring. The species previously identified as "characteristic" of the coldest zone are significantly more present in the coldest zone than in the control area (p-value<0.01) (Fig. 2). In the coldest zone, 14 species share frequency of occurrence from 11 to 61.7%. Among these species, only 2 species do not have a specific cryophilic character (*Rubus saxatilis* and *Vaccinium myrtillus*). 12 species identified as indicators of the cold zone are mainly located in the cold scree, like *Salix retusa*, *Salix reticulata*,

Dryas octopetala, Cladonia arbuscular and *rangifera, Cetraria islandica*). Four other share equivalent frequencies in the cold zone and in the control zone.

Other non-characteristic species will also be monitored in the case of the thermal dynamics would be disturbed with appearance of new species in the cold zone or with a modification of the frequencies for the species already present.

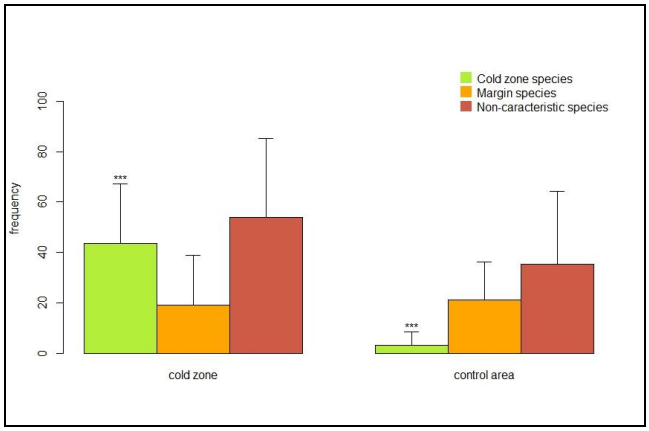

Figure 2. Comparison between cold zone and control area for the « characterictic » species. *** p-value<0.001

Conclusion

The monitoring protocol will be renewed in 2019 and 2020 in order to assess the evolution of the vegetation. It will be put into perspective with the results of thermal monitoring carried out in the same areas.

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