



Cryptic diversity and phylogeography of high alpine *Sattleria*—a case study combining DNA barcodes and morphology (Lepidoptera: Gelechiidae)

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Abstract

The taxonomy of *Sattleria*, a genus restricted to European high mountain systems, is critically revised based on morphology, DNA barcodes and phylogeography. Adult morphology combined with sequence information for the barcode region of COI supports the existence of 14 species. The full 658bp fragment of COI was obtained from 43 specimens representing 11 species and three shorter sequences were obtained from another two species. An illustrated key to the male genitalia of all species is provided. Three new species are described: *Sattleria karsholti* **sp. nov.** (Alpi Orobie, Adamello and Monte Baldo, Prov. Bergamo, Trento and Verona, Italy), *Sattleria cottiella* **sp. nov.** (Cottian Alps, Prov. Cuneo, Italy), and *Sattleria graiaaeella* **sp. nov.** (Alpi Graie, Prov. Aosta, Italy; Savoie, France). *Sattleria basistrigella* Huemer, 1997 **bona sp., stat. rev.** is raised from subspecies rank of *Sattleria triglavica* Povolný, 1987 to species rank.

Key words: Lepidoptera, Gelechiidae, *Sattleria*, phylogeography, cryptic diversity, new species, revised status, barcode, morphology, Europe, high mountains

Introduction

Lepidoptera from the Alps have recently gained increasing attention resulting in the description of numerous new, mostly endemic taxa (Huemer 1998, 2011). Several of these new taxa belong to hitherto unrecognized species complexes, many with brachypterous, flightless females which are well adapted to alpine environments (Sattler 1991, Whitebread 2007). The genus *Sattleria*, described by Povolný (1965), provides a striking example of such overlooked alpha-diversity. Although the first species was described in the 19th Century (Nowicki 1864), only two further species were known until recently. During the last two decades of the 20th Century several new species were described, mainly based on morphological characters of the adults and their genitalia. Some of these taxa occurred sympatrically, strongly supporting their status as distinct species (Huemer and Sattler 1992, Pitkin and Sattler 1991). However, Povolný (1987, 2001) argued that intraspecific variation was exceptionally high and only recognized a single highly polymorphic species, viz. *Sattleria dzieduszyckii* (Nowicki, 1864), separated into five subspecies (Povolný 2002). These conflicting taxonomic treatments were reviewed by Huemer and Karsholt (2010) who defined 10 species of *Sattleria* based on morphological characters and partially supported by a preliminary molecular dataset for a few taxa. Since this time, we have tried to advance species concepts in the genus through integrative taxonomy (Schlick-Steiner *et al.* 2010) including the acquisition of DNA barcodes from representative voucher specimens of *Sattleria*. These studies revealed considerable interspecific sequence divergence supporting the validity of the species recognized through prior morphological study. However, this work also revealed a surprising level of genetic diversity, particularly in the southwestern Alps, an observation that provoked our decision to revise the genus combining molecular and morphological traits.