ANARTIA

Publicación del Museo de Biología de la Universidad del Zulia
ISSN 1315-642X (impresa) / ISSN 2665-0347 (digital)

DOI: 10.5281/zenodo.7951625 / ***Anartia, 35 (diciembre 2022): 33-38***

Extension of the distribution of *Cochranella granulosa* (Taylor, 1949) in Colombia and Ecuador

Ampliación de la distribución de *Cochranella granulosa* (Taylor, 1949) en Colombia y Ecuador

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(Recibido: 15-12-2022 / Aceptado: 30-12-2022 / En línea: 19-05-2023)

Cochranella granulosa was described by Taylor (1949) from "Los Diamantes, one mile south of Guápiles, Costa Rica", on the Caribbean versant of the Talamanca range of Central America. The species is well distributed from southern Honduras throughout scattered localities in Nicaragua, and on both versants of Costa Rica towards Panama (Köhler 2010). Recently the species has been reported from a single locality in Colombia, very close to the Panamanian border (Díaz-Ricaurte & Guevara-Molina 2020). From there, there is an apparent hiatus until Ecuador, where the species was reported also recently from a single locality in Jardín de los Sueños, Cotopaxi Province, the southernmost locality recorded for the species (Culebras *et al.* 2020). Guayasamín *et al.* (2020) reported a further locality from Ecuador, 4 km West of Río Durango, 232 m in elevation, in Esmeraldas Province (Museo de Zoología, Pontificia Universidad Católica del Ecuador, Quito, Ecuador: QCAZ 32769). Herein we report a second locality based on photographic evidence from Colombia, plus two other photographic registers from iNaturalist, and a third individual of the species for Ecuador. In addition, photographic documentation of an uncollected individual offers us the possibility to build a distribution map of the species and comment upon phenotypic variation.

NEW RECORDS

Colombia: the new Colombian record is from Jurubira, Nuquí, Chocó Department (5.851196N, -77.278915W; 6 m elev). It was observed and photographed (University of Texas at Arlington Digital Collection UTADC 9853; Fig. 1A) by FRS on December 14, 2022, at around 20.00h under drizzling rain. This and other individuals were calling at around 2-3 meters over ground along a little creek close to the village of Jurubira. This is the second report of the species in Colombia after the one recorded close to the Panamanian border (Díaz-Ricaurte & Guevara-Molina 2020), filling a gap of more than 1,038 km from the previously known Colombian locality to the southernmost locality known in Ecuador. The new Colombian locality is 273 km South-southwest from previous records (Díaz-Ricaurte & Guevara-Molina 2020) and 550 km North-northwest from the Ecuadorian northernmost locality (Guayasamín *et al.* 2020). Two recent records in iNaturalist, clearly correspond to this species. The first is an observation by Alejandro Jaramillo at Acandí, Capurgana, Chocó Department; https://www.gbif.org/occurrence/3925025463) on April 13, 2022 (8.370089N, -77.127546W). A photo of the individual is online:

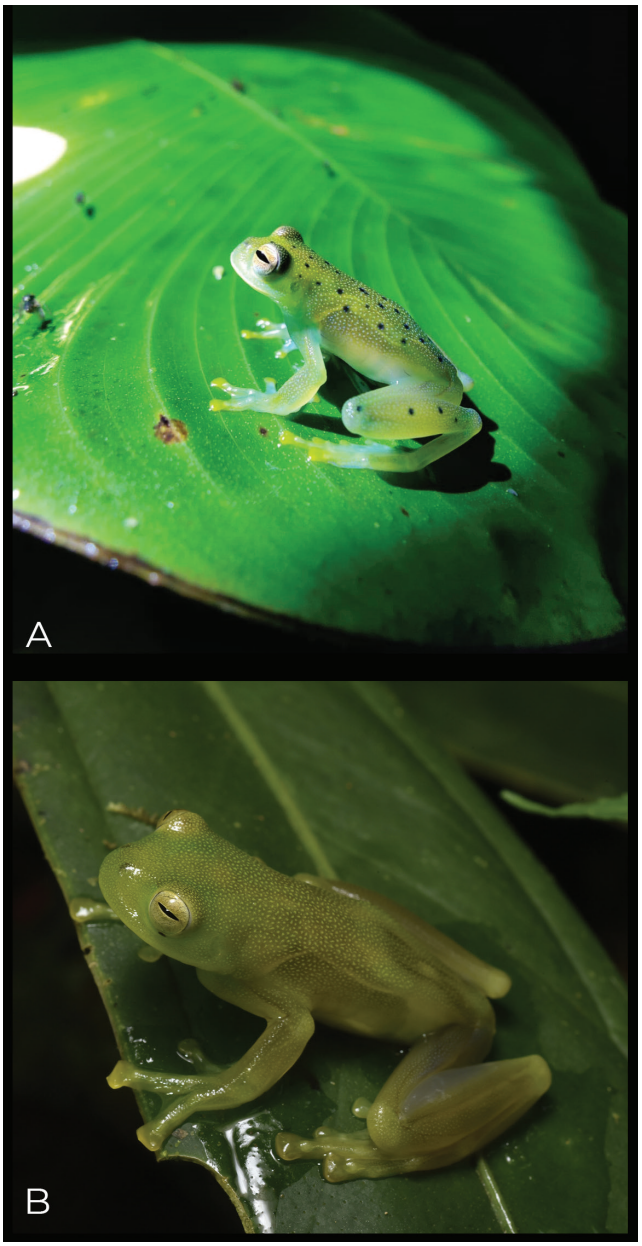

Figure 1. **A**. *Cochranella granulosa*, male from Jurubira, Nuquí, Chocó Department, Colombia (UTADC 9853). **B**. female from Reserva Itapoa, Parroquia Telembí, Esmeraldas, Ecuador. Photographs: Felipe Reyes Serna (A), César L. Barrio-Amorós (B).

https://www.inaturalist.org/photos/192984802. Another observation in the same platform by Marco Rada occurred nearby, at the foothills of Cerro Tacarcuna, comunidad Eyakera, corregimiento de Bilbao, municipio de Unguia, Chocó, 200 m (https://colombia.inaturalist.org/observations/39731) observed on November 18, 2011 (8.190422N, -77.194061W).

Ecuador: Our new locality is the third report from Ecuador, from Reserva Itapoa, Parroquia Telembí, Cantón Eloy Alfaro (0.511944N, -79.134206W; 432 m asl), Esmeraldas Province (UTADC 9742; Figs. 1B, 2), 78 km SW from the closest report at Río Durango (Guayasamín *et al.* 2020), on December 2, 2021. The female found at night (around 20.00h), was on a vertical trunk of a little tree on a creek shore, immobile, around 2 m above ground.

DISTRIBUTION

We report *Cochranella granulosa* as present from Honduras to NW Ecuador in a patchy distribution (Fig. 3). In Honduras it is present in the SE (Departments Olancho and Gracias a Dios) in an isolated patch contiguous to Nicaragua at Jinotega and Matagalpa (McCranie & Wilson 2002, Köhler 2011, HerpetoNica 2015, Fig. 4A, B), where it disappears almost entirely with some recent sightings at Chontales (Sunyer *et al*. 2014). In Costa Rica, this species is widely distributed across the country, except in the highlands (above 1,500 m) and the dry forest of Guanacaste (Savage 2002), present at both versants, the Atlantic (Fig. 4C) and the Pacific (Fig. 4D). In Panama, it is also well distributed along the country except on the highlands above 1,500 m and the arid Península de Azuero (Köhler 2011) (Fig. 4E, F). In Colombia (Díaz-Ricaurte & Guevara-Molina 2020), including our three new reports of this note, there are only four localities in total, three adjacent to the Panamanian border, and one in the central Chocoan rainforest at Nuquí. From there to the closest reported locality in Ecuador there are 553 km without any reports so far. In Ecuador, the three localities lie in the remnant Chocoan rainforest in the NW of the country (Culebras *et al.* 2020, Guayasamín *et al*. 2020, this work).

PHENOTYPES

At first glance, the coloration and pattern of the Central American and Colombian populations diverge from the two only photographed animals from Ecuador, MZUTI 4811 (Museo de Zoología, Universidad Tecnológica Indoamérica, Quito, Ecuador; Culebras *et al.* 2020) and the one reported herein (UTADC 9742; Fig. 1B, 2). Animals from Honduras to the Colombian Chocó look very similar in pattern and size, being small to medium, males 22.5-29 mm, females 29-32 mm. Dorsal surfaces are dark to pale green, and some individuals may have a bluish tonality on the posterior half of the body, including the hind limbs (Fig. 5A). The granules that cover the total surface of the body bear pale blue (Fig. 4A, B) to pale yellow (Fig. 4E) chromatophores; many or few dark blue dorsal spots are often present, although in some populations these can be randomly absent, both on males and fe-

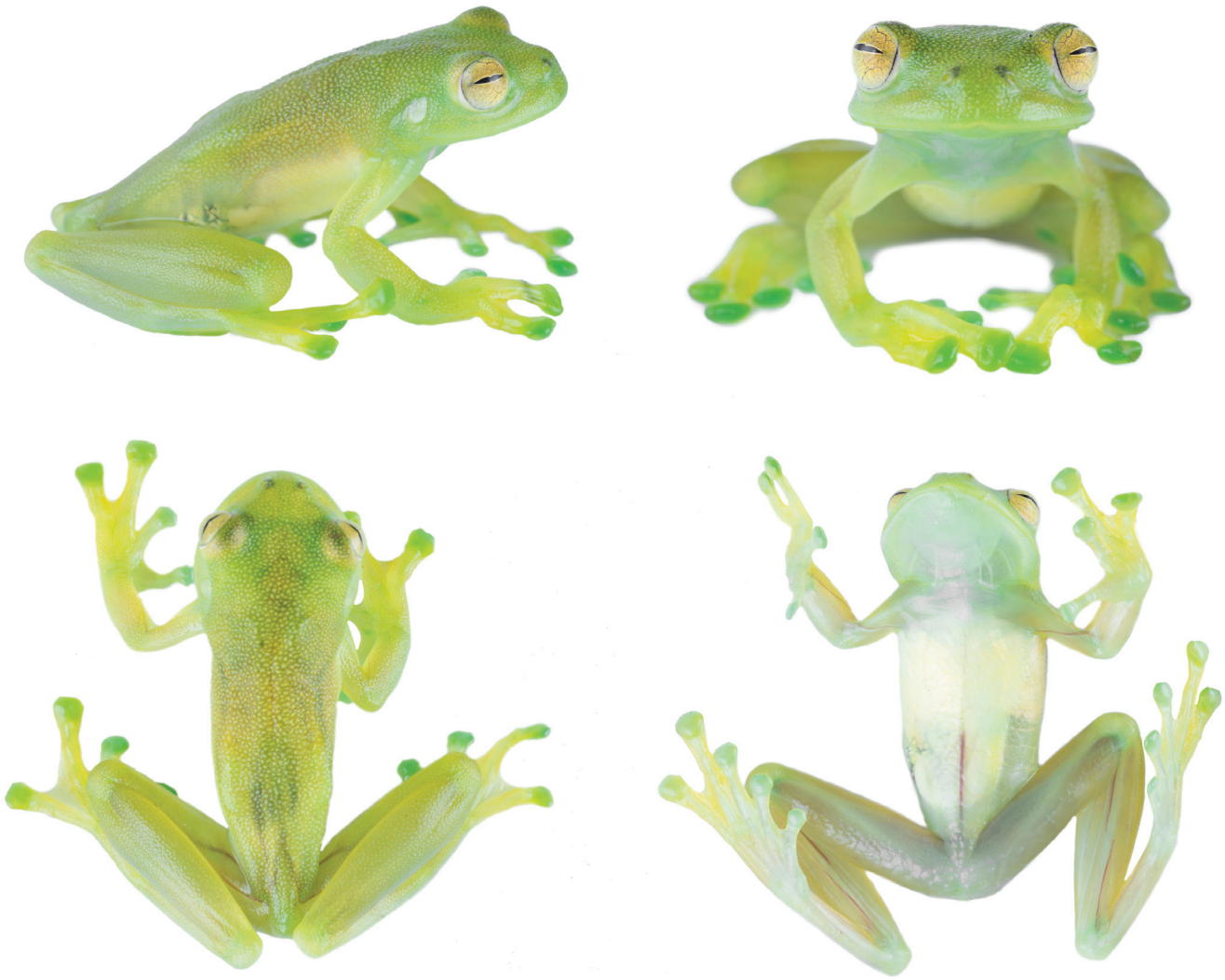

Figure 2. *Cochranella granulosa*. Same individual of UTADC 9853, showing lateral (top left), frontal (right left), dorsal (bottom left) and ventral (bottom right) views. Photographs: A. M. Forero-Cano.

males (Fig. 4D, 5B). Color of the disk fingers and toes can be bluish green to yellow, while irises can be gray, brown, orange or yellow.

On the other hand, a single Ecuadorian female of *Cochranella granulosa* was bigger than any other female seen so far in Costa Rica or Panama, measuring 35 mm. The range size reported by Savage (2002) and Leenders (2016) for Costa Rica is smaller, with females reaching up to 32 mm. Both male (MZUTI-4811) and female (UTADC 9742) are lime green without any trace of blue, lacking any dorsal spotting, bearing yellowish granules, yellow iris and much wider disks than Central American and Colombian populations. Despite the very limited sample studied, at first glance, the foot webbing is more extensive in the Ecuadorian individuals (Fig. 2 bottom right, Guayasamín *et al.* 2020: fig 67 bottom right).

DISCUSSION

The distribution of *Cochranella granulosa* is not well understood yet. The species is missing from most of Honduras and Nicaragua, abundant in Costa Rica and Panama, but very scarce in Colombia and Ecuador, west of the Andes. This could probably be a resulting effect of the difficulty of direct sightings because it is mostly a canopy species. However, the species has a unique call pattern that makes it easy to distinguish from other frogs. Most reports from Costa Rica come from audible transects.

The external differences shown by the northern (Central American and Colombian) and southern (Ecuadorian) populations possibly suggest a genetic differentiation that is further supported by the fact that both probably separated 4 M years ago (Guayasamín *et al.* 2020). Never-

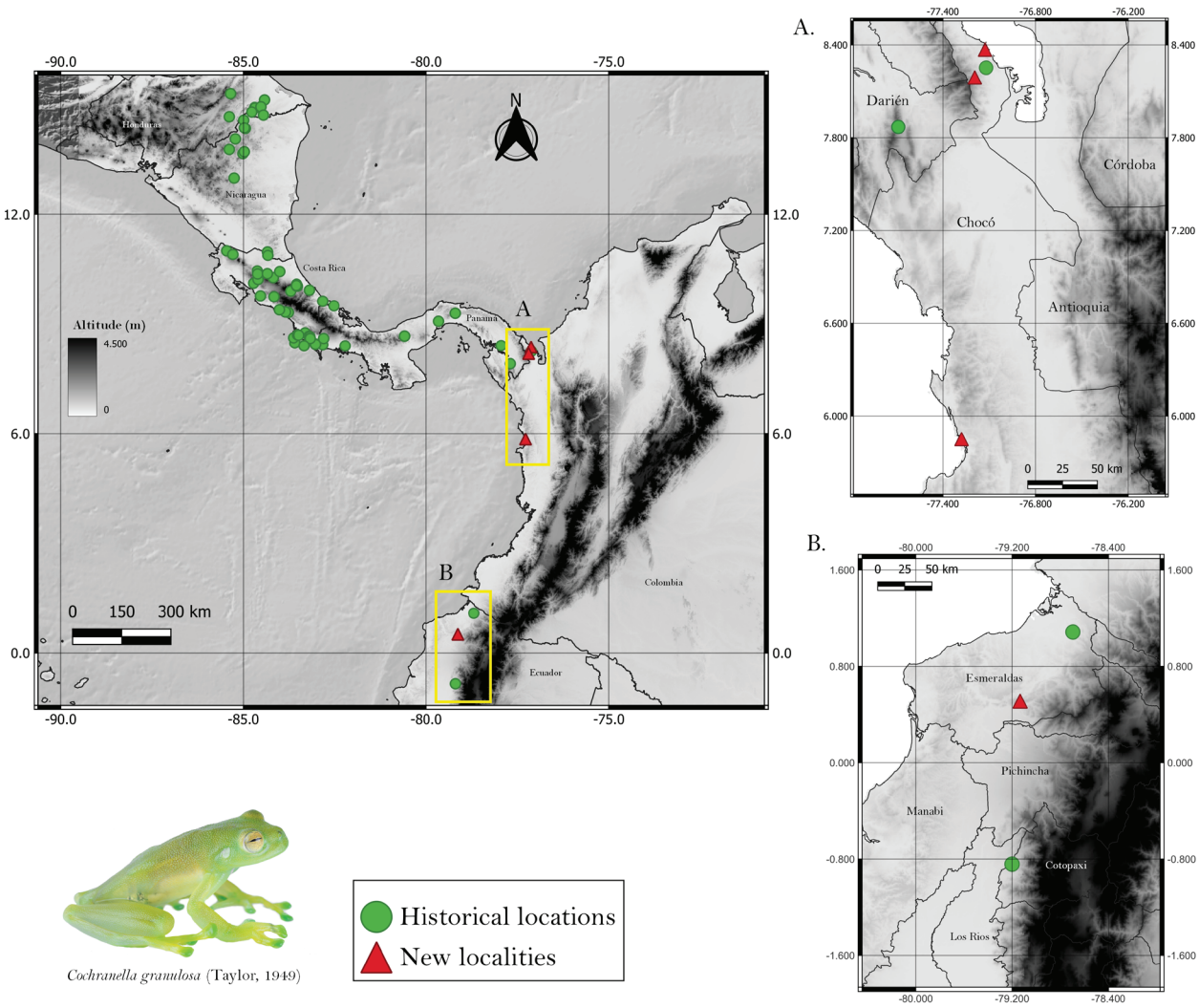

Figure 3. Distribution map of *Cochranella granulosa* in Northwestern South America and Central America. Map generated by A. M. Forero-Cano with QGIS 3.22.6 using Catalogue numbers from UCR. Literature and novel records by A. Batista and M. Ponce.

theless, the size of the sample and the lack of DNA studies do not allow at this time to determine whether speciation took place.

Nevertheless, it is important to highlight that the Mira River Valley, located between Colombia and Ecuador, has been identified by several authors as an important biogeographic barrier for small vertebrates, which facilitates the isolation and diversification of lineages (Arteaga *et al*. 2016, Yánez-Muñoz *et al.* 2018, 2021, Brito *et al*. 2020, Reyes-Puig *et al*. 2020). According to Yánez-Muñoz *et al.* (2021), the biodiversity patterns and species composition from north of the Mira River are influenced by mountain ridges of Cerro Golondrinas, an ancient geological formation between the San Juan and Mira rivers, which acts as an important biogeographical barrier. This mountainous barrier as well as the deep canyon formed by the Mira river, promoted conditions for the isolation and speciation of species with low vagility in southwestern Colombia and northwestern Ecuador. Although much remains to be studied, we could hypothesize that the southern morphotype of *Cochranella granulosa* could only be found in the southern region of the Mira river, between Colombia and Ecuador. A larger survey of this species on that region could give a better understanding of how the geography might have influenced biological processes.

ACKNOWLEDGEMENTS

We thank several friends and colleagues who facilitated data and/or photographs to illustrate this article. Gerardo Chaves "Cachí" shared data from Universidad de Costa

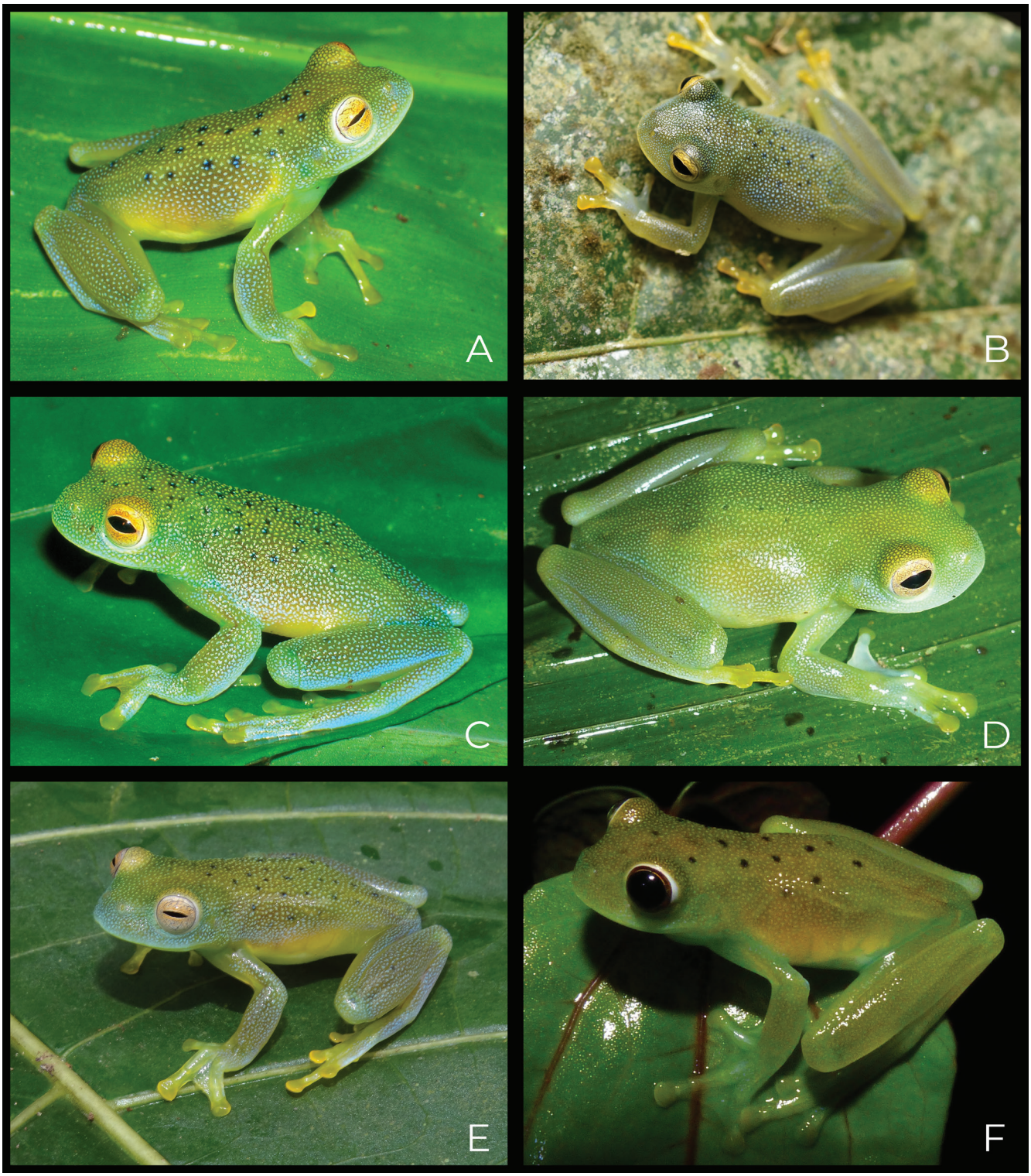

Figure 4. *Cochranella granulosa* from different localities. **A**. male from Bosawas, Jinotega, Nicaragua; **B**. female from Cerro Musún, Matagalpa, Nicaragua; **C**. male from Matina, Limón, Costa Rica; **D**. male from Ojochal, Puntarenas, Costa Rica; **E**. female from Changuinola, Bocas del Toro, Panama; **F**. male from Changuinola, Bocas del Toro, Panama. Photographs: Javier Sunyer (A, B) César L. Barrio-Amorós (C, D), Marcos Ponce (E, F).

Figure 5. *Cochranella granulosa* from different localities in Panama. **A**. an unsexed adult from Parque Nacional Darién, Darién. **B**. an amplectant pair from Parque Nacional Soberanía, Gamboa. Photographs: Abel Batista.

Rica; Josué Ramos Gadamez shared personal data of the species in Honduras. Jose Vieira offered data of the species in Colombia and Ecuador. Javier Sunyer, Abel Batista and Marcos Ponce shared their photos of the species from Nicaragua and Panama.

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