

New records of the harlequin frog *Atelopus nahumae*
RUIZ-CARRANZA, ARDILA-ROBAYO & HERNÁNDEZ-
CAMACHO, 1994, in the Sierra Nevada de Santa Marta
(Colombia), with notes of its distribution
(Anura: Bufonidae)

Neue Fundorte des Stummelfußfrosches *Atelopus nahumae* RUIZ-CARRANZA,
ARDILA-ROBAYO & HERNÁNDEZ-CAMACHO, 1994 in der Sierra Nevada
de Santa Marta (Kolumbien), mit Anmerkungen zur Verbreitung
(Anura: Bufonidae)

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KURZFASSUNG

Die Autoren berichten über die bisher bekannte Verbreitung des Stummelfußfrosches *Atelopus nahumae* RUIZ-CARRANZA, ARDILA-ROBAYO & HERNÁNDEZ-CAMACHO, 1994 und den Nachweis dreier neuer Fundorte im Nordwesten der Sierra Nevada de Santa Marta (Kolumbien). An den neuen Fundorten wurden Beobachtungen zum Paarungsverhalten des Frosches gemacht. Trotz neuer Nachweise in verschiedenen Hochtälern innerhalb des Gebirgsmassives der Sierra Nevada de Santa Marta (Cordoba Fußtal) ist der Kenntnisstand zur Verbreitung der Art in der Region als gering zu bezeichnen.

ABSTRACT

The known distribution of the harlequin frog, *Atelopus nahumae* RUIZ-CARRANZA, ARDILA-ROBAYO & HERNÁNDEZ-CAMACHO, 1994, is reported along with three new locality records in the northwestern Sierra Nevada de Santa Marta (Colombia). In the new localities, observations were made on the frog's mating behavior. This report adds the Cordoba River Basin, another high valley of the Sierra Nevada de Santa Marta, to the known range of *A. nahumae*. Nevertheless, the general distribution of the species in this region is largely unknown.

KEY WORDS

Amphibia; Anura; Bufonidae; *Atelopus nahumae*; distribution range, Cordoba basin; new record; Sierra Nevada de Santa Marta, Colombia, mating behavior, reproduction, natural history

INTRODUCTION

Atelopus nahumae RUIZ-CARRANZA, ARDILA-ROBAYO & HERNÁNDEZ-CAMACHO 1994, is an endemic species of the Sierra Nevada de Santa Marta (Department of Magdalena, Cuchilla de San Lorenzo, Colombia). It inhabits the sub-Andean forest in the vicinity of streams and rivers between 1082-2880 m a.s.l. This altitudinal range includes the life zones "very humid subtropical forest" [bosque muy húmedo - subtropical (bmh-ST)] and "very humid low montane forest" [bosque muy húmedo - montano bajo (bmh-MB)] (GRANDA-RODRIGUEZ et al. 2008; TAMARÍS-TURIZO & LÓPEZ-SALGADO

2006; ESPINAL & MONTENEGRO 1963). The harlequin frogs belong to one of the world's most endangered vertebrate genera (YOUNG et al 2004). Since its description in 1994 it had not been sighted again in the field until 2006; however, the incident was published only in 2008 (CARVAJALINO-FERNÁNDEZ et al. 2008). Due to lack of additional information for about 15 years and considering behavioral and conservation criteria, *A. nahumae* was listed by the International Union for Conservation of Nature and Natural Resources (IUCN) in the category "Critically Endangered" (RAMÍREZ PINILLA et al. 2004).

The genus *Atelopus* is well represented by six endemic species in the Sierra Nevada of Santa Marta, an isolated tropical mountain located at some distance from the Andes mountain chain. Despite this regional diversity, only *A. carrikeri* RUTHVEN, 1916, *A. nahumae* and *A. laetissimus* RUIZ-CARRANZA, ARDILA-ROBAYO & HERNÁNDEZ-CAMACHO, 1994, received some attention in

scientific articles, whereas information on life history and distribution of the others, was restricted to anecdotal observations and singular records (CARVAJALINO-FERNÁNDEZ et al. 2008; GRANDA-RODRIGUEZ et al. 2008; RUEDA SOLANO 2008). The aim of this paper was to summarize and present the known distribution data for *A. nahumae* based on field and literature information.

STUDY AREA AND METHODS

The field data were collected in three areas (empty symbols in Fig. 1):

(i) “Río Frio” Basin, between Cuchilla de Hiebrabuena and Pamichal (San Pedro), is located at 10°53'33.4"N, 74°00'27.0"W, 1720 m a.s.l. The sector is located in the sub-Andean forest (1100–2000 m a.s.l.) (ESPINAL & MONTENEGRO 1963) with an annual rainfall of nearly 4000 mm. The canopy is formed by palm trees of the genera *Chamaedorea* and *Geonoma* and species from the families Rubiaceae, Bromeliaceae, Moraceae, Piperaceae and Orchidaceae.

(ii) “Río Córdoba” Basin, is located at 11°01'8.39"N, 73°59'9.62"W, 2361 m a.s.l. The area has steep slopes; average annual rainfall is 2446 mm. The stream inside the sector is surrounded by riparian forest, characterized by the plant families Anacardiaceae, Arecaceae, Cecropiaceae, Moraceae, Piperaceae and Sapotaceae.

(iii) San Lorenzo waterfall (Río Gaira Basin), is located at 11°10'02"N, 74°10'41"W, 1560 m a.s.l. The location is characterized by its steep slopes and an average annual rainfall of 2446 mm. The stream is surrounded by riparian forest; typical plant families here are Anacardiaceae, Araceae, Cecropiaceae, Moraceae, Piperaceae and Sapotaceae. There is a high diversity of microhabitats in the sector, including rocky areas, sand and leaf litter on the banks of the

stream. Inside the riparian forest, undergrowth is found within about 10 m distance from the stream basin. The soil in the forest is covered mostly by leaf litter and dead wood, and there are fern patches where the tree cover is sparse.

Sampling was accomplished using visual encounter surveys (VES; CRUMP & SCOTT 1994; LIPS et al. 2001) scanning an area of approximately 1000 m in length x 30 m in width, along the river beds, including 10 m of the river banks. Field work was conducted by two researchers on May 17-23, 2007; (Cuchilla de Hiebrabuena and Pamichal) in the following periods of the day: 9:00-11:00 h, 12:00-14:00 h, 15:00-17:00 h, 18:00-20:00 h, and 21:00-23:00 h. In “Río Córdoba”, sampling was conducted by one researcher on August 10-13, 2010 in the following periods of the day: 9:00-12:00 h, 15:00-17:00 h, 19:00-21:00 h and 22:00-0:00 h. At San Lorenzo waterfall, sampling was conducted by one researcher on October 19, 2009, during the following periods of the day: 9:00-12:00 h, 15:00-17:00 h, 19:00-21:00 h and 22:00-0:00 h. Total sampling effort was 171 person hours.

This assessment was chiefly based on audiovisual records and did not include collecting of individuals; thus, the organisms were released immediately after identification.

RESULTS

Five adult individuals of *Atelopus nahumae* were recorded from the first sampling site (Cuchilla de Hiebrabuena and Pamichal). Three individuals were ob-

served on May 19 at 16:24 h and two (in amplexus) on May 22 at 13:05 h. The individuals were found on leaf litter on the banks of the stream, two of them in amplexus. The

frogs were recorded at 1720 m a.s.l., which corresponds to the life zone of “very humid subtropical forest” (ESPINAL & MONTENEGRO 1963).

Two individuals in amplexus were found on the second sampling site (Rio Cordoba) on August 10 at 13:16 h; both on leaf litter, a microhabitat predominant in the area with an altitude of 2043 m a.s.l. which corresponds to the life zone of “very humid subtropical forest” (ESPINAL & MONTENEGRO 1963).

Five adult individuals were found on the third sampling site (San Lorenzo waterfall) on October 19; three individuals within the period of 9:50-10:30 h and two in amplexus at night at 20:42 h. All *Atelopus* frogs were sitting on leaf litter, a microhabi-

tat predominant in the area at an altitude of 1560 m a.s.l. which corresponds to the life zone of “very humid subtropical forest” (ESPINAL & MONTENEGRO 1963).

In all of the three new record localities we observed reproductive behavior (amplexus on May 22, 13:05 h; August 10, 13:16 h; October 19, 20:42 h) which was reported only from the type locality (May 4, 2006 at 10:00 h) until now (CARVAJALINO-FERNANDEZ et al. 2008). The altitudes inhabited by *A. nahumae* ranged from 1092 m to 2800 m (for references see Table 1). The new finding sites were located in close vicinity to the rivers. The shortest distance between known populations was 13.2 km (Gaira River – Cordoba River) and the longest 90 km (Gaira River – Nabusimake).

DISCUSSION

Herpetology focused on anuran population dynamics for the last 30 years, which included the study of a possible global trend towards the extinction of amphibians (BLAUSTEIN & WAKE 1990). But, there are still many gaps in information, including our knowledge on threats to endangered species and basic aspects of their life history and distribution. A particular case is *Atelopus* in the Sierra Nevada de Santa

Marta (Colombia), a genus of frogs and perhaps vertebrates known as the most endangered of the world (LA MARCA et al. 2005). Current population assessments of lowland *Atelopus* species are less alarming than the one presented by COLOMA et al. (2010) that is, however, still valid for most species in mountainous areas.

The search for species' new localities is a good strategy in conservation because it

Table 1: Places where *Atelopus nahumae* RUIZ-CARRANZA, ARDILA-ROBAYO & HERNÁNDEZ-CAMACHO, 1994, was found, and notes about its distribution.

Tab. 1: Fundorte von *Atelopus nahumae* RUIZ-CARRANZA, ARDILA-ROBAYO & HERNÁNDEZ-CAMACHO, 1994 und Anmerkungen zu seiner Verbreitung.

Place / Fundort	Coordinates / Koordinaten N / W	Altitude a.s.l. (m) / Höhe ü. M. (m)	Source / Quelle	Life zone / Vegetationszone (ESPINAL & MONTENEGRO 1963)
Pueblo Bello to Nabusimake	10°24' / 73°35'	1092	GRANDA RODRIGUEZ et al. (2008)	Very humid subtropical forest - bmh-ST
San Lorenzo ravine	11°07'11" - 11°06'56.9" / 74°03'04.7" - 74°03'01.6"	2.100	CARVAJALINO-FERNÁNDEZ et al. (2008)	Humid low montane forest - bh-MB
San Lorenzo Experimental Station	11°11' / 74°03'	1900	RUIZ-CARRANZA et al. (1994)	Humid low montane forest - bh-MB
San Pedro de la Sierra	Not mentioned	2000-2800	RUIZ-CARRANZA et al. (1994)	Very humid low montane forest - bmh-M
Córdoba river basin	11°01'83.9" / 73°59'96.2"	2043	Present research Diese Arbeit	Very humid low montane forest - bmh-M
Palmichal - San Pedro de la Sierra	10°53'33.4" / 74°00'27.0"	1720	Present research Diese Arbeit	Very humid low montane forest - bmh-M
San Lorenzo Waterfall	11°10'02" / 74°10'41"	1560	Present research Diese Arbeit	Very humid subtropical forest - bmh-ST

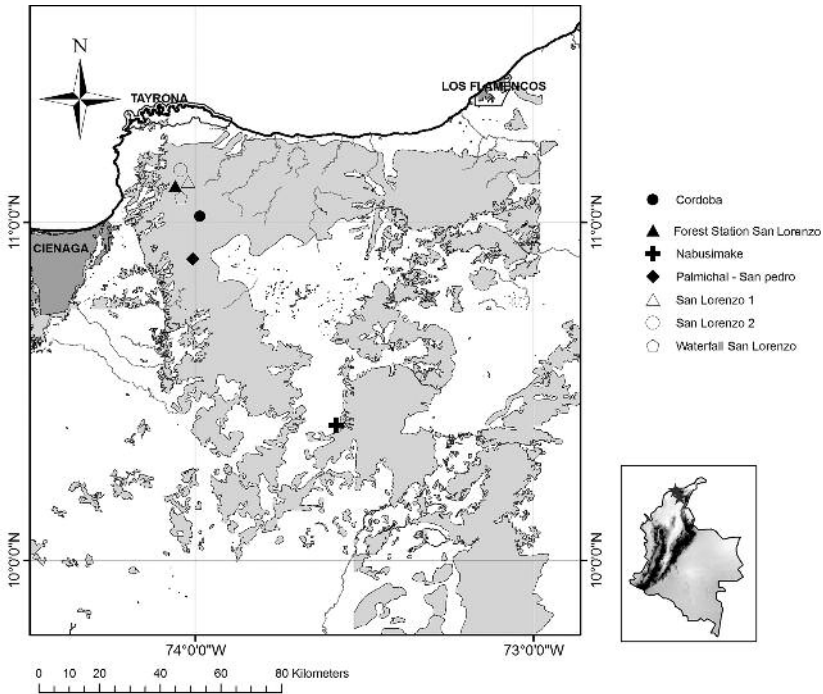


Fig. 1: Sierra Nevada de Santa Marta (Colombia) and the locations where *Atelopus nahumae* RUIZ-CARRANZA, ARDILA-ROBAYO & HERNÁNDEZ-CAMACHO, 1994, was found. The empty symbols refer to new records presented here.

Abb. 1: Die Sierra Nevada de Santa Marta (Kolumbien) und Fundorte von *Atelopus nahumae* RUIZ-CARRANZA, ARDILA-ROBAYO & HERNÁNDEZ-CAMACHO, 1994. Die leeren Symbole bezeichnen die hier vorgestellten neuen Fundorte.

could contribute to the identification of habitat preferences, detecting the genetic variability, and establishing migrations caused by rainy seasons, etc. Species distribution analysis contributes considerably to our understanding of their biology which is an important scientific basis for the development of management plans aiming towards the conservation of populations.

For this reason, the authors compiled information related to the distribution of sightings for *A. nahumae* and included three new locations (“San Lorenzo waterfall” in the Río Gaira basin; Río Cordoba basin, and “Palmichal” in the Río Frio basin) (Table 1, Fig. 1).

As to the abundance of this *Atelopus* species, 171 person hours of searching in May, August and October, across much of

the day, resulted in a total of 12 individuals of *A. nahumae*.

In all three sectors surveyed, mating behavior (amplexus, Fig. 2) was observed allowing for the conclusion that the species found suitable conditions for reproduction in these locations. This assumption was confirmed by the presence of tadpoles which were identified by their rheophilous habits and morphological adaptations.

Atelopus nahumae was found in three different life zones (Table 1). Due to the considerable variability of life zones inhabited and the existence of populations within an area of 90 km in longitudinal extension, one may conclude that the range area of *A. nahumae* covers a wide array of resources in relation to food, refuge and breeding sites, including niches of different dimension



Fig. 2: A pair of *Atelopus nahumae* RUIZ-CARRANZA, ARDILA-ROBAYO & HERNÁNDEZ-CAMACHO, 1994, in amplexus.

Abb. 2: Männchen und Weibchen von *Atelopus nahumae* RUIZ-CARRANZA, ARDILA-ROBAYO & HERNÁNDEZ-CAMACHO, 1994 in Amplexus.

(HUTCHINSON 1958). However, this hypothesis needs to be tested through studies of populations in the different areas.

In the Gaira River basin, *A. nahumae* and *A. laetissimus* are sympatric species; their populations co-occur in the altitudinal range between 1900 m and 2100 m (RUIZ-CARRANZA et al. 1994; CARVAJALINO-FERNANDEZ et al. 2008). In this location there are pine plantations, a factor that other studies considered unfavorable to amphibian communities (PARIS & LINDENMAYER 2004). When exploring the study area in a single visit during the mating season of *Atelopus*, CARVAJALINO-FERNANDEZ et al. (2008), found that neither species had colonized pine plantations even though there were small streams (i.e., a suitable microhabitat for the reproduction of the species). Since pine plantations may be a local threat to the populations of both *Atelopus* species, the new record localities of *A. nahumae* pre-

sented here are important in that they all are characterized by the absence of pine plantations; moreover, they cover different life zones in the basins of the Río Gaira, Río Cordoba and Río Frio, and along the road from Pueblo Bello to Nabusimake, this last location being situated at a lower altitude than is typical to the species (Table 1).

The authors postulate that the actual distribution of *A. nahumae* in the mountains of the Sierra Nevada de Santa Marta is much wider than currently known. They think so because environmental conditions prevailing in the altitudinal zones where the species was found are present along several tributaries of the northern (18 stream basins) western (5 stream basins) and southern (6 stream basins) flanks of the Sierra Nevada de Santa Marta. Further intensive field research will be necessary, to establish a representative map of the presence of the species in this massif.

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