



Research note

First record of the limestone rainfrog *Craugastor psephosypharus* (Amphibia: Anura: Craugastoridae) in Mexico

Primer registro de la rana de lluvia de piedra caliza Craugastor psephosypharus (Amphibia: Anura: Craugastoridae) en México

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Abstract

We document the first record of *Craugastor psephosypharus* (Craugastoridae) for Mexico. In October 2014, we collected 2 individuals of this species and observed another 8 specimens in a tropical moist forest fragment in the Lacandona region, southeastern Mexico. We found the frogs during daytime in the rainy season, in the vicinity of a small karst cave system. This new record extends the known distribution of the species 75 km to the west, near the Guatemala–Mexico border. We measured air temperature and vegetation structure at the study site. Air temperatures inside karst cavities were 0.5 °C lower than outside. This is the westernmost record of the species. The finding increases the number of known amphibian species in Mexico to 378.

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Keywords: *Craugastor psephosypharus*; Lacandona region; Warty forest frog

Resumen

Documentamos el primer registro de *Craugastor psephosypharus* (Craugastoridae) para México. En octubre de 2014 se recolectaron 2 individuos de esta especie y se observaron otros 8 especímenes en un fragmento de bosque tropical húmedo en la región Lacandona, sureste de México. Encontramos a las ranas durante el día, en la temporada de lluvias, en las cercanías de pequeños sistemas de cavidades kársticas. Este nuevo registro extiende la distribución conocida de la especie 75 km al oeste, cerca de la frontera entre Guatemala y México. Se midió la temperatura del aire y la estructura de la vegetación del sitio de estudio. Las temperaturas dentro de las cavidades kársticas fueron 0.5 °C menores que las del exterior. Este es el registro más occidental de esta especie. El hallazgo incrementa a 378 el número de especies conocidas de anfibios en México.

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Palabras clave: *Craugastor psephosypharus*; Región Lacandona; Rana de bosque verrugosa

Precise information on the distribution of the species is crucial for biodiversity conservation programs (Gotelli, 2004). The genus *Craugastor*, which includes 114 species, is distributed from the southwestern USA to northwestern South America (Ecuador and Colombia; Frost, 2016), and is one of the most

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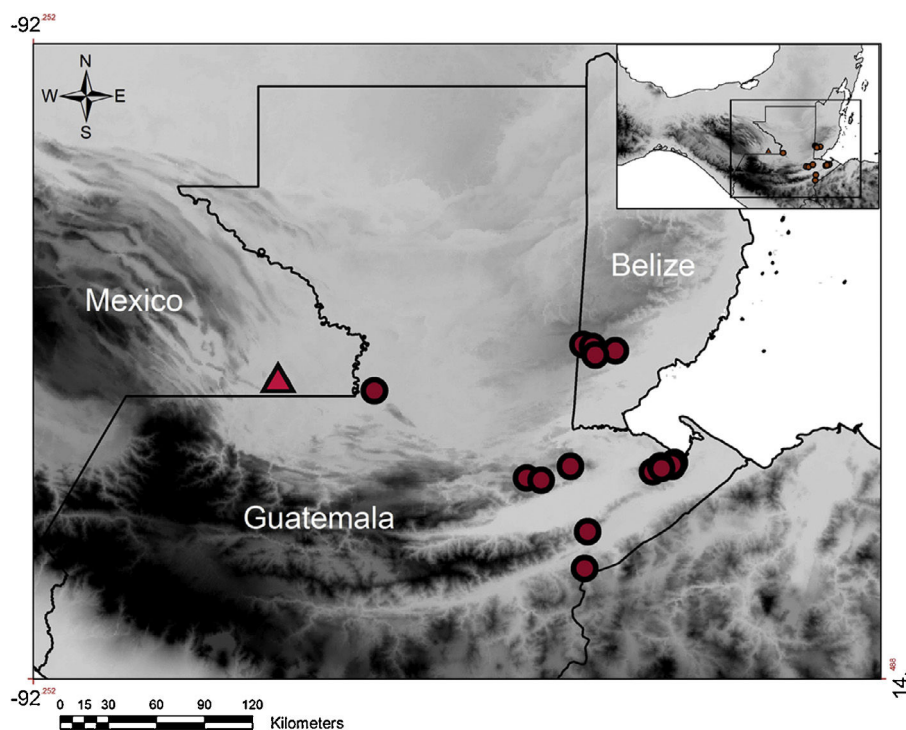


Figure 1. Geographical distribution of *Craugastor psephosypharus* according to previous records (circles) reported by Campbell et al. (1994) and the new record for Mexico (triangle).

diverse genera of frogs in America. This genus is currently considered a member of the subfamily Craugastorinae (family Craugastoridae), which is composed by 3 genera (*Craugastor*, *Haddadus* and *Strabomantis*; Frost, 2016; Padial, Grant, & Frost, 2014). In Mesoamerica and the Caribbean many species of *Craugastor* have very restricted geographic distributions (Hedges, Duellman, & Heinicke, 2008).

Craugastor species range from small to medium-sized (Vitt & Cadwell, 2014). Most species need very particular environmental conditions for survival, such as high humidity, low temperatures and abundant leaf-litter cover (Hedges et al., 2008). These frogs have direct development with female parental care (Wells, 2007). Encapsulated eggs are laid in moist terrestrial microhabitats, such as under stones or logs, or covered by soil or leaf litter (Vitt & Cadwell, 2014; Wells, 2007).

The Lacandona region, located in southeastern Mexico, is the westernmost portion of the Mayan forest, and consists of tropical moist forest (Petén-Veracruz moist forests, Olson et al., 2001). In Mexico, it is one of the most diverse areas in terms of both plant and animal species richness (Dirzo, 1994; González-García, 1993; Medellín, 1994). Yet, there is little information about amphibian diversity. Hernández-Ordóñez et al. (2014) reported 35 species, but suggested that 5 additional species, including *Craugastor psephosypharus*, could inhabit this region.

Craugastor psephosypharus, commonly known as “Limestone Rainfrog” or “Warty Forest Frog” (Campbell, 1998), is included in the *Craugastor rugulosus* group (Campbell & Savage, 2000). This species has terrestrial and nocturnal habits and is found far from water bodies, although they are active during rain (Campbell, 1998; Meyer & Foster, 1996). This species

is associated with limestone (karstic) formations, in conserved tropical moist forest (Campbell, 1998) and individuals can be found under rocks, in karst cavities and crevices or in the leaf-litter (Lee, 2000). It has been recorded in northeastern Guatemala and southeastern Belize (Fig. 1), between 150 and 1170 m asl (Campbell, Savage, & Meyer, 1994; Frost, 2016).

Here, we report the first record of the Limestone Rainfrog, *Craugastor psephosypharus*, in Mexico. Two specimens, an adult female and a juvenile (Fig. 2a and b) were collected during the rainy season (18 and 29 October 2014) in a 1000 ha patch of protected forest, belonging to the community of Ejido Playón, in the southeastern part of the Lacandona region (Municipality of Marqués de Comillas, Chiapas; 16°08.31' N, 90°52.91' W, Datum WGS84; 185 m asl). The specimens were captured during daytime, on the ground, inside small karst cavities, in a 120 ha area dominated by limestone outcrops. Additionally, 5 adults and 3 juveniles were observed active at night, outside the cavities, in the same area (Fig. 2c). The nearest stream was at a distance of 145 m.

We collected environmental data associated with the specimens. We measured air temperature at 0.30 m height, inside the cavities (2 m from the edge) and outside, during 10 h (11:00–21:00 h). Average air temperature was higher outside (24.6 ± 0.04 °C, max = 25.1 °C, min = 23.9 °C) than inside the cavities (24.1 ± 0.03 °C, max = 24.7 °C; min = 23.3 °C). Plant densities per m² in the surveyed area were: 0.2 ± 0.1 trees > 30 cm DBH (diameter at breast height), 4 ± 0.1 trees ≤ 30 cm DBH, 0.4 ± 0.3 palm trees, 6.8 ± 0.1 understory plants > 30 cm height, and 8.5 ± 0.1 understory plants ≤ 30 cm height, litter cover was $14\% \pm 4.3\%$ and litter depth was 4 ± 0.51 cm.



Figure 2. Photographs of the collected adult female (a), juvenile (b) and an adult female (c) observed at night outside of a karst cavity, on October 2014, Lacandona region, municipality of Marqués de Comillas, Mexico. Photos by Omar Hernández-Ordóñez.

Collected specimens were preserved and deposited in the Colección Nacional de Anfibios y Reptiles, Instituto de Biología, Universidad Nacional Autónoma de México (collection numbers CNAR-IBH-29549 and CNAR-IBH-29550); specimens were collected under special permit Oficio Núm/SGPA/DGVS/02132, Semarnat, issued to one of us (VHR). J.A. Campbell and J. Savage verified the identity of the specimens.

We compared our specimens with the holotype description and diagnostic characters of the species. The sizes of both the adult female (61.5 mm SVL, Fig. 2a) and the juvenile (28.8 mm SVL, Fig. 2b) are within ranges. In both specimens head and dorsum are strongly tuberculated with prominent clusters and some short folds, ventral skin is finely wrinkled, corresponding with diagnostic characters. In the adult female tympanum length is 57% of the length of the eye, exceeding the described range (43–53%); in the juvenile, tympanum length (53% of the length of the eye) is within the reported range (53–66%). Both specimens present subacuminate snout in dorsal view and rounded in profile, with a concave loreal region (strongly marked in the juvenile), corresponding with diagnosis. Upper eyelid lengths

are 135% and 128% of the interorbital distance, in the female and juvenile specimen, respectively; both are within the ranges (129–149% in adult females and 100–183% in subadults). The adult female's vomerines are larger than the choanae with the edge extending to the level of the median edge of the choanae; in the juvenile, the vomerine denticles have the same size as the choanae, corresponding with diagnosis. Both specimens have the first finger slightly longer than the second, with well-developed pads and discs, the same size of choanae. Fingers III and IV have discs that are wider than longer. In the adult female, the toe pad on finger III is 49% the length of the tympanum, and thus out of the range (62–83%); in the juvenile the value for this character is 58%, which is within the range (50–67%). We did not observe lateral keels on the fingers on either specimen. The adult female has no ulnar tubercle on the forearm, corresponding with diagnosis; but the juvenile has a small ulnar tubercle, contrasting with diagnosis. In both specimens, the forearm is covered with well-marked tubercles. We counted 12 tubercles on the heel of the adult female and 10 small and not well developed in the juvenile, which is within the range of diagnosis (10–30). Corresponding with the species' diagnosis and

holotype description, neither specimen has a linear series of tubercles or a fold along the outer edge of the tarsus, but both have a well developed tarsal fold (more distinguishable in the female). Also corresponding with diagnosis, 2 metatarsal tubercles are present in both specimens, with the inner tubercle oval and larger than the outer tubercle. Both specimens have toes with basal webbing corresponding with diagnosis. Discs on the female's toes III and IV are 83% and 81%, respectively, the size discs on the fingers, exceeding the reported range (70–80%). In the juvenile both fingers are within range (toe III: 73% and toe IV: 70%). In life, the dorsum and head color of the adult female were yellowish brown, as the diagnostic coloration. However, the color of the mottling pattern is not black, but dark-brown (Fig. 2a). The juvenile presented olive-brown color (as the diagnosis), and the mottling pattern had black, dark-brown, and red spots (Fig. 2b). The female's tibia, forearm and upper lips were dark-brown and not black (as diagnosed); the juvenile presented the same coloration pattern as its dorsum and head. In the adult female, the interorbital bar at the level of the anterior portion of the eyelids was pale yellow and not yellow-brown (as diagnosed); in the juvenile this bar was covered by red dots (Fig. 2b). The adult female's venter and thighs were not mostly purplish gray (as in the holotype and diagnosis), but rather whitish with a few purplish gray spots and irregular small black melanophores; in the juvenile the venter was purplish gray with several white dots and few black melanophores (corresponding with diagnosis). Adult female's throat did not have a high concentration of black melanophores, but are higher than in venter; the juvenile presented the same pattern as the venter. Both specimens had upper and lower jaw pattern corresponding to holotype description and diagnosis.

Three other species of the *rugulosus* group inhabit the Mayan forest: *Craugastor sandersoni*, *C. sabrinus* and *C. palenque* (Campbell, 1998; Lee, 2000). *C. sandersoni* differs in the shape of the cantus rostralis, which is moderately sharp (in *C. psephosypharus* it is rounded); toe webbing is extensive (in *C. psephosypharus* it is basal); the tarsal fold is flaplike (in *C. psephosypharus* it is strong); toe margins have fringes (in *C. psephosypharus* they have keels); ventral color in life is whitish or yellowish (in *C. psephosypharus* it is brown, purple or grayish, Campbell & Savage 2000). The other 2 species, *C. palenque* and *C. sabrinus*, differ in their size (*C. psephosypharus* being smaller); the texture of the dorsum is smooth to granulate (*C. psephosypharus* is strongly tuberculated); the cantus rostralis is moderately sharp (in *C. psephosypharus* it is rounded); toe webbing is moderate (in *C. psephosypharus* it is basal, Campbell & Savage 2000). Also, these 3 species, as most of the members of the *rugulosus* group, are associated with riparian habitats, while *C. psephosypharus* has been recorded far from streams (Campbell, 1998; Meyer & Foster, 1996).

Craugastor psephosypharus has been previously reported for 18 locations in the Maya Forest (13 in Guatemala and 5 in Belize; Figure 1; Campbell et al., 1994). More specifically, this species has been found in north-central Guatemala (El Petén and Sierra Chinajá), southeastern Guatemala (Sierra Las Minas, Sierra Santa Cruz, Montañas del Mico, and Sierra Merendón),



Figure 3. Photographs showing the habitat (a) where *Craugastor psephosypharus* individuals were found, and the interior of a karst cavity (b), where juvenile specimen was captured in Lacandona region, municipality of Marqués de Comillas, Chiapas, México. Photos by Omar Hernández Ordóñez.

and southern Belize (Mayan mountains). Our specimens represent the first record of the species for the Lacandona region, the Montes Azules Biosphere Reserve, the state of Chiapas, and Mexico. This record extends the former distribution of the Limestone Rainfrog 75 km west from the nearest record in north-central Guatemala (Sierra Chinajá) near the border with Mexico (Fig. 3).

Craugastor psephosypharus is listed as ‘Vulnerable’ in the IUCN red list (Lee, Walker, & Acevedo, 2004). In Belize it is listed as ‘Data Deficient’ (Meerman, 2005) and in Guatemala it was assigned to category ‘3’, i.e. “species that although not currently threatened with extinction may become so unless their use is not regulated” (Conanp, 2009). Also, based on Wilson, Johnson, and Mata-Silva (2013) the Environmental Vulnerability Score (EVS) for this species is 15, which represents high vulnerability.

Although *Craugastor psephosypharus* is not endemic to Mexico, we believe that this species is rare and has a very limited distribution within the country. The species is endemic to the Maya Forest of Mesoamerica. According to our environmental survey, the species requires specific habitat conditions, in particular, undisturbed tropical moist forest growing on karstic substrate. The main threat to *C. psephosypharus* is habitat loss and habitat degradation caused by human activities (Lee

et al., 2004). Deforestation rates in some parts of the Lacandona region are high (Couturier, Núñez, & Kolb, 2012), and it is still unknown whether or not the species is widely distributed within the Montes Azules Biosphere Reserve. We believe that in Mexico the species should be categorized as “subject to special protection” in the NOM-059.

The first record of *Craugastor psephosypharus* increases to 36 the number of amphibians in the Lacandona region based on Hernández-Ordóñez et al. (2015) and increases to 108 the number of amphibian species for Chiapas (Johnson, Mata-Silva, García-Padilla, & Wilson, 2015). Prior to our report 377 amphibian species were known for the Mexican territory (González-Hernández, Hernández-Ordóñez, Cervantes-López, & Reynoso, 2014); our report increases this number to 378.

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