

Climate change driven changes in pollen diversity and plant diversity at the ecosystem level from tropical pollen records: method evaluation and application

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Introduction

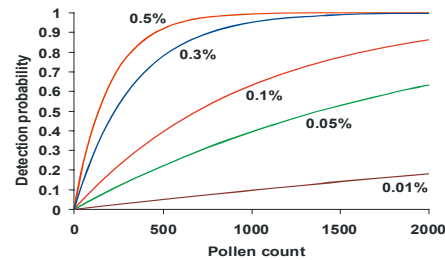
Records of past biodiversity change may provide clues as to how biodiversity at the ecosystem level may respond to future climate changes. Pollen records may potentially offer information about past changes of floral diversity at the ecosystem level. Pollen records also provide information on past environmental and climatic changes. The relationship between potential pollen diversity, observed pollen diversity, and real plant diversity in the vegetation is subject to exploration. Variations in pollen productivity and dispersal make the relationship between pollen diversity and diversity of the vegetation complicated. The limited pollen counts in the palynological investigations reduce the meaning of the observed pollen diversity. Pollen diversity from two pollen records from the upper montane forest belt of the Colombian Andes was analyzed, which are in the record of 85-0 kyr in Fuquene-7C and the record of 430-28 kyr in Funza-2.

Results

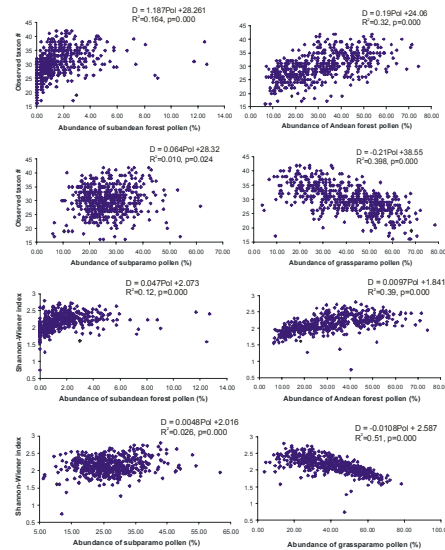
From low to high elevations, the altitudinal ecosystems are subandean forest (lower montane forest), Andean forest (upper montane forest), subparamo and grassparamo. The pollen diversity is positively correlated to the abundance of pollen from the upper montane forest, and negatively correlated to abundance of pollen from the grassparamo.

There is no such relationship between pollen diversity and the pollen abundance of subparamo vegetation, and only weak positive relationship exist for that of the lower montane forest pollen.

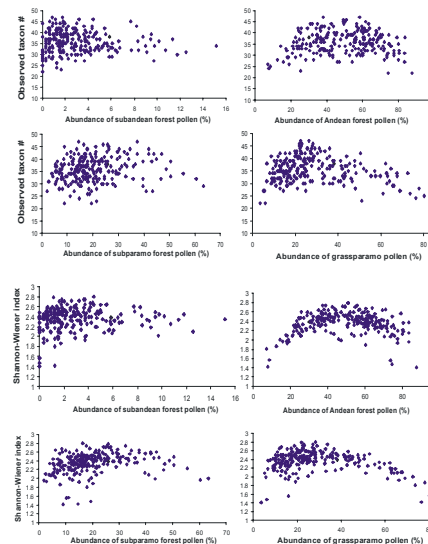
The relationships indicate that pollen diversity was mainly influenced by the altitudinal shifts of vegetation belts. The fluctuations of diversity levels in the study area reflect changes of relative contribution of the different altitudinal ecosystems to the total pollen supply under warmer climate conditions, more species-diverse vegetation (of low elevation) moved upslope and reached closer to the study site; under colder conditions, species-poor grassparamo moved downslope to surround the site.



Above: Dependence of the detection of pollen taxa on their frequencies and total pollen counts.

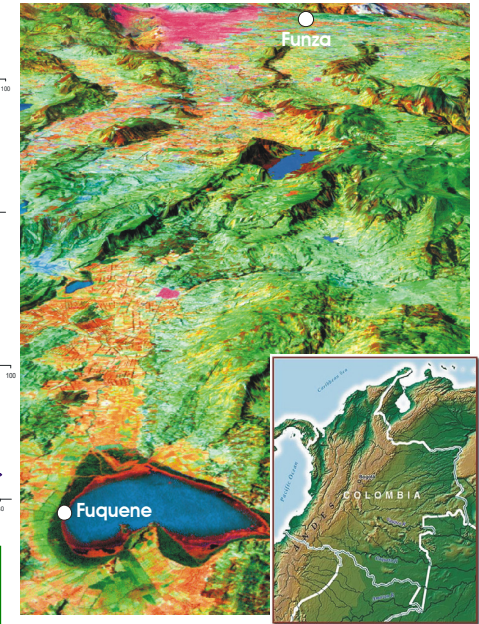


Left: Present altitudinal distribution of the ecosystems in the Eastern Cordillera, Colombia, and the down-slope moving of these systems during the glacial times.



Above: Relationship between pollen diversity and pollen abundance from the altitudinal ecosystems in Fuquene-7 core (85 - 0 ka). See the box below for more illustrations

Left: Relationships between the pollen diversity and pollen abundance from the altitudinal ecosystems in core Funza 2 (430 - 28 ka). The abundance of pollen from each altitudinal ecosystem indicates the relative distance of the ecosystem, which shifted up- and down-slope with climate changes. Pollen diversity is measured with both observed taxon number and shannon-Wiener index. It is positively correlated to the abundance of pollen from the upper montane forest, and negatively correlated to abundance of pollen from the grassparamo.



Above: Location of the study sites Funza and Fuquene: both are from intra-Andean high plains in the Eastern Cordillera, northern Andes. Sites are currently located in the upper montane forest (Andean forest) belt. Inlet shows the map of Colombia and the location of the study area

Conclusions

This result is significant for using downcore pollen diversity as a proxy to reconstruct changing plant diversity in time. However, pollen diversity has to be carefully measured by using large pollen counts in a sample, using the highest possible level of pollen identification, and monitoring carefully all discrete unidentified pollen taxa. The latter group may significantly contribute to the estimation of temporal changes in plant diversity at the ecosystem level.

