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Plant-related Biodiversity in the Alpine Air: a Review

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Abstract

Aerobiology can provide answers on the impacts of global change on plant biodiversity. It has been recognized that alpine environments are susceptible to such changes. However, there are only a few studies worldwide addressing plant-related particle biodiversity in air samples in open areas at high elevations or high geographical latitudes. This study reviews aerobiological papers that focus on assessing plant biodiversity in environments that are either part of the alpine biome or are functionally connected to it.

PubMed was searched for "pollen and alpine"; morphological studies, taxonomical studies, honey studies, fossil pollen studies, and non-English studies were excluded from the resulting papers. Further relevant studies were retrieved from bibliographic references of the same articles and from Google Scholar.

Based on 48 articles reviewed, i) the air sampling; ii) the identification method; iii) the bioaerosol biodiversity in relation to alpine vegetation were analyzed.

As for i), deposition sampling is the method of choice to collect the alpine bioaerosol, while only a few studies use volumetric air samplers. As for ii), the current state of the art for the identification of pollen and non-pollen palynomorphs is microscopic analysis. Yet, results from DNA metabarcoding show a higher taxonomic resolution in identifying plant taxa, than microscopic analysis alone can achieve. As for iii), the establishment of relationships between bioaerosol and plant biodiversity implies the assessment of vegetation diversity and abundance at different scales from the receptor site. Back trajectory models are employed to trace the origin of extra local, long-distance sources.

On the whole, the alpine bioaerosol mirrors the vegetation of wind-pollinated taxa from the immediate receptor site, e.g. herbaceous such as Poaceae, Cyperaceae, Juncaceae, and ferns. Entomophilous taxa, in contrast, are underrepresented. The biodiversity from the alpine air, however, does not only originate from local sources but also from extra-local, regional, and often over-regional areas. For the Eurosiberian plant region, the articles reviewed consistently report pollen from woody plants (Pinus, Picea, Corylus, Betula) above the timberline. Microscale air currents (0 - 2 km) cause the influx from around and below the timberline into the alpine air at the receptor site. Besides, mesoscale air masses (2 - 200 km) including topography-driven convections, thunderstorms, nighttime depositions as well as long-distance transport events (200 - 2000 km) add taxa to the bioaerosol.

Knowledge on the composition of the plant bioaerosol in alpine environments facilitates the reconstruction of past climate, models of climate change scenarios, the interpretation of gene

flow, and the genetic makeup of populations. Such is a valuable tool for plant conservation management in alpine environments.

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Improving Forecasting Pollen Concentration Using a Hirst Network and Phenological observations.

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Abstract

Pollen modeling is a crucial field for understanding the impact of pollen on human health and the environment. Deterministic models are the most common type of pollen model. They are generally more accurate than probabilistic models, but they require a good understanding of the physical laws that govern pollen production, release mechanism, and dispersion; further, a precise distribution of plants is needed, and it is not always possible with invasive species or seasonal plants that are continuously spreading.

This study aims to develop a neural network model that can accurately predict pollen concentration and the start of the pollen seasons in France.

We tested different neural network models combining phenological observations, pollen data from a Hirst network, and meteorological data, selecting two locations (Avignon and Brest). Over the 20 years of data, several random sets were selected, excluding different weeks, to test the ability to predict pollen concentration.

The "best" model was able to predict with accuracy above 80% pollen concentrations and the arrival of the grass season with an accuracy of 6 days. This is significantly better than the accuracy of either deterministic or probabilistic models alone. Notably, our findings indicate that pollen concentrations from Hirst samplers facilitate reliable prédictions at one week.