



## Species status of *Centrolene lema* Duellman and Señaris, 2003 (Amphibia: Centrolenidae) revealed by Integrative Taxonomy

SANTIAGO CASTROVIEJO-FISHER<sup>1</sup>, JUAN M. GUAYASAMIN<sup>2</sup> & PHILIPPE J. R. KOK<sup>3</sup>

<sup>1</sup>Subdepartment of Evolutionary Biology, Department of Evolution Genomics and Systematics, Evolutionary Biology Centre (EBC), Uppsala University, Norbyvägen 18D, 75236 Uppsala, Sweden. E-mail: santiago.castroviejo@ebc.uu.se

<sup>2</sup>Museo de Zoología, Escuela de Ciencias Biológicas, Pontificia Universidad Católica del Ecuador, Av. 12 de Octubre y Roca, Aptdo. 17-01-2184, Quito, Ecuador. E-mail: jmguayasamin@gmail.com

<sup>3</sup>Department of Vertebrates, Royal Belgian Institute of Natural Sciences, 29 rue Vautier, B-1000 Brussels, Belgium. E-mail: philippe.kok@naturalsciences.be

### Abstract

We evaluate the hypothesis of *Centrolene lema* as a species distinct from *C. gorzulae* using morphological, bioacoustic and genetic comparisons. Our results show that there are no consistent differences in any of these three areas; hence, we present *C. lema* as a synonym of *C. gorzulae*. Additionally we provide new data on the distribution and ecology of the species.

**Key words:** Bioacoustics, *Centrolene gorzulae*, Centrolenid frogs, Distribution, Glassfrogs, Guiana Shield, Guyana, mitochondrial DNA, Synonym, Venezuela

### Introduction

*Centrolene lema* Duellman and Señaris, 2003 is a rare species known only from the holotype collected in the Sierra de Lema in the Venezuelan Guiana Shield. According to the original description, *C. lema* closely resembles *Centrolene gorzulae* (Ayarzagüena, 1992). Duellman and Señaris (2003) differentiated between the species on the basis of five morphological characters (see Results for details).

Kok and Castroviejo-Fisher (2008) compared DNA sequences of *Centrolene lema* and *C. gorzulae*, and suggested that the two could be conspecific. However, they postponed taxonomic rearrangements until morphological and acoustic data were available.

The purpose of the present paper is to evaluate the taxonomic status of *Centrolene lema*. We adhere to the evolutionary species concept that defines a species as a single lineage of ancestor-descendent populations that maintains its identity from other such lineages and which has its own evolutionary tendencies and historical fate (Simpson 1961; Wiley 1978), and use an integrative taxonomic approach that exploits multiple lines of evidence to delimit species boundaries (Dayrat 2005; Will *et al.* 2005; Padial *et al.* in press). In particular, we evaluate the hypothesis of *Centrolene lema* as a species distinct from *C. gorzulae* by morphological, bioacoustic and genetic comparisons.

### Materials and methods

To assess the taxonomy of *Centrolene lema*, we studied its holotype and compared it to preserved museum material of *C. gorzulae* including its holotype, the type series of *Centrolenella auyantepuiana* Señaris and