

## Dendrochronological potential of *Polylepis* and *Espeletia* in the high-altitude ecosystems of the Colombian Central Cordillera, South America

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### Abstract

The Andean páramo, a key neotropical high-altitude environment, is a grassland biome inhabiting the narrow altitudinal belts located right above the Andean cloud forests (*bosque montano*; ca. 2,000-3,500m) and below the areas of “permanent” snow (above ca. 4,500m). The páramos have been widely recognized as a highly-sensitive environment to changes in climatic conditions occurring on global and regional scales. Our study will focus on the Los Nevados Natural Park, which is located on the El Ruiz-Tolima Volcanic Massif, on the Colombian Central Cordillera, and is well recognized for its high and sustained water supply sustaining multiple domestic, agricultural and industrial uses. The Environmental Engineering Program of the School of Engineering (Colombia) and the International Research Institute for Climate and Society of the Columbia University (US) have been working collaboratively over the past years on the analysis of linkages between the ongoing changes in climate conditions and the observed disruptions occurring in the area and the surroundings of the Los Nevados Natural Park<sup>1</sup>. Field inspections, analysis of observational periods and climate model projections suggest that future climatic conditions would be unfavorable for páramo life zones. Taking into account that these studies are based on observations limited to narrow historical periods, paleoclimatic records in this area are crucial to provide a long-term context in order to assess the extent and rate of the current observed climatic changes. In this context, the main aim of this proposal is to assess the dendrochronological potential of plant species inhabiting the high-altitude ecosystems of the central region of the Colombian Central Cordillera. The specific objectives include: (1) to develop a *Polylepis sericea* tree-ring width chronology; (2) to perform a stable isotope pilot study of *Espeletia hartwegiana*; and (3) to explore the dendroclimatic potential of other local plant species. *Polylepis sericea* can be found in the rainy subpáramo, wet subpáramo, and rainy páramo, in the altitudinal range 3,200-4,300 m. The suitability of the genus *Polylepis* for dendrochronological studies has been successfully demonstrated with *Polylepis australis* in Central Argentina and with *Polylepis tarapacana* in the subtropical mountains of Northwestern Argentina and in the Bolivian plateau at 4,000 and 5,200 m. Although several studies on the ecology and physiology of *Polylepis sericea* have been published in the Venezuelan Andes, a systemic dendrochronological work with this species has not been carried out yet. *Espeletia hartwegiana*, in turn, can be found in the rainy subpáramo, wet subpáramo, rainy páramo, and rainy superpáramo, at altitudes that range from 3,200 m to slightly above 4,300 m. The inner part of the *E. hartwegiana* stem is empty, making the classical dendrochronological approach impossible. However, the leaves from this species remain on the stem after their death making possible an innovative approach to obtain a paleoclimatic record. This pilot study is based on analyzing the isotope signatures of  $\delta^{13}\text{C}$  and  $\delta^{18}\text{O}$ , by means of a mass spectrometry, in the dead leaves from the different layers of the stem to obtain a chronosequence of *E. hartwegiana*. Finally, other local plant species with potential for future dendroclimatic studies may be opportunistically explored. These activities represent the first step forward in our long-term research interests on reconstructing, through ring-width or isotope chronologies, the past climate variability in these environments with annual resolution for the Holocene.

<sup>1</sup>[http://portal.iri.columbia.edu/portal/server.pt/gateway/PTARGS\\_0\\_0\\_4718\\_967\\_0\\_43/http%3B/iriportal.ldeo.columbia.edu%3B9086/irips/projectview.jsp?id=137](http://portal.iri.columbia.edu/portal/server.pt/gateway/PTARGS_0_0_4718_967_0_43/http%3B/iriportal.ldeo.columbia.edu%3B9086/irips/projectview.jsp?id=137)