



## On the presence of North American clubmoss *Huperzia lucidula* (Lycopodiaceae) in China: An intercontinental disjunction or misidentification

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### Abstract

The North American shining clubmoss, *Huperzia lucidula*, was originally thought to be endemic to North America. However it was reported from China by Ren Chang Ching in 1981, and hence was believed to have a disjunct distribution in North America and Asia. Since then, in all Chinese literature *H. lucidula* has been described as a disjunct taxon, although in North American literature it has nearly always only been reported from eastern North America. The studies on the Chinese taxon are at present insufficient to address this taxonomical and biogeographical disparity. In this study we have attempted to unravel this issue using integrative morphological and molecular analyses. Morphological study included a thorough examination of specimens from the entire distribution range of *H. lucidula* in the USA, Canada and China following field collections. Molecular study included Maximum Likelihood and Bayesian inference phylogenetical analyses of three chloroplast markers: the genes *rbcl* and *matK* and the *psbA-trnH* intergenic spacer. The results showed distinct morphological differences between the North American and Chinese taxa, sufficient to recognize them as separate species. The molecular results corroborated these findings and supported the separation of the two taxa. Based on our results, the Chinese taxon is neither a variant of *H. lucidula* nor sister to it and therefore the supposed disjunct distribution of *H. lucidula* is erroneous and a result of misidentification. The Chinese taxon that was firstly reported by Ching as *H. lucidula* var. *asiatica* has been elevated to the species rank and a new combination has been made.

**Keywords:** *Huperzia asiatica*, lycopods, *matK*, morphology, phylogeny, *psbA-trnH*, *rbcl*, taxonomy

### Introduction

*Huperzia lucidula* (Michx.) Trevisan de Saint-Léon (1875: 248), commonly known as shining club-moss, was first described as *Lycopodium lucidulum* by André Michaux in Flora Boreali-Americana (Michaux 1803: 224, 284). Since its discovery there have been various reports of this species from throughout the northeast United States as well as parts of Canada (Clute 1905, Beitel & Wagner 1982, Waterway 1986, Wagner & Beitel 1993). Ren Chang Ching (1981) proposed an infraspecific taxon based on the collection of S.L. Soong from Chang Bai Mountain in the Jilin province, northeastern China, which he named *H. lucidula* var. *asiatica* Ching (1981: 296). The single character he proposed to distinguish this variety from the North American taxon was their reflexed leaves. The infraspecific taxon of Ching (1981) was accepted by other Chinese taxonomists (eg. Wang 1990) in subsequent years, or it was synonymized under the species (*H. lucidula*), stating that there are no reliable morphological differences between the North American and the Chinese populations (Zhang & Kung 2000, Zhang & Iwatsuki 2013). The accepted distribution range of *H. lucidula* has subsequently been accepted frequently as occurring on two continents (FIGURE 1).

Despite its supposed occurrence in northeastern China, nearly in all North American literature the distribution range has been confined to eastern North America only (Clute 1905, Beitel & Wagner 1982, Waterway 1986, Wagner & Beitel 1993). Due to lack of sufficient comparative studies including the Chinese taxon, it has been difficult to ascertain if it is truly a variant of North American *Huperzia lucidula* as accepted by Ching (1981) and other Chinese taxonomists (Zhang & Kung 2000, Zhang & Iwatsuki 2013), or if it merits to be recognized as a separate species altogether. A consensus is yet to be established and existing studies have as yet been unable to solve this taxonomic uncertainty. In the present work we have therefore endeavored to unravel the relationship between these two geographically