

A Spanish botanist searches for prehistoric flora refuges in China

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This is a Ginkgo biloba leaf. Credit: Jordi Lopez

Jordi Lopez of the Barcelona Botanical Institute has joined local researchers in a study to locate and define "havens and museums of flora" in China – areas where vegetation resisted the glaciations of the Quaternary Period.

At the eastern edge of the Tibetan Plateau in the south-west of China, near the Burmese border, are Hengduan mountains. According to Jordi López Pujol, researcher at the Botanical Institute of Barcelona, "they are possibly the most rugged and steepest mountains on Earth." The study of this region, and others in China, consists of the search for areas where [flora](#) has remained intact for millions of years due to their privileged position.

Along with a team of four scientists from the Botanic Institute (belonging to the Chinese Academy of Sciences) López Pujol both literally and bibliographically went deep into one of the most biologically diverse regions on the planet, far beyond where China's three major rivers (the Yang-Tse, the Mekong and the Salween) pass through deep parallel valleys creating places such the Tiger Leaping Gorge or the Jade Dragon Snow Mountain.

Leading to two articles published in the *Mountain Research and Development Journal* and *Journal of Biogeography*, the study was designed to bridge the gap in China's floristic knowledge "mainly from a flora evolution point of view" adds López Pujol. It is based on the hypothesis that the great floristic abundance of China, the third country in the world in the number of plant species, is mostly due to its numerous flora refuges at the end of Tertiary Period and throughout the [Quaternary Period](#). During this era, the world's climate dramatically cooled and switched between glacial and interglacial periods.

"A range of evidence is available that points to the existence of these refuges," says the Catalan botanist. In China, an enormous amount of ancient flora still exists. This is called boreotropical flora. The lineage of these plants appeared millions of years ago which means that they are "authentic living fossils that date back to the Cretaceous and even the Jurassic Periods like the famous Ginkgo biloba," according to López Pujol.

In keeping with the results of the study, some 15 million years ago this abundance of species was common across the entire northern hemisphere. However, the harshening of the climate at the end of the Tertiary and Quaternary Period brought about the extinction of the lineages, with the exception of the refuges in the subtropical mountains of southern China.

The methodology of the study consisted of defining the endemic areas of flora as an indirect marker of the refuges of the Quaternary Period. For this purpose, a database of endemic species was compiled and their distribution was mapped," states López Pujol. The most innovative aspect of this study was that the researchers made an effort to differentiate between ancient endemic species (paleoendemic) and those that originated in the last millions years (neo-endemic).

The botanist says that the "areas with the greatest number of endemisms in general could only be found in the main mountain chains of central and southern China." These mountain regions remained on the edge of the great ice caps that covered most of Europe and North America which meant that they probably enjoyed relatively mild climatic conditions during the glacial periods.

Unhindered by geographical barriers, "these species were able to survive through altitudinal and latitudinal movement. Furthermore, the rugged topography of these mountains not only allowed the survival of various ancient lineages but created differentiation and speciation phenomena" mainly due to geography isolation.

For López, these refuges "can be seen as havens and museums for plants" but despite the fact that they were home to both paleoendemic and neo-endemic species, clear differences were evident between refuges. In this way the botanist points out that "the species that have formed in recent times are mostly located in the Hengduan mountains whereas the ancient species (or relicts) can be mainly found in the mountains of central, southern central and southeast [China](#)."

The researchers put this clear tendency down to the ages in which China's different mountain chains were formed. The mountains of the east of the Tibetan plateau are a lot older than the elevation of the plateau itself (which took place during the Pliocene and Pleistocene

Periods). López Pujol says that "like in the case of the Hengduan mountains, the orogenesis of the Tibetan plateau and its adjacent mountain systems created a broad range of new habitats which stimulated speciation phenomena."

For the Catalan botanist, the Hengduan mountains "constitute the main evolutionary front in the temperate areas of the northern hemisphere given that the areas further to the east enjoyed relative tectonic stability – something that favours the conservation of relic flora."

More information: Jordi López Pujol, Fu-Min Zhang, Hai-Qin Sun, Tsun-Shen Ying, Song Ge. Centres of plant endemism in China: places for survival or for speciation? *Journal of Biogeography*, 38, 1267-1280. 2011.

Jordi López Pujol, Fu-Min Zhang, Hai-Qin Sun, Tsun-Shen Ying, Song Ge. Mountains of Southern China as "Plant Museums" and "Plant Cradles": Evolutionary and Conservation Insights. *Mountain Research and Development*, 31(3), 261-269. 2011.

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