

RECENT HERPETOLOGICAL RECORDS OF SELDOM-OBSERVED SPECIES FROM THE CORDILLERA DE TALAMANCA, COSTA RICA

REGISTROS HERPETOLOGICOS RECIENTES DE ESPECIES POCO OBSERVADAS DE LA CORDILLERA DE TALAMANCA, COSTA RICA

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Costa Rica is home to a diverse herpetofauna, currently boasting 215 species of amphibians and 268 species of reptiles (Zumbado-Ulate et al., 2019, www.reptile-database.reptarium.cz/). Particularly in recent decades, the country's herpetofauna has been subject to considerable research attention (Sasa et al., 2010; Zumbado-Ulate et al., 2019). Part of this attention is related to extensive amphibian declines that have been observed during the past decades all over the country as well as in the rest of Central America (e.g., Whitfield et al., 2016). These declines likely resulted as a consequence of multiple anthropogenic, environmental, and pathogen-related threats and their mutual interactions (Lips et al., 2005; Pounds et al., 2006). Namely, these include habitat destruction, pollution and fragmentation, climate change, introduction of invasive species, and emerging diseases. One particularly widespread and detrimental cause of amphibian declines is the presence of the fungal pathogen *Batrachochytrium dendrobatidis* (*Bd*). Epizootics linked to *Bd* peaked during the 1980s and 1990s (e.g., Whitfield et al., 2016). Currently, *Bd* occurs widely throughout the country in an endemic state that continues to pose risk to amphibians (Zumbado-Ulate et al., 2019, 2022).

However, various dramatically-declined species have recently shown signs of recovery, while previously 'lost' amphibian taxa are being rediscovered (Abarca et al., 2010; González-Maya et al., 2013; Chaves et al., 2014; Jimenez & Alvarado 2017; Zumbado-Ulate et al., 2019, 2022). While some of these findings may indeed reflect shifts in disease dynamics, it is important to consider that

these records may also represent observations of rarely recorded species, and are now only being recorded due to an increase in survey efforts, including expeditions to previously unexplored areas (e.g., Boza-Oviedo et al., 2012; Salazar-Zuniga et al., 2019). One of the least-explored areas in Costa Rica is the Cordillera de Talamanca. A result of the tectonic uplift, this mountain range extends from southwest of the capital San José to beyond the Panamanian border (Marshall, 2007), rises up to an elevation of 3819 m asl, and is covered by the largest remaining natural forest in Central America. Due to the longstanding isolation of ancestral populations in this region, the Cordillera de Talamanca is the area in Costa Rica with the highest degree of endemism (Sasa et al., 2010).

Three informal herpetological surveys into the Cordillera de Talamanca as part of an ecotouristic visit to Costa Rica were conducted during July-August 2021 (Fig. 1). Visual records of reptiles and amphibians were gathered at three visited areas, comprising of the Valle del Silencio (Fig. 2A), the headwaters of the Río Lori (Cerro Arbolado, Fig. 2B, C) in Parque Internacional La Amistad, and the highlands of the Parque Nacional Tapantí - Macizo de la Muerte (Fig. 2D). All records were independently verified by experts, and photo vouchers were deposited in the University of Texas at Arlington Collection of Vertebrates Digital Collection (catalog # UTADC 9763 - 9804). To assess whether our records represent distribution extensions or rediscoveries, we consulted online repositories of museum collections (MVZ Herp Collection; LACM Vertebrate Collection; SDNHM Herpetology

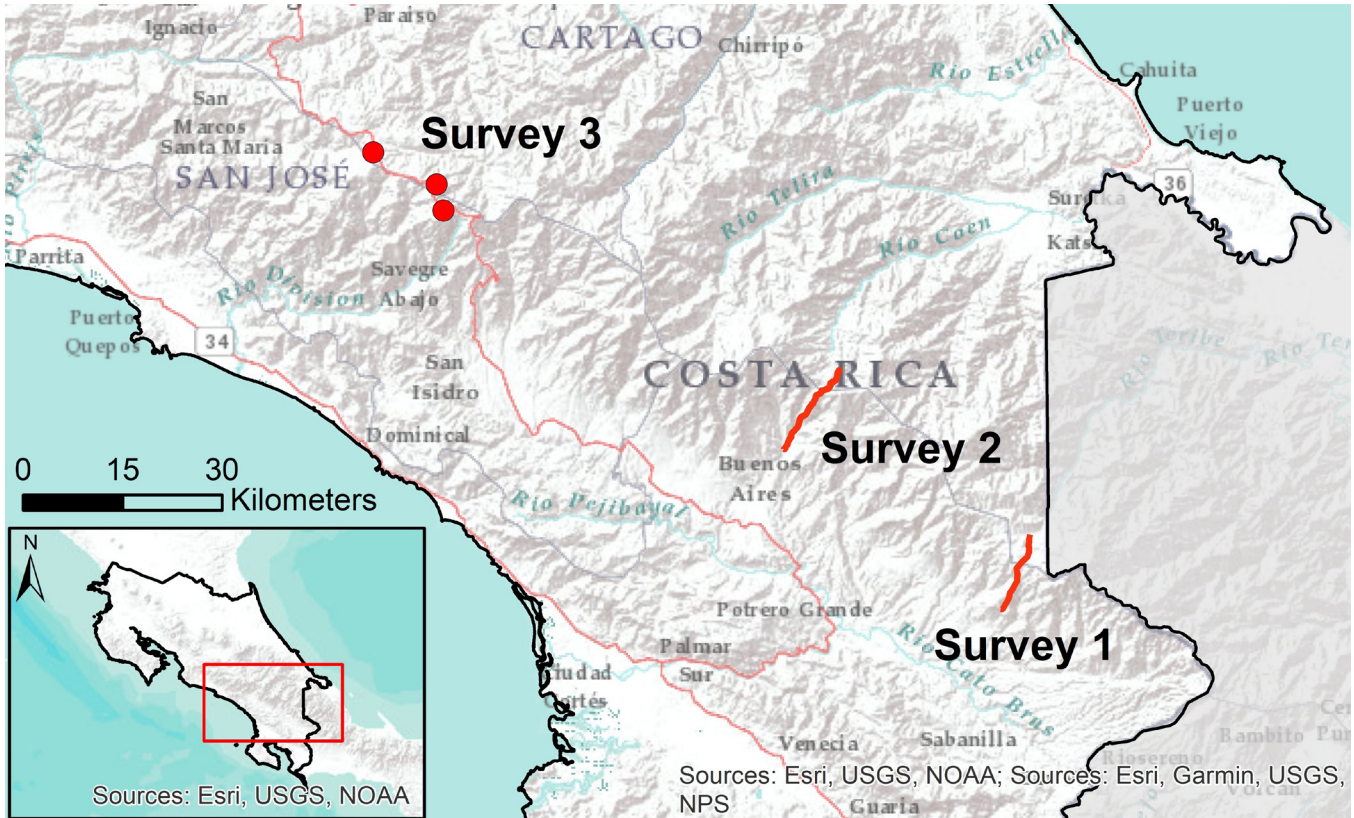


Figura 1. Descripción general de los sitios estudiados. /Figure 1. Overview of prospected sites.

Collection; NHNH Extant Specimen Records; KUBI Herpetology Collection; Museum of Comparative Zoology, Harvard; ZFMK Herpetology Collection; UTA Amphibians; University of Michigan Museum of Zoology; LSUMZ Herps Collection) and citizen science repositories (inaturalist.com; observation.org) that provided an overview of existing and recent species observations. Thus, below, we elaborate on the records of several species of amphibians and reptiles that constitute distribution extensions, relevant natural history observations, or rediscoveries of species which have not been recorded for multiple decades. A full list of our herpetofauna records from the aforementioned three areas is available upon request.

***Bolitoglossa bramei* / *Bolitoglossa gomezi* Wake, Savage & Hanken, 2007.** Provincia de Limón; Cantón de Talamanca; Distrito Telire; Parque Internacional La Amistad, along a trail descending from the continental divide, just after crossing the Río Lori (9.3561 N, 83.2195 W, 1,887 m a.s.l.), recorded on 8 August 2021 around 19:45 h (Fig. 3A). The individual was identified as a member of the *B. bramei* – *B. gomezi* species group based on

moderately webbed hands and feet, truncate toe tips with well-developed subterminal pads, brownish-red dorsal colour which becomes lighter posteriorly along the trunk, and grey-black venter and flanks with light cream flecks (Wake et al., 2007). Photo voucher UTADC 9766 (University of Texas at Arlington Collection of Vertebrates Digital Collection, as *B. cf. gomezi*); ID verified by Eduardo Boza-Oviedo and Jonathan Campbell. This is the second record for the *B. bramei* – *B. gomezi* species group from Provincia de Limón, extending the distribution 21 km west in a straight line from the closest known locality for *B. bramei* at Cerro Dudu, and 25 km northwest in a straight line from the closest known locality for *B. gomezi* on the continental divide at Cerro Kasir (Boza-Oviedo et al., 2012). *Bolitoglossa bramei* and *B. gomezi* cannot be distinguished from each other based on colour pattern alone (Wake et al., 2007). Recent phylogenetic work revealed that two lineages of this group occur seemingly intermittently in the area visited by us (i.e. along the Cordillera de Talamanca between Ujarrás and the Panamanian border); one of these corresponds to *B. bramei*, while the other was attributed to *B. gomezi*, even though the authors acknowledge that the latter

ID is tentative given that genetic material from the type locality of *B. gomezi* near San Vito is not available (Boza-Oviedo et al., 2012). Whether the second lineage indeed comprises *B. gomezi*, or represents an undescribed lineage from the same species group, remains unclear. Syntopic species included *Bolitoglossa splendida* Boza-Oviedo, Rovito, Chaves, García-Rodríguez, Artavia, Bolaños & Wake, 2012 (see also below), *Craugastor aenigmaticus* Arias, Chaves & Parra-Olea, 2018, and *Pristimantis caryophyllaceus* (Barbour, 1928).

***Bolitoglossa compacta* Wake, Brame & Duellman, 1973.** Provincia de Limón; Cantón de Talamanca; Distrito Telire; Parque Internacional de la Amistad, near a cabin in the Valle del Silencio at multiple locations along a trail leading to the Rio Terbí (9.1114 N, 82.9621 W, 2467 m a.s.l.), recorded on 1 August 2021 between 19:00 h and 22:00 h (Figs. 4B, C). Identified as *B. compacta* based on colour pattern, consisting of dark grey to

black dorsal and ventral colouration with bright red patches on the upper dorsum, tail, and head. Photo voucher UTADC 9767-9770 (University of Texas at Arlington Collection of Vertebrates Digital Collection); ID verified by Jonathan Campbell. Our records fall within the known distribution and elevation range, but are noteworthy because all observed *B. compacta* displayed clearly visible, pale-coloured postiliac glands (Fig. 4C; see also Wake et al., 1973) which might represent a previously unnoticed diagnostic character for this species. Two consecutive night surveys resulted in records of four individuals of this species, of which two were found ~1.50 m high up on moss covered tree branches, one was climbing ~2.50 m high in vegetation, and one was walking on the forest floor. One of the recorded individuals (an adult male), recognizable by its colour pattern, had been photographed before during an excursion led by a local nature guide in November 2020 (Spizaetus Tours, pers. com.). The salamander was recorded ~70 m from where it was initially found

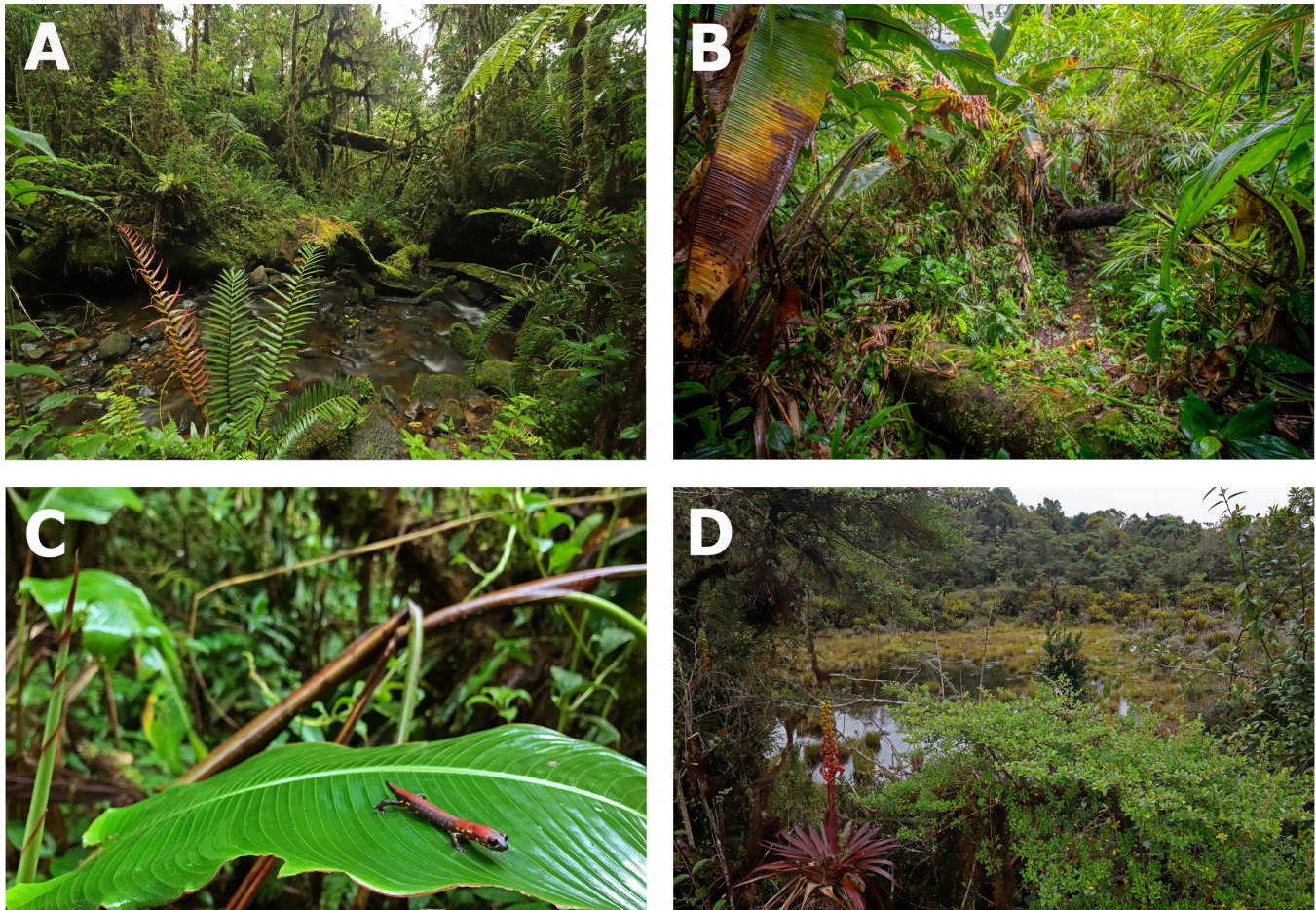


Figura 2. Ejemplo de hábitats en (A) Valle del Silencio (muestreo 1), (B) y (C) Cerro Arbolado (muestreo 2), y (D) Macizo de la Muerte (muestreo 3).

Figure 2. Exemplary habitats in (A) Valle del Silencio (survey 1), (B) & (C) Cerro Arbolado (survey 2), and (D) Macizo de la Muerte (survey 3).

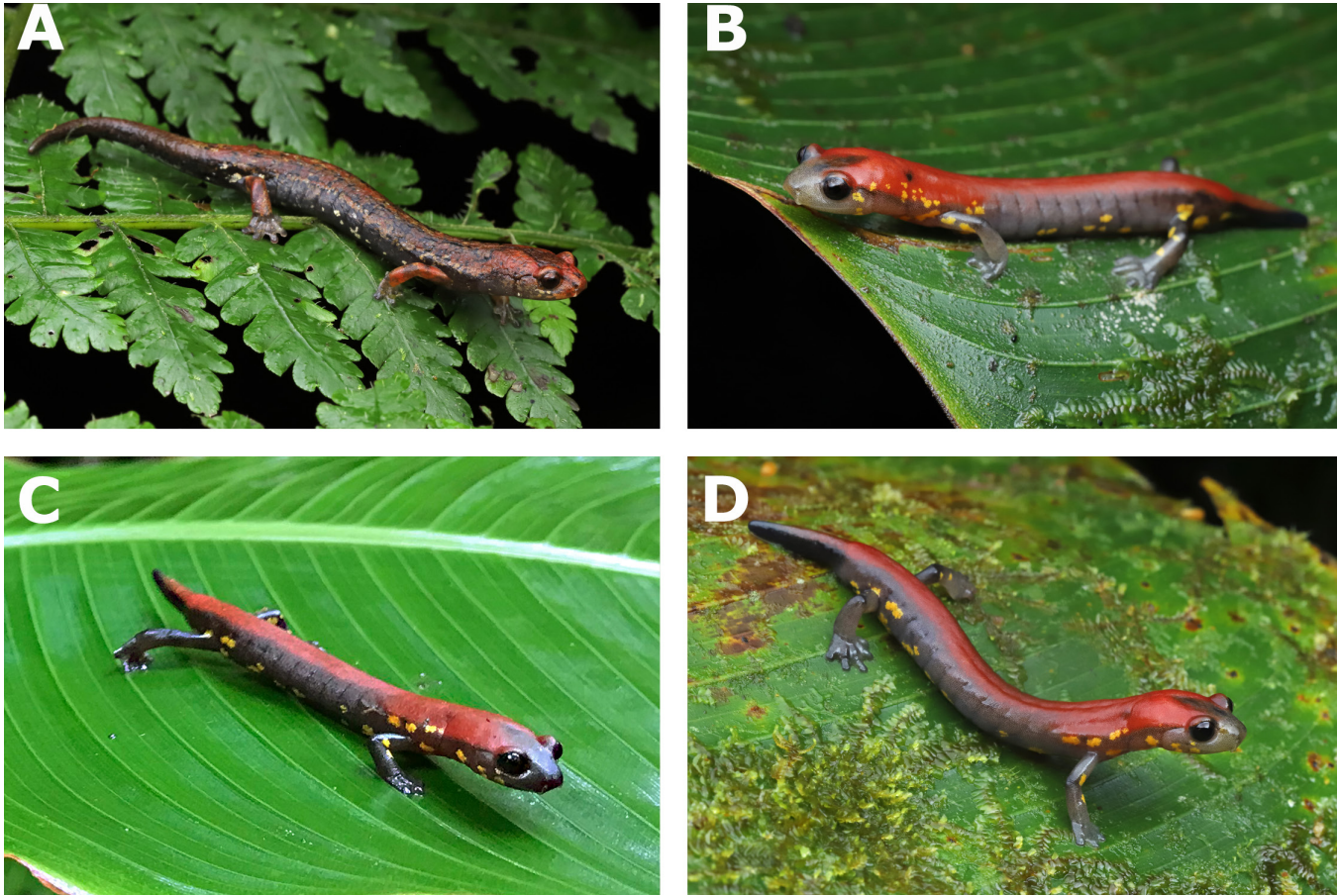


Figura 3. Registros destacados del Cerro Arbolado (área 2). (A) *Bolitoglossa bramei* / *Bolitoglossa gomezi*. (B) *Bolitoglossa splendida*, flanco izquierdo. (C) *Bolitoglossa splendida*, coloración diurna. (D) *Bolitoglossa splendida*, coloración nocturna.

Figure 3. Noteworthy records from the Cerro Arbolado (area 2). (A) *Bolitoglossa bramei* / *Bolitoglossa gomezi*. (B) *Bolitoglossa splendida*, left flank. (C) *Bolitoglossa splendida*, day-time colouration. (D) *Bolitoglossa splendida*, night-time colouration.

in 2020. Syntopic species included *Craugastor podiciferus* (Cope, 1875), *Diasporus ventrimaculatus* Chaves, García-Rodríguez, Mora & Leal, 2009 and *Isthmohyla pictipes* (Cope, 1875; see also below).

***Bolitoglossa sooyorum* Vial, 1963.** Provincia de Cartago; Cantón de El Guarco; Distrito San Isidro de El Guarco; in a small extension of Parque Nacional Tapantí - Macizo de la Muerte touching the Carretera Interamericana, wedged in between two isolates of Reserva Forestal Río Macho near Salsipuedes (9.6485 N, 83.8455 W, elevation 2,768 m a.s.l.) recorded on 10 August 2021 around 22:00 h (Fig. 5A). Identified as *B. sooyorum* based on long and slender limbs, moderately-webbed (3/4) hands and feet, distinctly-flattened rounded digits that extend beyond the webbing, and its dark lavender brown dorsal, limb, and feet colour, interspersed by profuse, minute, yellow cream flecks (Vial, 1963). Photo voucher UTADC 9777 (University of

Texas at Arlington Collection of Vertebrates Digital Collection); ID verified by Jonathan Campbell and Twan Leenders. Our observation comprised a single individual that was recorded sitting exposed in a large arboreal bromeliad at a height of ~1.60 m during light rain, in the direct vicinity of the type locality. To the best of our knowledge, *B. sooyorum* has not been formally recorded for decades (no records available via www.gbif.org after 1994). However, salamanders characterized by a similar colour pattern as the individual observed by us have in recent years been increasingly recorded in the vicinity of the *B. sooyorum* type locality, often by citizen scientists. These salamanders are generally identified as *Bolitoglossa cerroensis* (Taylor, 1952) (see e.g., www.inaturalist.org, n = 7 observations since 2010). Yet, *B. cerroensis* was described as having a cream-coloured dorsum with brown stippling and longitudinal streaking, a dark upper tail, dark upper eyelids, and ventral cream mottling. This

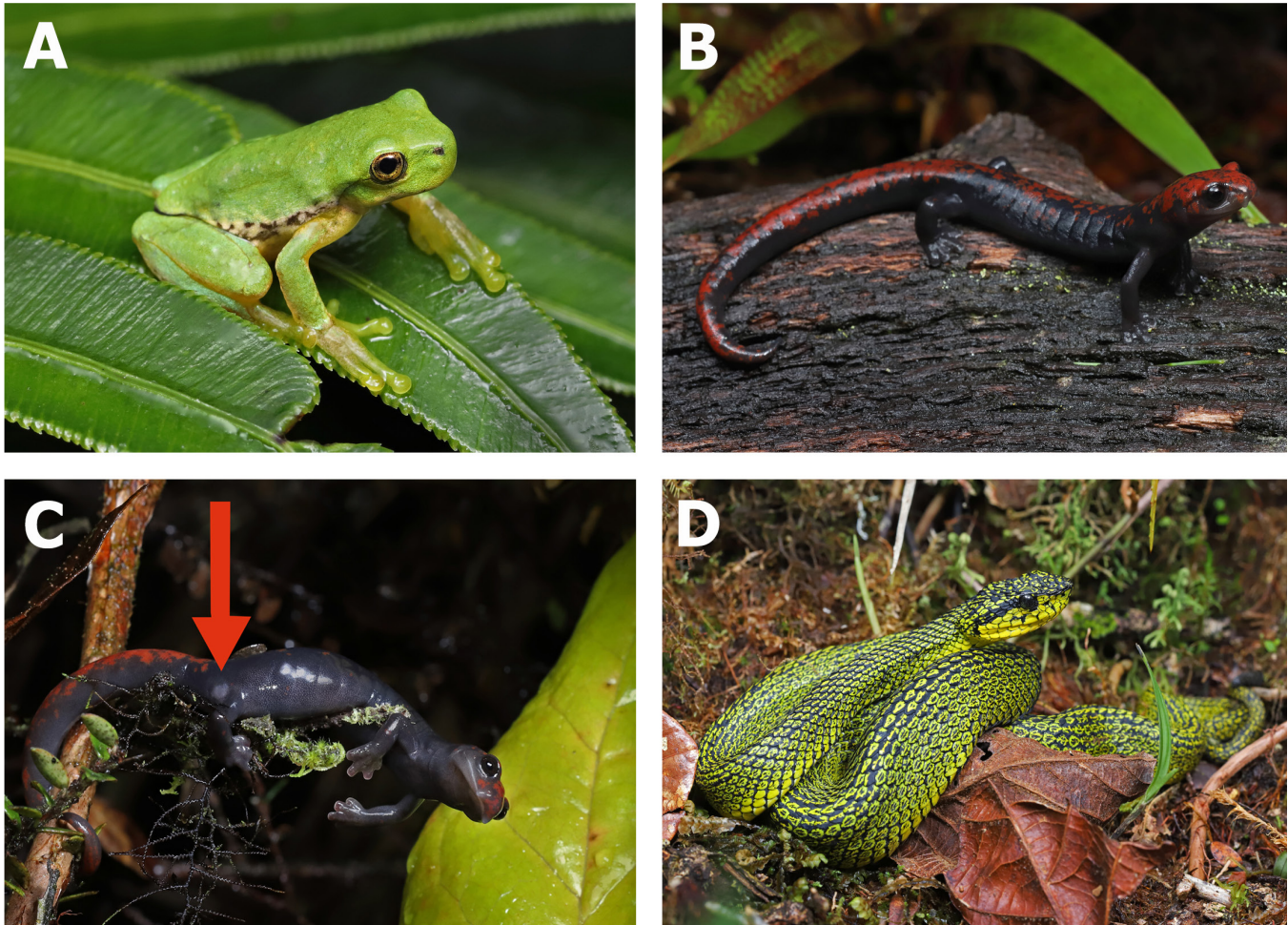


Figura 4. Registros destacados del Valle del Silencio (área 1). (A) *Isthmohyla pictipes*, metamorfo. (B) *Bolitoglossa compacta*, macho. (C) *Bolitoglossa compacta*, fotografiada tal como se encuentra. Tenga en cuenta la glándula postiliaca claramente visible (indicada por la flecha roja). (D) *Bothriechis nigroviridis*, hembra, fotografiada tal como se encuentra.

Figure 4. Noteworthy records from the Valle del Silencio (area 1). (A) *Isthmohyla pictipes*, metamorph. (B) *Bolitoglossa compacta*, male. (C) *Bolitoglossa compacta*, photographed as found. Note the clearly visible postiliac gland (indicated by the red arrow). (D) *Bothriechis nigroviridis*, female, photographed as found.

description as well as the drawings of *B. cerroensis* in Taylor (1952), strikingly differ from salamanders observed in the vicinity of the *B. sooyorum* type locality. Instead, the salamanders from this area strongly match with the description of *B. sooyorum* by Vial (1963). Thus, we attribute the individual observed by us to that species. Moreover, we tentatively suggest that the observations made by citizen scientists might have been incorrectly assigned to *B. cerroensis*, while they actually constitute observations of *B. sooyorum*. Recent phylogenetic work confirms that *B. sooyorum* and *B. cerroensis* constitute separate evolutionary lineages, as opposed to being part of a single, morphologically variable species (e.g., Batista et al., 2014; Kubicki and Arias, 2016). A clear need hence exists for further research into salamander systematics along the Macizo de la Muerte, in order to shed light

on the occurrence and relationships of its various salamander species (García-París et al., 2000). Syntopic species included *Isthmohyla picadoi* (Dunn, 1937).

***Bolitoglossa splendida* Boza-Oviedo, Rovito, Chaves, García-Rodríguez, Artavia, Bolaños & Wake, 2012.** Provincia de Limón; Cantón de Talamanca; Distrito Telire; Parque Internacional La Amistad, along a trail descending from the continental divide, just after crossing the headwaters of the Río Lori (9.3561 N, 83.2195 W, 1,887 m a.s.l.), recorded on 8 August 2021 at 20:17 h (Fig. 3B, C, D). Identified as *B. splendida* based on colour pattern, consisting of a deep red dorsum and bright yellow flecks on the extremities, lower flanks, neck, and posterior jaw. Photo voucher UTADC 9778 (University of Texas

at Arlington Collection of Vertebrates Digital Collection); ID verified by Jonathan Campbell and Twan Leenders. This is the second record (and second individual) of *B. splendida*, roughly 1,050 m east in a straight line from the type locality, but north of the Río Lori. Like the holotype, the individual was female and

found in the evening on the upper side of a *Heliconia* sp. leaf, at a height of ~1.50 m above the surface. Like the holotype, the newly recorded individual was missing its tail. The individual displayed a notable difference between day time and night time colouration not described in the original description (Boza-



Figura 5. Registros destacados del Macizo de la Muerte (área 3). (A) *Bolitoglossa soayorum*. (B) *Bolitoglossa tica*.

Figure 5. Noteworthy records from the Macizo de la Muerte (area 3). (A) *Bolitoglossa soayorum*. (B) *Bolitoglossa tica*.

Oviedo et al., 2012); i.e. the colouration of the snout, flanks and extremities changed from a blackish colouration during day-time to a purplish-grey colouration during night-time (Fig. 3C, D). Syntopic species included *B. bramei* / *B. gomezi*, *C. aenigmaticus*, and *P. caryophyllaceus*.

***Bolitoglossa tica* García-París, Parra-Olea & Wake, 2008.** Provincia de San José; Cantón de Dota; Distrito Copey; along a road branching off the Carretera Interamericana just south of Salsipuedes (9.6458 N, 83.8474 W, elevation 2,765 m a.s.l.), recorded on 10 August 2021 between 19:00 h and 22:00 h (Fig. 5B). Six individuals were found crawling on mossy road banks. Identified as *B. tica* based on a combination of the following characteristics: particularly well-defined head, long and slender tail, reddish-brown dorsal colouration with a darker tail, and whitish flecks on the lower flanks and venter (García-París et al., 2008; Leenders, 2016). Not all individuals displayed whitish flecks. Photo voucher UTADC 9779-9781 (University of Texas at Arlington Collection of Vertebrates Digital Collection); ID verified by Jon Campbell and Twan Leenders. Our records extend the highly restricted distribution of this species about 6.3 km south in a straight line from the closest known locality near Tres de Junio along the Carretera Interamericana, and increases the elevation limit for *B. tica* from 2500 m to 2765 m (García-París et

al., 2008). Syntopic species included *Bolitoglossa pesrubra* (Taylor, 1952) and *I. picadoi*.

***Isthmohyla pictipes* (Cope, 1875).** Provincia de Limón; Cantón de Talamanca; Distrito Telire; Valle del Silencio, which is part of Parque Internacional de la Amistad, near a cabin along a trail leading to the Río Terbí (9.1119 N, -82.9614 W, 2,466 m a.s.l.), recorded on 2 August 2021 around 20:00 h (Fig. 4A). Identified as *I. pictipes* based on colour pattern, comprising a bright-green dorsum, and a whitish band with dark mottling separating the dorsum and venter, the latter being brightly yellow coloured. Photo voucher UTADC 9795 (University of Texas at Arlington Collection of Vertebrates Digital Collection); ID verified by Jonathan Campbell and Twan Leenders. This rare hylid is listed as Critically Endangered on The IUCN Red List of Threatened species as a result of drastic declines attributed to *B. dendrobatidis* (IUCN SSC Amphibian Specialist Group, 2020). A single metamorph was found on a leaf at ~1.20 m above the surface. The individual showed impaired locomotion activity reminiscent of *B. dendrobatidis* infection. Syntopic species included *B. compacta*, *C. podiciferus*, and *D. ventrimaculatus*. Chaves-Acuña et al. (2020) recently reviewed the (historical) distribution, paucity of recent records, and status of *I. pictipes*. Its distributional range stretches from the northern slopes of the Cordillera Central in Costa Rica

through the highlands of the Cordillera de Talamanca, where the type locality is located (“between Cerro Pat and the headwaters of the Río Lari, elev. 1,520–2,135 m”, Arias & Chaves, 2014) and reaches its southernmost limit in La Amistad International Park bordering Panama (Bolaños et al., 2008). While between the years of 1957 and 1979 more than 200 observational records were submitted to public collections, the last record was documented in the mid 90ies (Chaves-Acuña et al., 2020, Appendices 1, 2). Although it is true that most of the species’ range has not been exhaustively surveyed by herpetologists (Bolaños, 2009; García-Rodríguez et al., 2012; IUCN 2020), several recent surveys have been conducted in highland areas close to sites of historical and potential occurrence for *I. pictipes* (Abarca, 2012; Acosta-Chaves et al., 2015; Hertz et al., 2012), which have not led to any new observations. However, in their recent publication, Chaves-Acuña et al. (2020) report findings of adults and larvae of *I. pictipes* in the Cerro de la Muerte region, roughly two decades after it was last registered. Thus, the observation presented here constitutes, to the best of our knowledge, the first sighting in several decades from the eastern Costa Rican Cordillera de Talamanca, located roughly 93 km southeast in a straight line from the nearest site of recent rediscovery. The rediscovery of *I. pictipes* at several sites in the Cordillera de Talamanca, together with recently reported records of *I. angustilineata* (Taylor, 1952) (Nishida 2006) and *I. rivularis* (Taylor, 1952) (Olsen & Cossel, 2014; Jiménez et al., 2019), could “indicate a trend towards reappearance in stream-breeding congeners that have remained undetected for several years or even decades in Costa Rica” (Chaves-Acuña et al., 2020). The near simultaneous rediscovery of *I. pictipes* (including adults, metamorphs and tadpoles) at several sites from which they had previously disappeared is a significant result for the conservation of *I. pictipes*.

***Bothriechis nigroviridis* Peters, 1859.** Provincia de Limón; Cantón de Talamanca; Distrito Telire; Parque Internacional de la Amistad, on two different locations on and along a trail (9.1145 N, 82.9622 W and 9.1237 N, 82.9613 W, 2,469 m and 2,431 m a.s.l.), recorded on August 2, 2021 around 11:00 h and 14:00 h (Fig. 4D). Identified as *B. nigroviridis* based on its unmistakable colour pattern, and on distribution (Doan et al., 2016). Photo voucher UTADC 9782-9783 (University of Texas at Arlington Collection of Vertebrates Digital Collection); ID verified by Jonathan Campbell. Two female individuals were encountered during a day hike, basking on ground level on and along the trail. Our records fall within the known distribution and elevation range, but are noteworthy because they confirm that at the highest elevations, where night temperatures drop significantly, *B. nigroviridis* appears to be chiefly diurnal and ground-dwelling,

rather than arboreal and nocturnal (e.g., Leenders, 2019). Syntopic species included *Mesaspis monticola* (Cope, 1878).

CONCLUDING REMARKS

In summary, the noteworthy records reported here include the rediscovery of *Isthmohyla pictipes* in the eastern section of the Costa Rican Cordillera de Talamanca, the second record of *Bolitoglossa splendida*, and the geographical and elevational range extension for *B. tica* and *B. bramei* / *B. gomezi*. We comment on the morphology and ecology of *Bolitoglossa compacta*, and the ecology of *Bothriechis nigroviridis*. Finally, we discuss the status of *Bolitoglossa sooyorum* and *B. bramei* / *B. gomezi*, emphasizing the need for further research into salamander systematics along the slopes of the Macizo de la Muerte and the eastern section of the Costa Rican Cordillera de Talamanca. Ultimately, the objective of publishing anecdotal records, like the ones presented here, is to eventually aid in assessing the species’ conservation status as well as to inform future conservation efforts and further focused research.

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