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A new species of *Andinobates* (Amphibia: Anura: Dendrobatidae) from west central Panama

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Abstract

Dendrobatid frogs are among the best known anurans in the world, mainly due to their toxicity and associated bright colors. A recently described dendrobatid genus, *Andinobates*, comprises frogs distributed among the Colombian Andes and Panama. During field work in the Distrito de Donoso, Colón province, Panama, we found a poison frog that we here describe as a new species. The new species belongs to the *A. minutus* species group and is described herein as *Andinobates geminisae* sp. nov. This new species differs from all other members of the group by having uniformly orange smooth skin over the entire body and a distinctive male advertisement call. The new species is smaller than other colorful dendrobatids present in the area, such as *Oophaga pumilio* and *O. vicentei*. We also provide molecular phylogenetic analyses of mitochondrial DNA sequences of dendrobatids and summarize genetic distances among *Andinobates* species. *Andinobates geminisae* occurs in Caribbean versant rainforest on the westernmost edge of the known distribution of *A. minutus*, and represents the fourth species within this genus in Panama. This is vulnerable to habitat loss and excessive harvesting and requires immediate conservation plans to preserve this species with a restricted geographic range.

Key words: *Andinobates geminisae* sp. nov., conservation, DNA barcoding, geographic distribution, molecular phylogenetics, Panama, poison dart frogs

Resumen

Los dendrobátidos, están entre los anuros más conocidos del mundo, debido principalmente a sus colores brillantes que cautivan la vista humana. Un nuevo género de dendrobatidos recientemente descrito, *Andinobates*, incluye ranas distribuidas entre los Andes colombianos y Panamá. Durante trabajos de campo realizados en el área del Distrito de Donoso, Provincia de Colón, Panamá, hemos encontrado una de estas joyas, la que procedemos a describir aquí como una nueva especie. Esta especie, pertenece al grupo de especies de *A. minutus* y se diferencia de los otros miembros del grupo por tener el dorso y el vientre uniformemente naranja, piel lisa y por el llamado de advertencia de los machos. Su tamaño pequeño, también diferencia a la nueva especie, de otros dendrobatidos coloridos presentes en el área, tales como: *Oophaga pumilio* y *O. vicentei*. Nosotros también proveemos aquí un análisis filogenético molecular de secuencias de ADN mitocondrial, que destaca las distancias genéticas entre las especies más cercanas. *Andinobates geminisae* sp. nov., se encuentra en los bosques lluviosos de la vertiente del Caribe, en el borde occidental de la distribución conocida de *A. minutus*, y representa la cuarta especie de este género en Panamá. Como otras especies del género, con distribuciones geográficas restringidas, *A. geminisae* es vulnerable a la pérdida del hábitat y a la recolección excesiva, por lo tanto este nuevo taxón requiere del inmediato desarrollo y aplicación de planes de conservación para preservar sus poblaciones.

Palabras claves: código de barras de ADN, *Andinobates geminisae* sp. nov., conservación, distribución geográfica, filogenética molecular, Panamá, Ranas dardo-venenosas

Discussion

According to the molecular phylogenetic results, we include *A. geminisae* in the *A. minutus* species group. However, the new species shows some marked differences with those diagnostic characters for the group proposed by Brown *et al.* (2011). The lack of stripes on dorsum and the pale marbling on venter, along with the bright coloration are discordant traits relative to the current definition of the *A. minutus* species group. Polymorphism within and rapid divergence among species of *Ranitomeya* and *Andinobates* in coloration is common (Brown *et al.* 2011), often caused by mimicry or local adaptation (Symula *et al.* 2001). Therefore, the marked differences presented here between *A. geminisae* and other species of the *A. minutus* group should not be surprising. Additional traits such as larvae morphology and call properties appear to be more conserved within the genus (Brown *et al.* 2011).

To identify possible cryptic species of Neotropical frogs from genetic distance data, thresholds of 10% at COI and 3% at 16S have been suggested (Fouquet *et al.*, 2007), whereas *A. geminisae* (MVUP 2428) shows at COI 6–8% divergence and at 16S 2.5% divergence from *A. minutus* (Table 4–5). Many dendrobatid lineages, however, show even smaller interspecific genetic distances (Roberts *et al.*, 2006), e.g., among species of *Oophaga* and *Dendrobates* (Fig. 4). The phylogenetic results statistically place the new species firmly in the *Andinobates minutus* species group (Fig. 4), while the above genetic distances suggest that *A. geminisae* could be considered a candidate species (Padial *et al.* 2010). We therefore used morphological and bioacoustic data to diagnose and differentiate the new species from all congeners within the species group and within the geographic region.

The call of *A. geminisae* showed remarkable differences compared to the other species of *Andinobates* from Panama. The presence of one or two spaced pulses (“clicks”) at the beginning or at the end of the call have been reported previously in *A. minutus* (Myers & Daly 1976, Fig. 16B), however the specimen recorded is from an indeterminate locality (either Colombia or Panama), and the call is >5.4 kHz, thus unlikely to be conspecific with *A. geminisae*. It is not known if the spaced pulses found in *A. geminisae* (Fig. 7) have some influence on behavior, but in many anuran species the calling male may modify his call, and usually these modifications play a role in communication. e.g., in the mating call, the territorial call, the distress call, the warning call or the release call (Littlejohn 1977; Narins *et al.* 2000).

Amphibians are in constant threat by many factors that have been discussed at length elsewhere (Lips *et al.* 2006; Wake & Vredenburg 2008; Hof *et al.* 2011). For the geographically restricted *A. geminisae* as for other Caribbean lowland endemics in Panama (e.g., *A. claudiae*, and *Craugastor evanescens* Ryan *et al.* 2010) habitat reduction remains the main issue that could threaten population stability and persistence over the short term. Integrative studies on this new species are urgently required, due to the lack of information on this newly discovered species. Data on population ecology, bioacoustic behavior, breeding biology and parental care are much needed for *A. geminisae*.

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