

## Short Note

# Altitudinal and life zone extension of the Harlequin frog *Atelopus laetissimus*, in the Sierra Nevada de Santa Marta, Colombia

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## INTRODUCTION

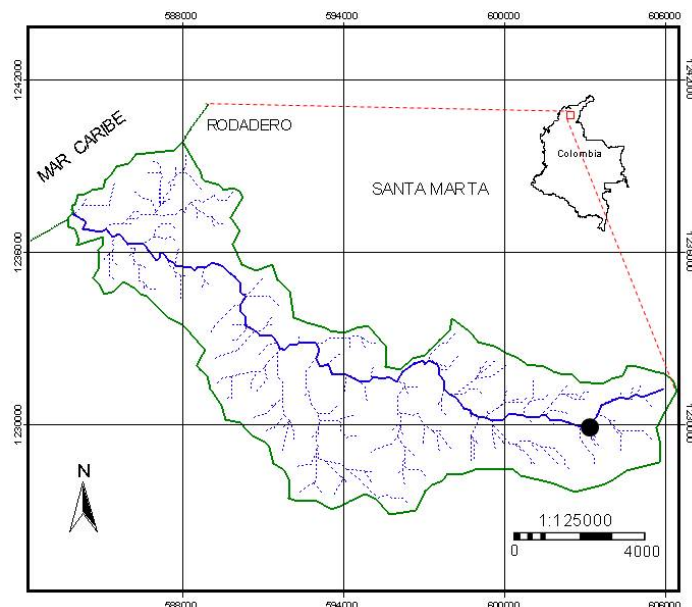
The endemic species, *Atelopus laetissimus* Ruiz-Carranza, Ardila-Robayo & Hernández-Camacho (1994), from Sierra Nevada de Santa Marta (department of Magdalena, Cuchilla de San Lorenzo, Colombia), inhabits streams and rivers in humid low montane (sub-Andean) forest (bmh-MB; Espinal and Montenegro, 1963; Tamaris-Turizo & López-Salgado, 2006) between 1900 and 2880 m. This species belongs to the world's most endangered vertebrate genus (Young et al., 2004), listed under the Critically Endangered category by Ramírez-Pinilla (2004). Since its description in 1994 it was not seen again until 2006 (Carvajalino-Fernández, et al. 2008). After rediscovery, the species has been subject of only limited research (Granda-Rodriguez et al., 2008). Here we report new localities for *A. laetissimus*, which extend its lower altitudinal limit and report another life zone for the specie; with temperature data from different microhabitats used.

The study area is known as "La Cascada" (11°10'02.0" N, 74°10'41.5" W, 1,560 m; Fig.

1). It is characterized by steep slopes and has an average annual rainfall of 2446 mm. The area is surrounded by forest composed mainly of Anarcadiaceae, Areaceae, Cecropiaceae, Moraceae, Piperaceae and Sapotaceae. Microhabitats are characterized by rocky areas with sand and leaf litter on the banks at the river (Fig 2a). The soil in the forest is mostly covered by leaf litter and wood in decomposition process; and ferns in open fields (Fig. 2b).

Sampling was by visual encounter surveys (VES; Lips et al., 2001; Crump & Scott, 1994) in an approximate area of 1000 m x 30 m along the watershed, including 10 m at each side of the riverside. Field work was conducted on November 11 and 12, 2008; January 30 and 31, 2009; March 18 and 19, 2009, during the following periods: 09:00 to 11:00 h, 12:00-14:00 h, 15:00-17:00 h, 18:00-20:00 h and 21:00-23:00 h by a single person. Sampling was repeated from October 18 to 28, during the following periods: 09:00-12:00 h, 15:00-17:00 h, 19:00-21:00 h and 22:00-00:00 h by two observers. This gave a total sampling effort of 234 hours/person.

## Zone extension of *Atelopus laetissimus* in Colombia



**Figure 1.** Map of Gaira river in the Sierra Nevada de Santa Marta (Colombia) showing the new locality for *Atelopus laetissimus* (black point).

Microhabitat	T°max	T°min	T° mean	Differences between T°max and T°min
Air	17.66	14.90	16.23	2.76
Rock	16.71	15.86	16.36	0.85
Green Leaf	17.76	14.80	16.25	2.96
Dead wood	17.28	15.28	16.37	2
Soil	16.38	14.85	15.84	1.53
Leaf litter	17.14	14.85	16.18	2.29

**Table 1.** Available microhabitat possibly used by *Atelopus laetissimus* in a very humid subtropical forest in the Sierra Nevada de Santa Marta. Maximum temperature (T°max). Minimum temperature (T°min). Mean temperature (T°mean). All data of temperature are in degrees Celsius (°C).

Body and substrate temperature were recorded with an infrared thermometer (Oakton InfraPro D:S=12:1). In total eight temperature sensors recorded temperatures in the different microhabitats available for *A. laetissimus*. Microhabitat use was previously evaluated in another locality (Granda-Rodriguez et al., 2008). The micro-environmental temperature graph was developed using the software HOBOware Pro (Oneset Computer Corporation, 2006).

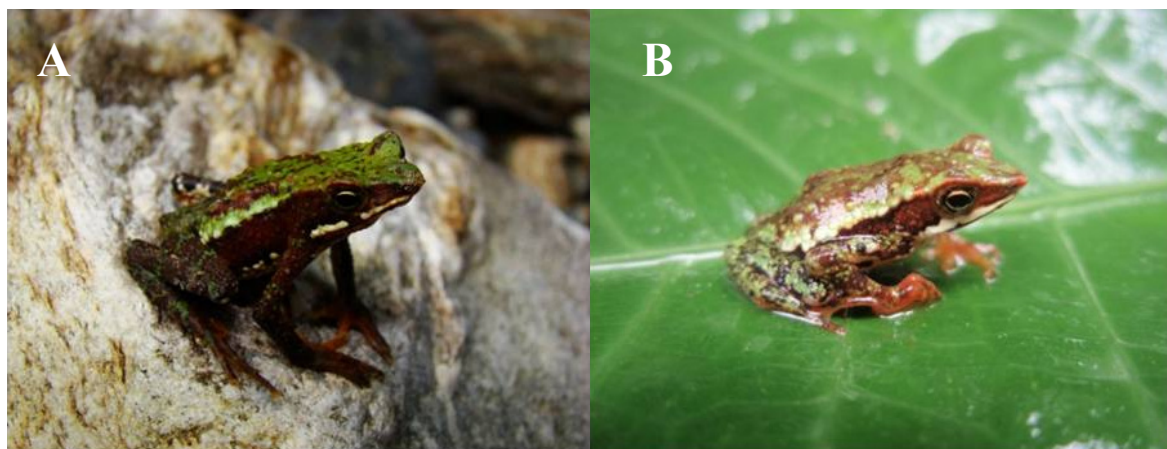
Two juveniles were found. The first was on March 19 at 14:10 h, the second on October 19 at 11:05 h. The first frog was found on rocks on the banks of the watershed with a body temperature of 19.4°C and a substrate temperature of 18.6°C. The second frog was

found on green leaf litter at the right riverside with a body temperature of 15.7°C and a substrate temperature of 15.7°C (Fig. 3). Both individuals were recorded at an altitude of 1560 m, which corresponds to the life zone of very humid subtropical forest (Espinal & Montenegro, 1963). Morphometric measurements of the second frog were: snout vent length (20.4 mm), arm length (5.5 mm), femur length (8.8 mm), head width (7.2 mm), forearm length (6.6 mm). Additionally we show the temperature of some microhabitats probably used by *A. laetissimus* (Granda-Rodriguez et al., 2008). Temperatures ranged from 0.85 °C to 2.96 °C, and the average of 2 °C did not vary more than 1 °C (Table 1).

The conservation of any species depends on biological knowledge. This is a limiting premise



**Figure 2.** Sites where *Atelopus laetissimus* frogs were found. The right riverside (A); Rock banks of the watershed (B).



**Figure 3.** Photographic records of specimens of *Atelopus laetissimus* in a very humid subtropical forest in the Sierra Nevada de Santa Marta. Individual found on rock on March 19 of 2009 (A). Individual found on green leaves on October 19 of 2009 (B).

in the case of endangered and poorly known species such as *A. laetissimus*. The first step for the conservation initiative of this species is the localization of populations, and basic knowledge regarding to habitat use and life history. This work had a significant sampling effort but found few individuals, which is in concordance with its current classification status as an endangered species. These results report a new locality at a lower altitude than previously reported in the same watershed (Carvajalino-Fernández et al., 2008; Granda-Rodríguez et al. 2008).

In addition to extend the altitudinal range, we report the species in a life zone with plant physiognomy different to that previously known. The very humid subtropical forest is a good scenario for *A. laetissimus* conservation, mainly because of the absence of pine tree plantations, a factor that has been considered

detrimental for amphibian communities (Paris & Lindenmayer, 2004) and that possibly poses a conservation problem for the species in the type locality (Carvajalino-Fernández et al., 2008).

The differences between extreme temperatures among localities varied more than 2 °C (Table 1). Therefore, the species is potentially tolerant to diverse thermal regimes in altitude settings. This will be important for *A. laetissimus*, because other species within the Andean region have been reported to display body temperatures matching soil temperature. Thus, the temperature data reported here will serve as a reference for future thermal ecology studies.

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