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Rediscovery of the Endangered Carchi Andean Toad, *Rhaebo colomai* (Hoogmoed, 1985), in Ecuador, with comments on its conservation status and extinction risk

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Abstract

Since 1984 there have been no records of *Rhaebo colomai* (Hoogmoed, 1985) within the territory of Ecuador. This species was known from 2 localities in the province of Carchi, northwestern Ecuador, and the department of Nariño, southwestern Colombia, which were reported in 1979 and 2015, respectively. We report the recent sightings of *R. colomai* at 3 new localities in Ecuador and discuss and evaluate this species' extinction risk and conservation status.

Key words

Biodiversity threats, Bufonidae, Dracula Reserve, population decline.

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Introduction

The Carchi Andean Toad, *Rhaebo colomai* (Hoogmoed, 1985), was described on the basis of a single adult female collected in 1984 at the headwaters of the River Baboso, near Lita, province of Carchi, Ecuador. The holotype

was deposited at the Naturalis Biodiversity Center, the Netherlands (RMNH 21905), formerly Rijksmuseum van Natuurlijke Historie or National Museum of Natural History, Leiden (Hoogmoed 1985, Gassó Miracle et

al. 2007). Two additional specimens were collected with the holotype and reported to be deposited at the Museo Ecuatoriano de Ciencias Naturales (MECN 0115, 0141), but only 1 specimen remains deposited in this museum (DHMECN 0795; Hoogmoed 1989). Hoogmoed (1989) reported an older specimen collected by E. W. Schupp in 1979 near the town of Chical, also in the province of Carchi. It was deposited at the National Museum of Natural History, Smithsonian Institution, Washington, DC, USA. Thus, this species was only known from 2 localities at the River Baboso and Chical, both located on the Andean slopes of northern Ecuador, about 30 km apart in a straight line. This species remained known only from Ecuador until Ron et al. (2015) reported 6 males and 3 females from a population from the Reserva Natural Río Nambi, department of Nariño, Colombia. This population had been overlooked because it was previously reported as *Rhaebo olallai* (Hoogmoed, 1985) by Murillo-Pacheco et al. (2005). Assigning this population to *R. colomai* extended the known geographic range of the species to Colombia, approximately 40 km north from Chical (specimens deposited in the Herpetology Collection at Universidad de Nariño,). Since it was last seen in Ecuador in 1984, *R. colomai* was classified as Critically Endangered and Possibly Extinct by the IUCN Red List of Threatened Species (Coloma et al. 2004), but was categorized as Endangered in the most recent evaluation (IUCN SSC Amphibian Specialist Group 2018). We report the recent observation of adult males, adult

females, and juveniles of *R. colomai* at 3 new localities in Ecuador and discuss its extinction risk and conservation status.

Methods

We discovered populations of *Rhaebo colomai* during expeditions carried out by 2 field teams: (i) Museo de Zoología of Pontificia Universidad Católica del Ecuador and (ii) Universidad San Francisco de Quito, the Natural History Museum, University of Wolverhampton, Complutense University of Madrid, Central University of Kerala, Friedrich Schiller University of Jena, and Instituto Nacional de Biodiversidad. We located specimens during active searches. We sacrificed the specimens by spraying benzocaine directly on the mouth, fixed them in 8% formalin, and preserved them in 70% ethanol. We determined the sex of individuals by dorsal skin texture and size, and also by direct inspection of gonads through a dorsolateral incision in collected specimens. Euthanized specimens were deposited at the Instituto Nacional de Biodiversidad (DHMECN) and Museo de Zoología, Pontificia Universidad Católica del Ecuador (QCAZ). Coordinates were obtained using a Garmin GPSMAP 64s GPS receiver using the WGS84 datum. Collections were made under permits MAE-DNB-CM-2016-0045 and 002-16-IC-FAU-DNB/MA issued by Ministerio del Ambiente del Ecuador. We evaluated the extinction risk according to the IUCN (2012) guidelines. Area of

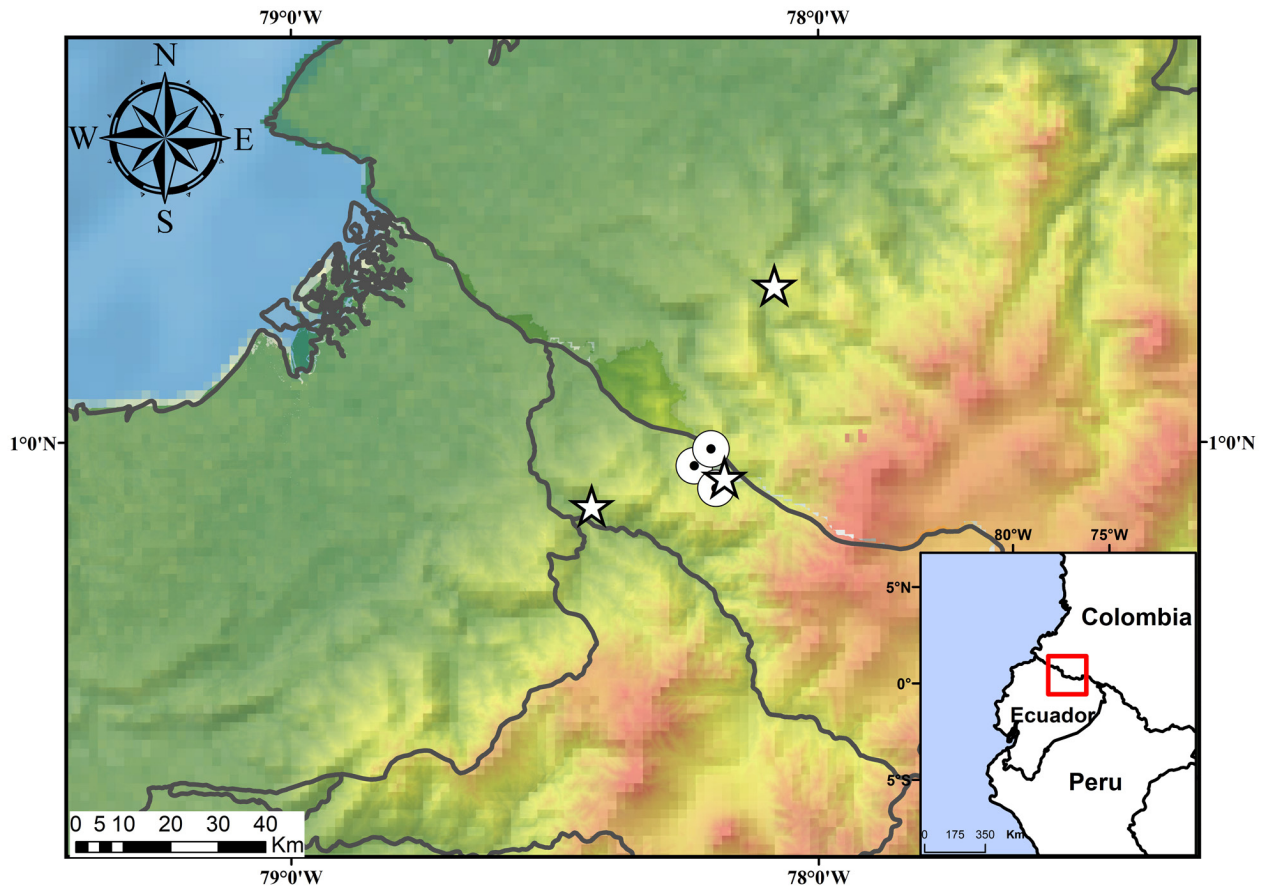


Figure 1. Known localities of *Rhaebo colomai*. Stars represent the previously reported records (Hoogmoed 1985, 1989, Ron et al. 2015). Circles represent the new records reported herein.

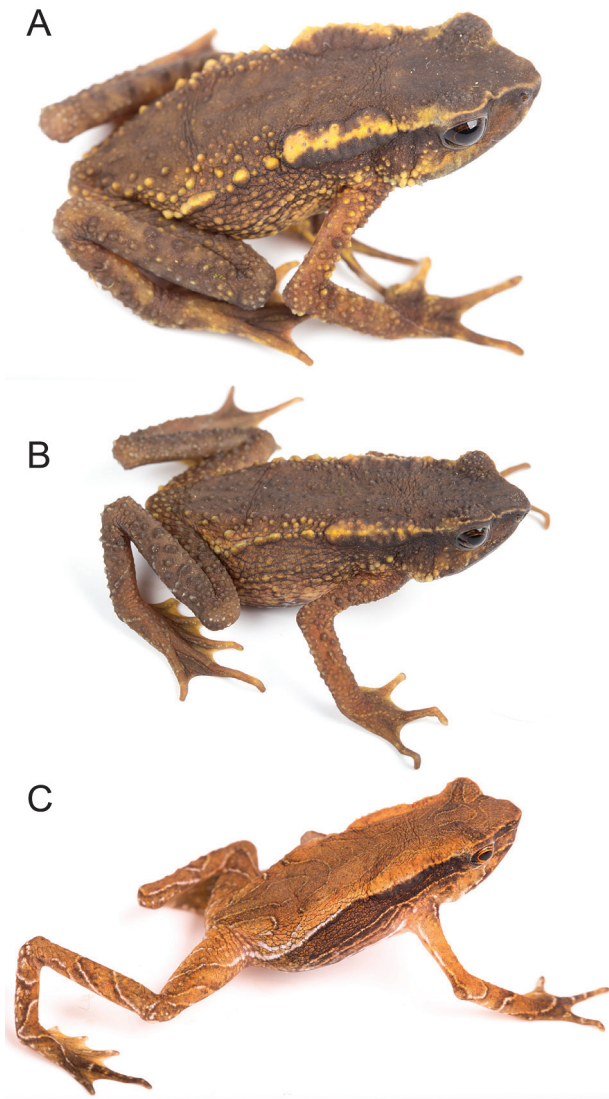


Figure 2. *Rhaebo colomai*. **A.** Adult female. **B.** Adult male. **C.** Juvenile. The individuals are at the ex-situ amphibian conservation program Balsa de los Sapos at Pontificia Universidad Católica del Ecuador. Photographs by Santiago R. Ron, BIOWEB-Ecuador.

occupancy and extent of occurrence were calculated using software GeoCAT, and an IUCN default cell width of 2 km was used for the analysis (IUCN 2017).

Results

New records. We discovered populations of *Rhaebo colomai* at three localities (Fig. 1). ECUADOR • 13 adults and 26 juveniles and subadults; province of Carchi, parish of Chical, at Río Pailón; 00°57.35'N, 078° 14.12'W; 1660 m alt.; Sept. and Dec. 2016; by Diego Almeida; found during night surveys along 2 streams (Fig. 2); 2 specimens collected and deposited, an adult female (QCAZ 67853, snout-vent length = 44.8 mm) and an adult male (QCAZ 67908 snout-vent length = 35.7 mm). • 1 specimen; province of Carchi, parish of Chical, at

the Peñas Blancas road; 00°59.20'N, 078°11.86'W; 1088 m alt.; 31 July 2017; by Gabriela B. Bittencourt-Silva, Carolina Reyes-Puig, Jeffrey W. Streicher, María Torres-Sánchez, Simon Maddock, Ramachandran Kotharambath, Francesca Nicole Angiolani Larrea and Hendrik Müller; found at night (18h00–21h00 hrs), perching ca 1.30 m above ground on vegetation, near streams of crystal clear water with surrounding vegetation within well-preserved forest; 1 specimen collected and deposited (DHMECN 13828, snout-vent length = 55.3 mm). • 1 specimen; province of Carchi, parish of Chical, at Cerro Oscuro, Reserva Orquideológica Dracula; 00° 54.78'N, 078.20'W; 1303 m alt.; 01 August 2017; by María Torres-Sánchez, Carolina Reyes-Puig, Gabriela B. Bittencourt-Silva, Jeffrey W. Streicher, Mark Wilkinson, Simon Maddock, Ramachandran Kotharambath, and Francesca N. Angiolani Larrea; found at night (18h00–21h00 hrs), perching ca 0.90 m above ground on vegetation, near streams of crystal clear water with surrounding vegetation within well-preserved forest; 1 specimen collected and deposited (DHMECN 13829, snout-vent length SVL = 52.0 mm) (Fig. 3).

Identification. All specimens of *R. colomai* reported herein match descriptions of this species by Hoogmoed (1985, 1989) and Ron et al. (2015): flat head, projected snout, upper eyelid margin with sharp rim, elongated parotoids that produce yellow secretions, flanks with areolate skin and oblique and continuous row of small warts, long and slender limbs, webbed fingers and toes, and absent enlarged cephalic crests. Females have smooth dorsal skin, small tubercles, and a larger body size (snout-vent length 54.9–59.1 mm) while males have spiculated tubercular dorsal skin and a smaller body size (32.6–38.4 mm).

Our new observations and records from the reviewed literature show that *R. colomai* is distributed within a small area on the western Andean slopes between extreme southern Colombia and extreme northern Ecuador. This species is apparently restricted to areas in the vicinity of streams surrounded by native old-growth forests. Between the first and second visit to Río Pailón (September–December 2016), the forest was logged in a terrain adjacent to one of the streams. Nevertheless, several individuals were observed near the stream. Forest fragmentation and loss across the species' distribution is extensive, and only few forest patches remain, probably due to their inaccessibility. Habitat degradation on the western Andean slopes of the province of Carchi is extensive and continues due to expansion of agriculture.

Currently available information suggests that the extinction risk of *R. colomai* is relatively high. It is known from just 3 places: (i) River San Juan drainage, including all sites in Chical and surroundings, (ii) River Mira drainage, including the type locality at River Baboso, and (iii) River Ñambi drainage, including the only known Colombian site. Its extent of occurrence was calculated as approximately 650 km² and its

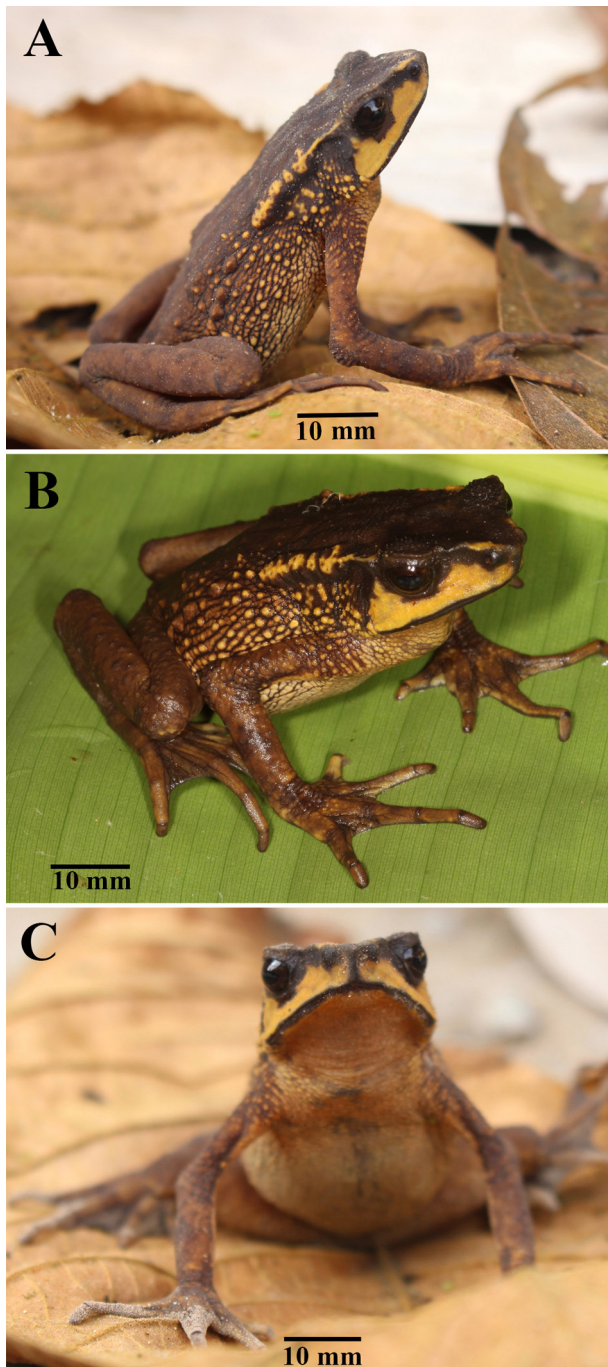


Figure 3. *Rhaebo colomai*, adult female DHMECN 13828, LRC = 52.0 mm. **A, B.** Dorsolateral views. **C.** Frontal view. Photographs by Carolina Reyes-Puig (A, C) and Gabriela Bittencourt-Silva (B).

area of occupancy was calculated as approximately 20 km². Its habitat is suffering an accelerated and continued decline, mainly because the increase of mining concessions within this area (Vandegrift 2018). We infer, based on geographical data and deforestation statistics (Sierra 2013), that continuous decline of its habitat quality across most of its distribution has occurred over the last 10 years, and we suspect this is ongoing. With this new information, we recommend that *R. colomai* should be classified under the IUCN category Endangered, Blab (i, ii, iii, iv).

Discussion

After over 30 years without any records in Ecuador, our observations of *Rhaebo colomai* at 3 new localities highlight the need for urgent action to ensure its long-term conservation. Unfortunately, habitat loss and fragmentation in the province of Carchi is caused by unsustainable timber extraction, uncontrolled expansion of the agricultural frontier, and replacement by non-native plantations (Dodson and Gentry 1991, Kuecker 2007, MAE 2013, Sierra 2013). The Dracula Reserve seems to be the only protected area in Ecuador that might maintain populations of this threatened species. This reserve is managed by the Ecominga Foundation and is key for the conservation of not only amphibians in the area but also other rare and threatened taxa, such as orchids of the genera *Dracula* and *Lepanthes*, and the Spectacled Bear, *Tremarctos ornatus* (Cuvier, 1825) (Baquero and Gary, 2015).

We recommend urgent establishment of the following research and conservation actions to improve knowledge and promote conservation of *R. colomai*: (i) surveying other areas in the province of Carchi, Ecuador, and in the department of Nariño, Colombia; (ii) studying the life history, ecology, and population dynamics; (iii) developing a joint species conservation action plan between Ecuador and Colombia; (iv) expanding the Dracula Reserve to cover all surrounding areas in which the species inhabits and promoting the establishment of new public, communal and private reserves to protect remaining habitat; (v) promoting resource and habitat protection policies, especially focused on the conservation of watersheds; (vi) working with local landowners and governments to promote good practices for the management of forests and riverine areas; (vii) enhancing knowledge exchange between private and public stakeholders, including local governmental authorities, to promote research and conservation actions; (viii) raising local, national, and international awareness about the unique and rich biodiversity of the province of Carchi; and (ix) lobbying for the establishment, compliance, and enforcement of national, provincial, and local legislation that promotes protection and restoration of forests in the province of Carchi.

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Authors' Contributions

DFCH, MW, and JWS raised funds for part of the investigation. CRP, MW, JWS, STM, GBBS, MTS, RK, HM, FNAL DAR, and SRR participated in the data collection. All authors wrote and contributed to the final version of the manuscript.

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