



Biogeography of Shangri-la flora in southwestern China

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Abstract

Shangri-la region of southwestern China is within the Hengduan Mountains biodiversity hotspot and is exceptional in floral diversity. Based on intensive field investigations and herbarium specimens, 6807 species of native seed plants from 1297 genera and 166 families were recognized. The flora is dominated by families and genera with cosmopolitan and north temperate distributions, including Apiaceae, Asteraceae, Ericaceae, Fabaceae, Gentianaceae, Lamiaceae, and the genera *Pedicularis*, *Rhododendron*, and *Salix*, which contribute up to 73.15 % of the total number of species, but only make up a small portion of the total number of families and genera. Families and genera with fewer species more commonly have tropical distributions, while East Asian and Chinese endemic families and genera are mostly monotypic and oligotypic, and contribute little to the floristic diversity of the region. It is revealed that the flora of Shangri-la might have evolved through rapid speciation mainly from families and genera of cosmopolitan and north temperate distributions with the uplift of the Himalayas and climatic oscillations after the late Tertiary. The macroevolution of the flora in the Shangri-la region interpreted by floristic patterns is well supported by phylogeographic studies on plant taxa in Hengduan-Qinghai-Tibet Plateau regions.

Keywords: Biogeography; floristic composition; geographical elements; Shangri-la; southwestern China

Introduction

Shangri-la region is situated in the northwestern corner of China's Yunnan Province (27°10'–28°27' N and 98°53'–99°42' E) (Figure 1). It lies within the Hengduan Mountains (Li 1987), which is one of the world's biodiversity hotspots (Boufford & Dijk 2000; Le *et al.* 2007). Shangri-la is one of the most biodiverse regions in China and is of global conservation priority (Myers *et al.* 2000).

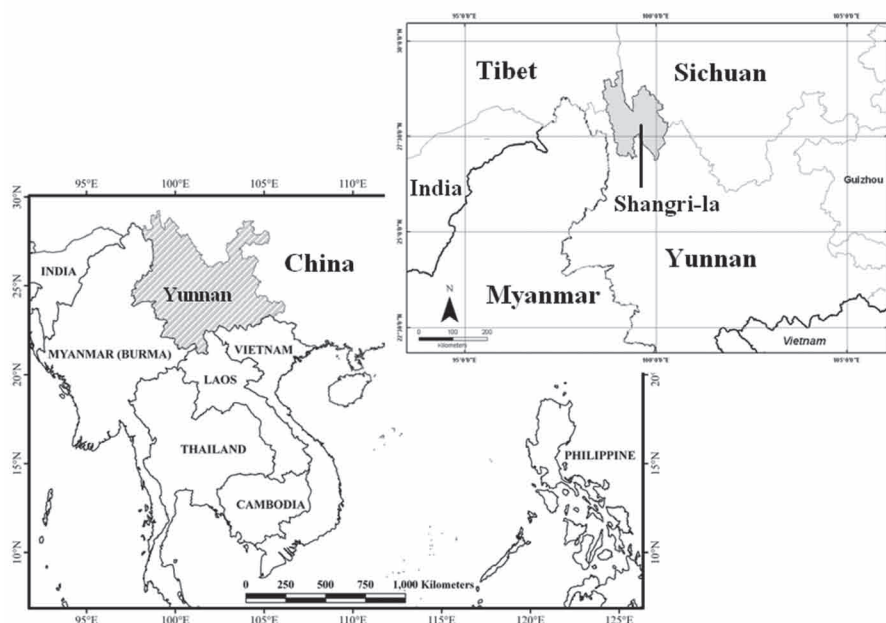


FIGURE 1. Map showing the study area, the Shangri-la region in SW China.

The Hengduan Mountains was also refugia for some north temperate genera during the last glacial cycle (Liu *et al.* 2006; Wang *et al.* 2008; Wang *et al.* 2009; Li *et al.* 2010; Sun *et al.* 2010; Zhang *et al.* 2010; Yang *et al.* 2012; Xue *et al.* 2012). For example, the genus *Angelica* L. (Apiaceae) consists of some 90–110 species distributed throughout north temperate regions, and 45 species in China, of which 32 are endemic to the Hengduan Mountains (She *et al.* 2005). A phylogeographic study revealed that Northeast Asia, Western Europe, and North America were ancestral areas of the genus, and the Hengduan Mountains was a refugia and a major diversification center for *Angelica* (Tu *et al.* 2009). Hengduan Mountains is also the centre of diversity for *Primula* (Hu 1994). It was found that Pleistocene climatic oscillations, combined with the complex local topography, were responsible for the phylogeographic pattern of *Primula ovalifolia* Franch., and that central and southwestern China were areas of important refugia for the survival, persistence, and further speciation of most East Asian flora, which has led to high species diversity in this region (Xie *et al.* 2012).

Evidently, the relatively quick uplift of the Himalayas and climatic oscillations after the late Tertiary have resulted in the rapid speciation and diversification of plants in the Hengduan Mountains. This is supported by both phylogeographic and floristic studies of the region that the dominant cosmopolitan and north temperate families and genera diversified rapidly in the region.

Conclusions

The flora of Shangri-la region is dominated by families and genera with cosmopolitan and north temperate distributions, while families and genera that are less species rich have diverse distributions, of which those with East Asian and Chinese endemic distributions are a minority. Among the species-rich families and genera of cosmopolitan and north temperate distributions, the regional endemic species contribute a conspicuously high percentage. The floristic patterns illustrate that the flora of Shangri-la could have evolved through rapid speciation mainly from families and genera of cosmopolitan and north temperate distributions, with the uplift of the Himalayas and climatic oscillations since the last glacial ages. The flora is obviously younger in evolutionary history than is usually supposed, and, therefore, not part of the age-old eastern Asian flora. The macroevolution of the flora in Shangri-la region is well corroborated by the phylogeographic implications of plant taxa in Hengduan-Qinghai-Tibet Plateau regions.

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