



Seed morphology of *Boschniokia sensu lato* (Orobanchaceae) and its taxonomical implications

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Abstract

Seeds of 25 samples of 4 species of the holoparasitic genus *Boschniokia sensu lato* were investigated using light and scanning electron microscopy. Previous phylogenetic and morphological evidence indicated the division of *Boschniokia s.l.* into three genera: *Boschniokia*, *Kopsiopsis*, and *Xylanche*. However, results of the recent phylogenetic analysis are that *Kopsiopsis hookeri* and *K. strobilacea* are sister taxa in one lineage and *Boschniokia himalaica* and *B. rossica* are sister taxa in a different lineage. Differences in seed size and sculpture can be very auxiliaries in determining the taxonomic position of these species. In this study, analysis of the morphology of seeds showed the presence of three types of seed. The most significant is differences between the distinct type of seed *B. rossica* and *B. himalaica*. The usefulness of micromorphological studies on seeds is demonstrated. A comparison of the main characteristics distinguishing the seeds of *Boschniokia s.l.* is also presented and discussed.

Key words: *Boschniokia*, seed morphology, systematic significance, SEM

Introduction

The family Orobanchaceae is morphologically diverse, containing 2060 species mostly parasitic on the roots of other plants (McNeal *et al.* 2013). The family has a worldwide distribution, but the main centers of distribution are the warmer parts of the Mediterranean, western and central Asia, northern Africa and North America (Kreutz 1995; Fischer 2004). *Orobanche sensu lato* is the largest holoparasitic genus, comprising ca. 200 species (Beck von Mannagetta 1930; Pusch & Günther 2009), many of which are rare or with unclear taxonomic position (e.g. Piwowarczyk & Przemyski 2009, 2010; Piwowarczyk *et al.* 2010, 2011, 2014, 2015; Piwowarczyk 2011; Joel *et al.* 2013).

Boschniokia C.A. Meyer in Bongard (Bongard 1833: 157) *sensu lato*, a genus in the holoparasitic Orobanchaceae family, extends into the farthest north and in cold areas at high altitudes, e.g. in woods and tundra, on rocky slopes or cliffs. As currently circumscribed, it comprises four perennial species: *Boschniokia rossica* (Chamisso & Schlechtendal) B. Fedtschenko in Fedtschenko & Flerow (1910: 896), *B. hookeri* Walpers (1844: 479), *B. strobilacea* Gray (1856: 118), and *B. himalaica* Hooker f. & Thomson (1884: 327). *Boschniokia rossica* occurs in Alaska, Canada, Russia, China, and Japan; *B. hookeri* in western North America (British Columbia, California, Oregon, Washington); *B. strobilacea* in western North America (California, Oregon, Baja California), *B. himalaica* mostly in temperate and subalpine Himalaya, to altitudes over 4000 m (Nepal, Bhutan, India, and China, but disjunct in Taiwan) (Beck von Mannagetta 1930; Abrams & Ferris 1960; Ozenda & Capdepon 1978; Hulten & Fries 1986; Yang & Lu 1998). They are parasites on the roots of woody hosts: *B. rossica* is a parasite on *Alnus* spp. (Betulaceae), *B. hookeri* on *Gaultheria shallon*, as well as (rarely, and it need of confirmation) *Arctostaphylos*, *Vaccinium*, *Arbutus* (Ericaceae) (Beck von Mannagetta 1930; Olsen & Deyrup Olsen 1981), *B. strobilacea* on *Arctostaphylos* spp. and *Arbutus menziesii* (Ericaceae) (Beck von Mannagetta 1930; Magney 1987), *B. himalaica* on *Rhododendron* spp. (Ericaceae) (Beck von Mannagetta 1930).

Beck von Mannagetta (1890) transferred *Boschniokia hookeri* and *B. strobilacea* to *Orobanche* sect. *Kopsiopsis* Beck (1890: 74, 85) (as a single, species *O. tuberosa* Hooker (1834: 92), and described the new genus *Xylanche* Beck (1890: 58) for *B. himalaica*. Later (1930), he raised *O.* sect. *Kopsiopsis* to the genus *Kopsiopsis* (Beck) Beck in Engler (1930: 304), comprising two species: *K. tuberosa* Beck in Engler (1930: 304) (= *K. hookeri* (Walpers) Govaerts in Walpers (1844: 479) and *K. strobilacea* (A. Gray) Beck in Engler (1930: 306). In that work, the genus *Boschniokia*