NATURE NOTES

Amphibia: Caudata

Bolitoglossa heiroreias. **Tail bifurcation.** Cases of deformity or malformation in amphibians regularly are described as a result of human-mediated causes (e.g., pesticides) or diseases; however, naturally occurring deformities are documented less frequently (Blaustein and Johnson, 2003; Henle et al., 2012). Tail autotomy perhaps is the most costly, because each incident of tail loss can directly reduce reproductive activity throughout the ensuing period of tail regeneration; however, the frequency of missing or regenerating tails usually is lower in species specialized for tail loss, rather than in those with lesser provisions for tail autotomy (Beneski, 1989). *Bolitoglossa heiroreias* (Caudata: Plethodontidae) is endemic to moderate elevations in the vicinity of Cerro Montecristo Trinational Park (McCranie and Castañeda, 2007), a highland protected area located at the convergence of the borders of El Salvador, Guatemala, and Honduras (Comisión Nacional del Plan Trifinio, 2005). This species was described by Greenbaum (2004) and previously has been reported at elevations from 1,800 to 1,820 m in montane humid pine-oak forest and cloud forest (Greenbaum, 2004; McCranie and Castañeda, 2007). Due to its limited distribution, *B. heiroreias* is considered Endangered by the IUCN (IUCN Red List of Threatened Species. 2014. www.iucnredlist.org; accessed 15 April 2014).

On 30 June 2011, an adult *B. heiroreias* (Fig. 1A; USNM 580939) with a bifurcated tail was found after a heavy rain in intact cloud forest habitat on the Honduran side of Cerro Montecristo Trinational Park (14.454722°N, 89.319722°W, datum: WGS84, elev. = 1,955 m), an upward extension of 135 m in elevational distribution (McCranie and Castañeda, 2007). USNM 580939 measured 24.6 mm SVL, and otherwise appeared to be an outwardly healthy individual; pigmentation was similar on both tail segments and each segment appeared cylindrical in cross-section (Fig. 1B). Following examination of a radiograph of the preserved specimen (Fig. 1C–D), it was apparent that approximately 4.8 mm of distal portion of the tail had been autotomized skeletally but remained attached by soft tissue, with a new tail-tip extending 2.7 mm from the point of autotomization (Fig. 1C). This constitutes the first known report of tail bifurcation in a tropical plethodontid salamander.

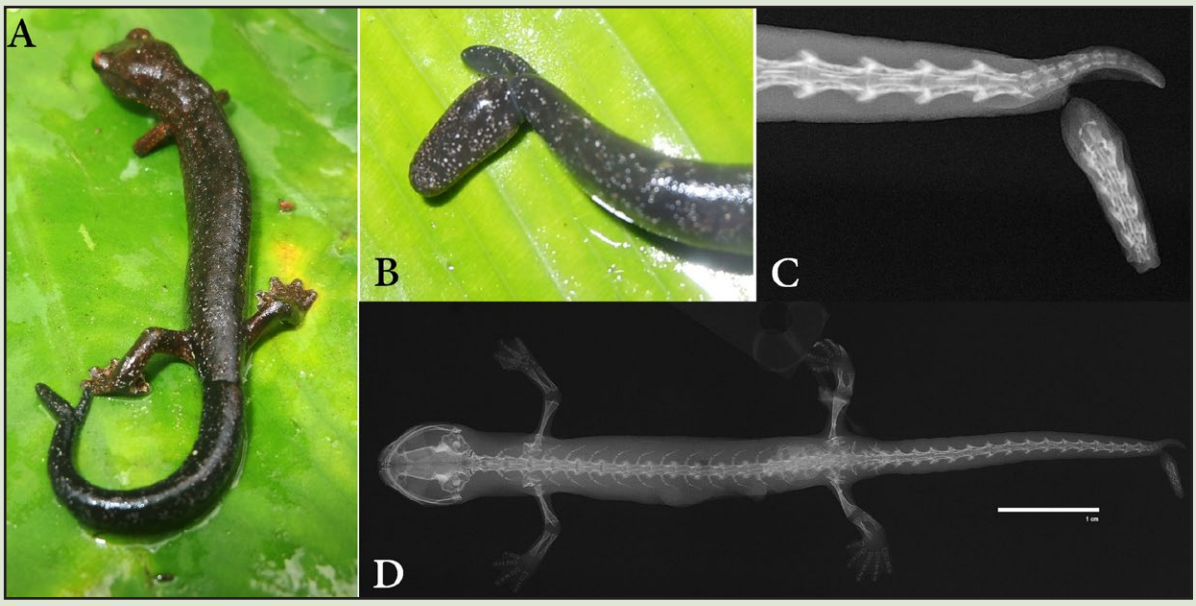

Fig. 1. (A) Adult *Bolitoglossa heiroreias* (USNM 580939) in life, showing tail bifurcation; (B) close-up of tail-bifurcation; (C) radiograph showing detail of tail-bifurcation; and (D) radiograph of whole animal.

We thank Sandra J. Raredon and Steve Gotte (National Museum of Natural History, Smithsonian Institution) for accessioning and providing the digital radiographs of the specimen, and Einstein Flores, Dorian Escoto, and Olvin Oyuela for support in the field.

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Reptilia: Squamata (lizards)

Aspidoscelis deppii. **Diet.** *Aspidoscelis deppii* is a terrestrial, locally abundant, diurnal teiid with a distribution extending from Mexico to Costa Rica. In Nicaragua, this species occurs below 800 m in elevation, mostly on the Pacific versant, with an additional disjunct population on the lowlands of the northeastern corner of the country (Köhler, 2001). This species is known to feed on a variety of prey items. In a study on a sandy beach in southwestern Nicaragua, Vitt et al. (1993) recorded 42 types of prey items in the stomach contents of this species, including insects, spiders, opilionids, pseudoscorpions, centipedes, crustaceans, mollusks, and plant seeds.

At 1030 h on 6 October 2008, ca. 1.5 km W Altagracia (11.565°N, 85.584°W, datum WGS84; 95 m elev.), Biosphere Reserve Ometepe Island, department of Rivas, Nicaragua, we observed an adult *A. deppii* chasing a conspecific juvenile in a plantain plantation that also contained a scattering of larger trees. The adult subdued the juvenile by biting it on the neck, and then shook it violently against the ground until it died (Fig. 1). Subsequently, while positioning the head of the juvenile for entry its mouth, it walked to the edge of a large rock and disappeared; unfortunately, we were unable to watch the swallowing process. We are unaware if cannibalism in this species has been reported. This observation took place on a sunny morning following three days of heavy and continuous rains, which caused the collapse of sand and rock embankments in different parts of the island.

Fig. 1. An adult *Aspidoscelis deppii* preying on a conspecific juvenile. © Billy M. Alemán

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Ctenosaura similis. **Diet.** As much as 90% of the diet of young *C. similis* has been reported to consist of insects, but within their first year of life the quantity and diversity of animal matter decreases as the intake of vegetable matter increases (Mora, 2010). Although primarily vegetarian, adult *C. similis* are opportunistic omnivores that during the dry season often feed on certain fruits and flowers, but this species also is known to consume such food items as insects, spiders, crabs, frogs, small birds, lizards and lizard eggs (even of their own species), and small mammals; the consumption of human excrement also has been reported (Álvarez del Toro, 1972; Fitch, H. S., and J. Hackforth-Jones, 1983; Savage, 2002). In Florida, where *C. similis* has been introduced, a young tortoise (*Gopherus polyphemus*) was found in the stomach of a specimen (Avery et el., 2009). Pasachnik and Corneil (2011) observed a *C. similis* in Costa Rica feeding on a dead *Rhinella marina*, leading these authors to suggest that carnivory in ctenosaurs might be more prevalent than previously thought.

On 16 May 2014 one of us (KD) photographed a young adult female *C. similis* preying on an adult tarantula (*Aphonopelma crinirufum*) at ca. 3 km NE of Playa Naranjo on the road to the headquarters of Parque Nacional Santa Rosa, Área de Conservación Guanacaste, Provincia de Guanacaste, Costa Rica. Fitch and Henderson (1978) reported spiders of the family Lycosidae in the diet of *C. similis*, and although Mora (2010) included a total of 19 spiders in the stomach contents of young ctenosaurs, none of the species were identified. This report is the first to confirm a spider of the family Theraphosidae in the diet of *C. similis*. We thank Rick West and Carlos Víquez for identifying the tarantula.

Fig. 1. A young adult *Ctenosaura similis* preys on an adult theraphosid spider (*Aphonopelma crinirufum*). 📷 © Kristyn Dion

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Reptilia: Squamata (snakes)

Leptophis ahaetulla. **Behavior.** The distribution of *Leptophis ahaetulla* extends from central Veracruz, Mexico, to northeastern Argentina and northern Uruguay on the Atlantic versant (excluding the northeastern portion of the Yucatan Peninsula, Mexico, but including islands off the coast of Venezuela and Trinidad and Tobago), and on the Pacific versant is known to occur from Oaxaca, Mexico, and from northwestern Costa Rica to west-central Ecuador (Oliver, 1948; McCranie, 2011). When threatened, *L. ahaetulla* has been reported to raise the anterior part of the body off the ground, open the mouth wide in a defensive posture, and sometimes expose the enlarged rear teeth; if the threat continues, individuals sometimes inflate the neck region to reveal the yellow interstitial skin, and attempt to bite the intruder (Campbell, 1998; Savage, 2002; Solórzano, 2004).

On 18 May 2014, at ca. 1230 h, one of us (ML), along with a friend, observed an adult *L. ahaetulla* foraging along the ground at Reserva Pacuare, Matina, Provincia de Limón, Costa Rica. After watching the snake for several minutes, it became aware of our presence and immediately raised the anterior part of the body (ca. ¼–⅓ of the body length) off the ground in what appeared to be a threatening posture, but perhaps to gain a better view of the intruders (Fig. 1). As we backed away, the snake retreated into shrubbery and later climbed a tree (Fig. 2). Although *L. ahaetulla* is known to raise the head off the ground, the degree to which this posture can be accomplished has not been explained; Fig. 1 demonstrates the snake's body as nearly perpendicular to the substrate.

On 19 August 2014 at ca. 1100 h., Rodolfo Cubero García was walking along a reed bed along the Río Sucio in a sector called Finca 2, at Río Frío de Sarapiqui, Provincia de Heredia, Costa Rica, when he saw an adult *L. ahaetulla* swimming near the bank. When the snake became aware of his presence, it raised the anterior part of the body (Fig. 3), and at that point RCG remained as still as possible and photographed the event. The snake remained in the upright position for at least three minutes before lowering its head and swimming away (Fig. 4).

Whereas *L. ahaetulla* has been reported to undergo an elaborate display when threatened, these events suggest the use of body posture to visually gain a better view of a situation, which perhaps provides an insight into this species' inquisitive nature. Henderson et al. (1977) indicated how *L. mexicanus* forages for prey by day and occasionally after dark, and the ability of *L. ahaetulla* to raise the anterior part of the body to such a degree likely constitutes part of its foraging strategy.

Fig. 1. Adult *Leptophis ahaetulla* assuming a nearly vertical posture after being startled by intruders.

Fig. 2. The snake later was photographed after it climbed a tree. © Marcela León

Fig. 3. Adult *Leptophis ahaetulla* with the head and anterior part of the body raised vertically.

Fig. 4. After holding that position for some time, the snake lowered its head and swam away. © Rodolfo Cubero García

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Micrurus alleni. **Predation.** The diet of *M. alleni* consists predominantly of Swamp Eels (*Synbranchus marmoratus*), but lizards also are taken (Roze, 1996). At 1915 h on 26 May 2014, on a rainless night, one of us (JAH) was hiking along a rocky creek at Bahía Drake, Península de Osa, Provincia de Puntarenas, Costa Rica (8°41.494' N, 83°41.346' W; elev. 33 m) and spotted a coralsnake (*M. alleni*); the immediate area consisted of rocks interspersed with leaf-litter and coarse sand. Upon removing some leaves to uncover the snake, about 20 cm away JAH also discovered a caecilian (*Oscaecilia osae*), which was immobile and bleeding from the mouth and between the annuli. A few minutes later, the snake bit the caecilian and pulled it into the back of a rock (Figs. 1, 2). At that point JAH moved away from the scene, and at ca. 2200 h returned to find that the snake had consumed a good portion of the caecilian (Fig. 3). As the snake became aware of his presence it began to regurgitate the caecilian (Fig. 4); to prevent further disturbance, JAH left and did not return. The approximate TL of the snake was 70 cm, and that of the caecilian ca. 50 cm.

Fig. 1. *Micrurus alleni* biting a caecilian (*Oscaecilia osae*) it subdued with its venom.

Fig. 2. The snake subsequently drags the caecilian behind a rock. © José Alberto Huertas

Fig. 3. The snake later is photographed while ingesting the caecilian.

Fig. 4. Once disturbed, the snake begins to regurgitate the caecilian. © José Alberto Huertas

Allopatric populations of *Micrurus alleni* on each versant of Costa Rica are distinctive in several morphological characteristics, and commentary in Savage and Vial (1974), Savage (2002), and Campbell and Lamar (2004) suggest that these populations might constitute different species.

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Ninia maculata. **Behavior.** The genus *Ninia* presently consists of nine species of small Neotropical dipsadine snakes that primarily are semifossorial and feed on soft-bodied invertebrates. Several species are known to flatten their body when disturbed, and in a study conducted in southern Veracruz, Mexico, Greene (1975) provided an excellent review of the defensive behavior of one species (*N. sebae*). Among a series of behaviors exhibited by *N. sebae*, Greene reported that, "When startled, a snake flattened its entire body dorsoventrally and raised the anterior third or half vertically." Further, he noted that "During high intensity displays the head was cocked slightly downward and the posterior tips of the mandibles and the yellow nape skin were spread laterally." Henderson and Hoevers (1977) reported similar behavior for *N. sebae* in northern Belize; a photograph of another individual from Belize with a partially elevated head and flattened neck also appears in Lillywhite (2014: p. 134).

On 8 April 2014, in San Rafael de Heredia, Provincia de Heredia, Costa Rica, Diego Rodríguez startled a small snake (*N. maculata*); it immediately flattened its body and raised the anterior half vertically while facing away from the intruder, as seen in Fig. 1. The photograph is vouchered as UTADC-8194 in The University of Texas at Arlington Collection of Vertebrates Digital Collection.

Savage (2002: p. 619) noted that individuals of *N. maculata* flatten their entire body when alarmed, especially the head, and may feign death by extruding the tongue and flipping over onto their back. This report demonstrates that *N. maculata* also is capable of flattening the entire body dorsoventrally and raising about one-half of its anterior portion vertically, a similar defensive behavior to that reported for *N. sebae*. I thank Joe Mendelson for commenting on this note.

Fig. 1. Adult *Ninia maculata* in a threat display after being startled in the garage of a home.

© Diego Rodríguez

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***Sibon nebulatus*. Predation.** *Sibon nebulatus* is a dipsadine snake with a wide distribution that extends from northern Veracruz, Mexico, through Trinidad and Tobago to northern Brazil on the Atlantic versant, and discontinuously on the Pacific versant from southern Nayarit, Mexico, to western Ecuador (McCranie, 2011). This nocturnal, terrestrial and arboreal species occurs in a variety of habitats at low to intermediate elevations, and its diet consists of snails and slugs (Savage, 2002; Solórzano, 2004).

On 18 May 2014, at ca. 1700 h, I was hiking along a trail ca. 0.5 km NE of the research station at Sector San Cristóbal, in the Área de Conservación Guanacaste, Provincia de Guanacaste, Costa Rica, when I photographed a Swainson's Toucan (*Rhamphastos swainsonii*) perched low on a tree (Fig. 1). As I changed lenses on my camera, the toucan grabbed a *Sibon nebulatus*, and moments later I took a photograph (Fig. 2). The toucan soon flew off with the snake to a higher tree, and kept biting it until it stopped moving (Fig. 3). Another toucan then joined the scene (Fig. 4). I watched this event for approximately 20 min before leaving. After closely examining the photographs, the snake apparently was an adult female carrying eggs.

Fig. 1. A Swainson's Toucan (*Rhamphastos swainsonii*) perched low on a tree.

Fig. 2. Soon after, the toucan captured an adult *Sibon nebulatus*.

Fig. 3. The toucan moved to another tree and holds the nearly lifeless snake.

Fig. 4. A second toucan joins the scene.

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Range extensions and new departmental records for amphibians in Nicaragua

Nicaragua is located in the southern portion of Mesoamerica, and after Mexico is the second largest country in this area. Nevertheless, it is the third least herpetologically-diverse country in this megadiverse region, after Belize and El Salvador, and the least diverse of those that share Pacific and Atlantic (Caribbean) oceanic boundaries (Wilson and Johnson, 2010). Despite the interesting zoogeographic position of the country, compared with neighboring countries Nicaragua historically has received limited attention from herpetologists. During the last decade and a half, however, increased research in Nicaragua has resulted in the description of several new species of amphibians and reptiles, as well as in the addition of species to the country's list. Still, an inventory of the herpetofauna of Nicaragua is far from complete, and with advances in herpetological research several species recorded in adjacent Costa Rica and Honduras, in addition to undescribed endemic species, are expected to be found in the country (Sunyer and Köhler, 2010). From a herpetological perspective most of the 17 departments in Nicaragua remain understudied, and their habitats are under extreme pressure from uncontrolled deforestation, including in national protected areas.

As a result of recent field surveys, herein we report several range extensions and new departmental records for amphibian species in Nicaragua. We also provide a few natural history comments, and place each of the mentioned localities (Fig. 1) within the nine forest formations identified for the country based on the life zone concept proposed by Holdridge (1967) and used by Sunyer and Köhler (2010), as follows: Lowland Moist Forest (Aguazarca, Kahkabila, Muelle de los Bueyes, Moss, Wisconsin, Papaturro, Río Frío, Finca Santa Elena, Santo Domingo, and portions of Cerro Musún below 600 m a.s.l.); Lowland Dry Forest (Finca de Escameca Grande, Morgan's Rock, Finca Concepción de María, Chinandega, and portions of Volcán Momotombo and Volcán Mombacho below 600 m a.s.l.); Premontane Wet Forest (portions of Cerro Musún ranging from 600 to 1,200 m a.s.l.); Premontane Moist Forest (portions of Volcán Mombacho, Cerro Datanlí-El Diablo, and Cerro Kilambé ranging from 600 to 1,200 m a.s.l.); and Lower Montane Moist Forest (portions of Miraflores, Cerro Datanlí-El Diablo, and Cerro Kilambé above 1,200 m a.s.l.). El Abuelo corresponds to a transitional area between Lowland Moist and Dry forests. Lost Canyon corresponds to a transitional area between Lowland Dry and Arid forests. In addition, Kahkabila, Papaturro, El Abuelo, and lowlands located on the southern slope of Volcán Mombacho are immersed or surrounded by wetlands.

We handled all animals according to the approved IACUC standards and protocols (IACUC #16–13). We include photographs for all records that lack voucher specimens; the photographs are vouchered at The University of Texas at Arlington Collection of Vertebrates Digital Collection (UTADC). Acronyms for museum collections follow those of Sabaj-Pérez (2013). Collecting and exportation permits were authorized by the MARENA (Ministerio del Ambiente y los Recursos Naturales), Managua,

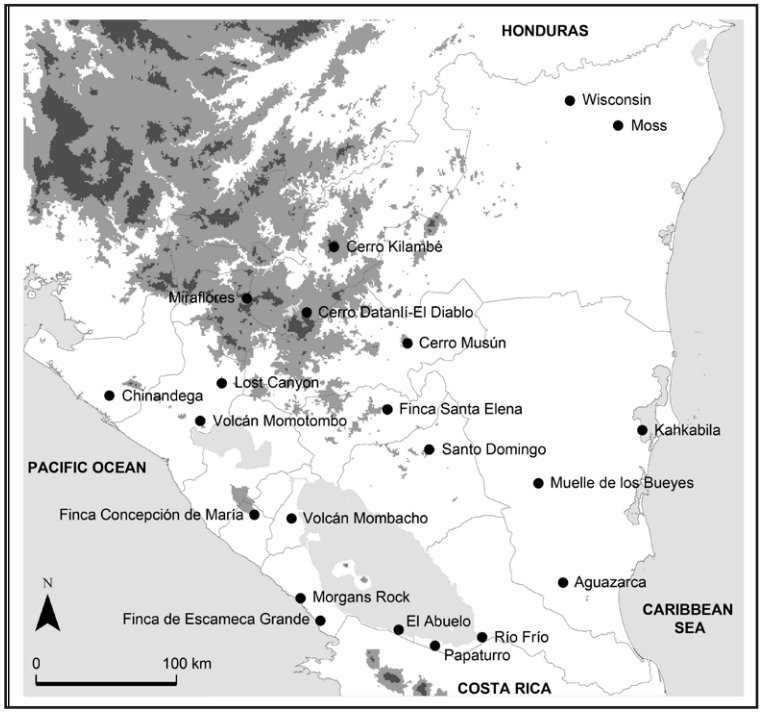

Fig. 1. Map of Nicaragua showing the collecting localities mentioned in the text. Water surfaces = pale gray; areas 600–1,200 m in elevation = gray; and areas above 1,200 m in elevation = dark gray.

Nicaragua. We thank Andreas Hertz, Armando Gómez, Darwin E. Manzanarez, Iris Garbayo, Jenny A. Gubler, John G. Phillips, Kirsten E. Nicholson, Luis Arauz, Luis Gutiérrez-López, Marlon Chávez, Maynor A. Fernández, and Sebastian Lotzkat for field assistance, Sean M. Rovito for molecular corroboration of one species, Justin Touchon for the loan of a photograph, Carl Franklin for providing museum voucher numbers for photographs, and Louis W. Porras for helpful suggestions that substantially improved the manuscript. JS was partially supported by the DAAD (Deutscher Akademischer Austausch Dienst), Germany. DMGU was supported by the Facultad de Ciencias, Universidad de Los Andes, Bogotá, Colombia, and the Wilhelm-Peters-Fond of the Deutsche Gesellschaft fuer Herpetologie und Terrarienkunde, Germany.

Order Caudata

Family Plethodontidae

Bolitoglossa striatula (Noble, 1918). GRANADA: Southern slope of Volcán Mombacho (11.77161°N, 85.96110°W, WGS84); elev. 66 m; 7 January 2011. José G. Martínez-Fonseca and Milton Salazar-Saavedra. We encountered an individual on a palm leaf. GRANADA: southern slope of Volcán Mombacho (11.77113°N, 85.95906°W, WGS84); elev. 59 m; 31 May 2012. José G. Martínez-Fonseca and Milton Salazar-Saavedra. We found another individual (UTADC-8196; Fig. 2A) under a fallen log. These salamanders represent a new departmental record, with their closest localities in the departments Chontales and Rivas (Noble, 1918; Villa, 1972).

Oedipina koehleri Sunyer, Townsend, Wake, Travers, Gonzalez, Obando, and Quintana, 2011. JINOTEGA: Reserva Natural Cerro Datanlí-El Diablo, El Gobiado (13.15784°N, 85.87355°W, WGS84); elev. 1,275 m; 3 October 2011. Javier Sunyer, José G. Martínez-Fonseca, and Maynor A. Fernández. Sean M. Rovito identified the specimen (MVZ 269556; Fig. 2B) through a molecular analysis. We found the salamander at night in a coffee plantation, under a fallen log. For this endemic species, the specimen represents (1) an elevational record, exceeding the previously-known elevational range by 330 m, (2) the northwesternmost record, (3) the fourth know locality, and (4) a new departmental record, with the closest locality in the department of Matagalpa (Sunyer et al., 2011).

Order Anura

Family Bufonidae

Incilius melanochlorus (Cope, 1877). RIVAS: Reserva Silvestre Privada El Abuelo (11.12556°N, 85.28386°W, WGS84); elev. 51 m; 7 June 2013. José G. Martínez-Fonseca and Milton Salazar-Saavedra. We came across a single individual (UTADC-8197; Fig. 2C) of this species at night in a rocky area, which represents (1) the northwestern-most distributional record for the species, (2) the third known locality in Nicaragua, and (3) a new departmental record, with the closest locality in the department of Río San Juan (Köhler et al., 2004; Sunyer et al., 2009).

Rhaebo haematiticus Cope, 1862. CHONTALES: Santo Domingo, Reserva Silvestre Privada Las Brumas (12.28°N, 85.09°W, WGS84); elev. 562 m; 20 July 2012. Javier Sunyer and Diana M. Galindo-Uribe. UTADC-8198; Fig. 2D. We found two individuals on the ground at night in a disturbed patch of forest, which represent a new departmental record; the closest localities are in the departments Matagalpa (see below) and Atlántico Sur (Brattstrom and Howell, 1954; Köhler, 2001). MATAGALPA: Reserva Natural Cerro Musún, La Canoga (12.95874°N, 85.22723°W, WGS84); elev. 628 m; 8 July 2006. Javier Sunyer, Lenin A. Obando, and Darwin E. Manzanarez. We found a single specimen (SMF 87964, Fig. 2E) of this bufonid at night, between flat rocks on the shore of a permanent stream. It represents the westernmost recorded locality in Nicaragua, and a new departmental record with the closest localities in departments of Chontales (see above), Atlántico Norte, and Jinotega (Noble, 1918; Köhler, 2001; King et al., 2007).

Family Centrolenidae

Cochranella granulosa (Taylor, 1949). CHONTALES: Santo Domingo, Reserva Silvestre Privada Las Brumas (12.28°N, 85.09°W, WGS84); elev. 562 m; 21 July 2012. Javier Sunyer and Diana M. Galindo-Uribe. UTADC-8199; Fig. 2F. We found two individuals calling and guarding egg masses at night, at ca. 3 m above the ground on a tree above a permanent stream, in a disturbed patch of forest. CHONTALES: Santo Domingo, B2GOLD mining concession (12.25878°N, 85.07110°W, WGS84); elev. 482 m; 20 April 2013. Milton Salazar-Saavedra and Luis Arauz. UTADC-8200; Fig. 2G. We discovered an additional five individuals calling at night while perched > 5 m above the ground on trees above a small stream, in a patch of disturbed forest. Collectively, these individuals represent a new departmental record, with their closest locality in the department of Matagalpa (Villa, 1972; Köhler, 2001).

Hyalinobatrachium fleischmanni (Boettger, 1893). CHONTALES: Santo Domingo, Reserva Silvestre Privada Las Brumas (12.28°N, 85.09°W, WGS84); elev. 562 m; 20 July 2012. Javier Sunyer and Diana M. Galindo-Uribe. UTADC-8201; Fig. 2H. We observed three of these centrolenids calling and in amplexus at night, at a height of ca. 3–7 m above the ground in trees above a permanent stream in a disturbed patch of forest. CHONTALES: Santo Domingo, B2GOLD mining concession (12.25122°N, 85.06617°W, WGS84); elev. 455 m; 8 November 2012. Milton Salazar-Saavedra and Luis Arauz. UTADC-8202; Fig. 3A. We found 16 individuals calling and in amplexus at night, at a height > 5 m above the ground on trees above a small stream in a disturbed patch of forest. These frogs represent a new departmental record, with the closest locality in the department of Boaco (Villa, 1972). JINOTEGA: Reserva Natural Cerro Datanlí-El Diablo, La Esmeralda (13.08550°N, 85.86508°W, WGS84); elev. 1,157 m; 3 August 2005. Javier Sunyer, Lenin A. Obando, and Darwin E. Manzanarez. We collected a single specimen (SMF 84919) calling at night (2115 h) while perched ca. 1.7 m above the ground on herbaceous vegetation along the shore of a permanent and relatively large stream. JINOTEGA: Reserva Natural Cerro Kilambé (13.57767°N, 85.69914°W, WGS84); elev. 1,303–1,356 m; 13 August 2005. Javier Sunyer, Lenin A. Obando, and Darwin E. Manzanarez. We captured four specimens (SMF 84920, 98534–36) calling at night (2030–0030 h) while on herbaceous vegetation or perched on trees at a height of 1–10 m above the ground, on the shore of a permanent stream. These specimens represent a new departmental record, with the closest localities in the departments of Atlántico Norte and Matagalpa (Mayorga, 1967; Köhler, 2001).

Teratohyla pulverata (Peters, 1873). BOACO: Camoapa, Finca Santa Elena (12.53579°N, 85.35665°W, WGS84); elev. 530 m; 16 September 2009. Javier Sunyer and Lenin A. Obando. We found a single member of this species (MHUL 164, Fig. 3B) at night, while calling from vegetation ca. 1 m above a permanent stream. The specimen represents a new departmental record, with the closest locality in the department of Matagalpa (Köhler, 2001).

Family Craugastoridae

Pristimantis cerasinus (Cope, 1875). MATAGALPA: Reserva Natural Cerro Musún, La Canoga (12.95874°N, 85.22723°W, WGS84); elev. 628 m; 8 July 2006. Javier Sunyer, Lenin A. Obando, and Darwin E. Manzanarez. We collected one specimen (SMF 87821) at night on vegetation 1 m above the ground, which represents a new departmental record; the closest locality is in department of Atlántico Norte (Köhler, 2001).

Pristimantis ridens (Cope, 1866). CHONTALES: Santo Domingo, Reserva Silvestre Privada Las Brumas (12.28°N, 85.09°W, WGS84); elev. 562 m; 20 July 2012. Javier Sunyer and Diana M. Galindo-Uribe. We found one individual (UTADC-8203; Fig. 3C) at night on vegetation ca. 1 m above the ground, in a disturbed patch of forest. CHONTALES: Santo Domingo, B2GOLD mining concession (12.25823°N, 85.07630°W, WGS84); elev. 531 m; 8 November 2012. Milton Salazar-Saavedra and Luis Arauz. (UTADC-8204; Fig. 3D). We found two individuals at night, calling from vegetation near a small stream in a disturbed patch of forest. They represent a new departmental record, with the closest localities in the departments of Atlántico Sur and Río San Juan (Noble, 1918; Köhler, 2001).

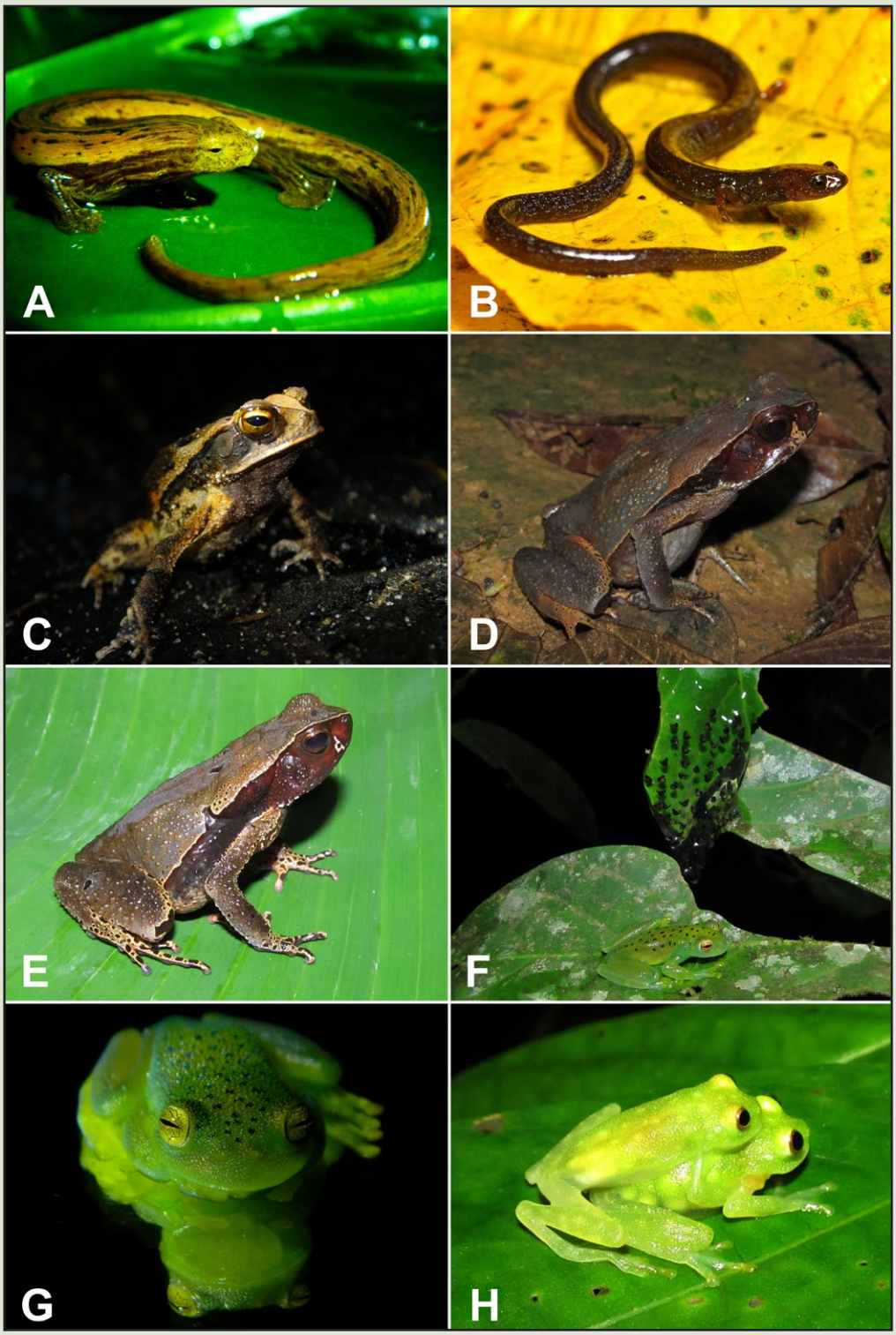

Fig. 2. (A) *Bolitoglossa striatula* from the department of Granada; (B) *Oedipina koehleri* from the department of Jinotega; (C) *Incilius melanochlorus* from the department of Rivas; (D) *Rhaebo haematiticus* from the department of Chontales; (E) *R. haematiticus* from the department of Matagalpa; (F and G) *Cochranella granulosa* from the department of Chontales; and (H) *Hyalinobatrachium fleischmanni* from the department of Chontales.

Family Eleutherodactylidae

Diasporus diastema (Cope, 1875). CHONTALES: Santo Domingo, Reserva Silvestre Privada Las Brumas (12.28°N, 85.09°W, WGS84); elev. 562 m; 20 July 2012. Javier Sunyer and Diana M. Galindo-Uribe. UTADC-8205; Fig. 3E. We observed two individuals at night, calling from trees at a height of ca. 2 m above the ground in a disturbed patch of forest. They represent a new departmental record, with the closest localities in the departments of Atlántico Sur and Matagalpa (Noble, 1918; Gaige et al., 1937; Köhler, 2001).

Family Hylidae

Agalychnis callidryas (Cope, 1862). CARAZO: Reserva Silvestre Privada Finca Concepción de María (11.86207°N, 86.20999°W, WGS84); elev. 132 m; 24 May 2012. Milton Salazar-Saavedra. We encountered one individual (UTADC-8206; Fig. 3F) at night, perched on a palm leaf in a coffee plantation; it represents a new departmental record, with the closest localities in the departments of Granada, Managua, and Masaya (Köhler, 2001; Savage and Heyer, 1967). CHONTALES: Santo Domingo, Reserva Silvestre Privada Las Brumas (12.28°N, 85.09°W, WGS84); elev. 562 m; 21 July 2012. Javier Sunyer and Diana M. Galindo-Uribe. UTADC-8207; Fig. 3G. We found several dozen of these hylids at night in back of the reserve's building, calling from trees at heights up to 4 m above the ground. They represent a new departmental record, with the closest localities in the departments of Atlántico Sur and Boaco (Noble, 1918; Köhler, 2001; Savage and Heyer, 1967). ESTELÍ: Reserva Natural Miraflores (13.24722°N, 86.25750°W, WGS84); elev. 1,325 m; 5 June 2005. Javier Sunyer and Darwin E. Manzanarez. We collected a single specimen (SMF 84941) at 1900 h, about 1 m above the ground on herbaceous vegetation along a permanent lagoon. It represents a new departmental record, with the closest locality in the department of Jinotega (Savage and Heyer, 1967; Köhler, 2001).

Dendropsophus ebraccatus (Cope, 1874). ATLÁNTICO NORTE: Río Wawa, Moss (14.35449°N, 83.87750°W, WGS84); elev. 30 m; 11 October 2007. Javier Sunyer and Darwin E. Manzanarez. We captured three of these frogs (SMF 87971–72, 98453) at night, while in amplexus and calling from banana plants that emerged from a seasonal pond in a pasture. ATLÁNTICO SUR: Laguna de Perlas, Kahkabila (12.40339°N, 83.72230°W, WGS84); elev. 5 m; 26 July 2012. Javier Sunyer and Diana M. Galindo-Uribe. UTADC-8208; Fig. 3H. We spotted five individuals at about 2100 h, calling from herbaceous vegetation that emerged from a large permanent pond. ATLÁNTICO SUR: Muelle de los Bueyes (12.06289°N, 84.38754°W, WGS84); elev. 286 m; 12 December 2013. José G. Martínez-Fonseca, Marlon Chávez, and Luis Gutiérrez-López. UTADC-8209; Fig. 4A. We found three members of this species at night in a seasonal pond. BOACO: Camoapa, Finca Santa Elena (12.53579°N, 85.35665°W, WGS84); elev. 530 m; 18 September 2009. Javier Sunyer and Lenin A. Obando. UTADC-8210; Fig. 4B. We saw six individuals at night, calling from herbaceous vegetation that emerged from a seasonal pond in a cattle field. CHONTALES: Santo Domingo, B2GOLD mining concession (12.26092°N, 85.06662°W, WGS84); elev. 640 m; 21 July 2012. Milton Salazar-Saavedra and Luis Arauz. UTADC-8211; Fig. 4C. We found 15 individuals at night, while in amplexus and calling from herbaceous vegetation on the shore of a large deep pond. JINOTEGA: Reserva Natural Cerro Datanlí-El Diablo, El Volcán (13.13108°N, 85.84258°W, WGS84); elev. 998 m; 1 August 2005. Javier Sunyer, Lenin A. Obando, and Darwin E. Manzanarez. We collected five specimens (SMF 84890, 98454–57, Fig. 4D) at 2130 h, calling from herbaceous vegetation that emerged from a pond adjacent to a small permanent lagoon. JINOTEGA: Reserva Natural Cerro Datanlí-El Diablo, La Esmeralda (13.08411°N, 85.87319°W, WGS84); elev. 1,147 m; 2 August 2005. Javier Sunyer, Lenin A. Obando, and Darwin E. Manzanarez. SMF 84891, 98458. We found two of these hylid frogs at 2000 h, calling from herbaceous vegetation that emerged from a pond adjacent to a small permanent lagoon. JINOTEGA: Reserva Natural Cerro Kilambé, La Escuelita (13.61834°N, 85.72208°W, WGS84); elev. 1,012 m; 15 August 2005. Javier Sunyer, Lenin A. Obando, and Darwin E. Manzanarez. We came across three specimens (SMF 84892–93, 98459) at 2200 h, calling from herbaceous vegetation that emerged from a pond adjacent to a small permanent lagoon. In total, we report new departmental records for Atlántico Norte, Boaco, Chontales, and Jinotega, as well as for the mainland of Atlántico Sur. Previously, this species was poorly known in Nicaragua, reported only from the departments of Atlántico Sur (where its distribution was restricted to the Corn Islands), Matagalpa, and Río San Juan (Duellman, 1970; Villa, 1972; Köhler, 2001; Sunyer et al., 2009).

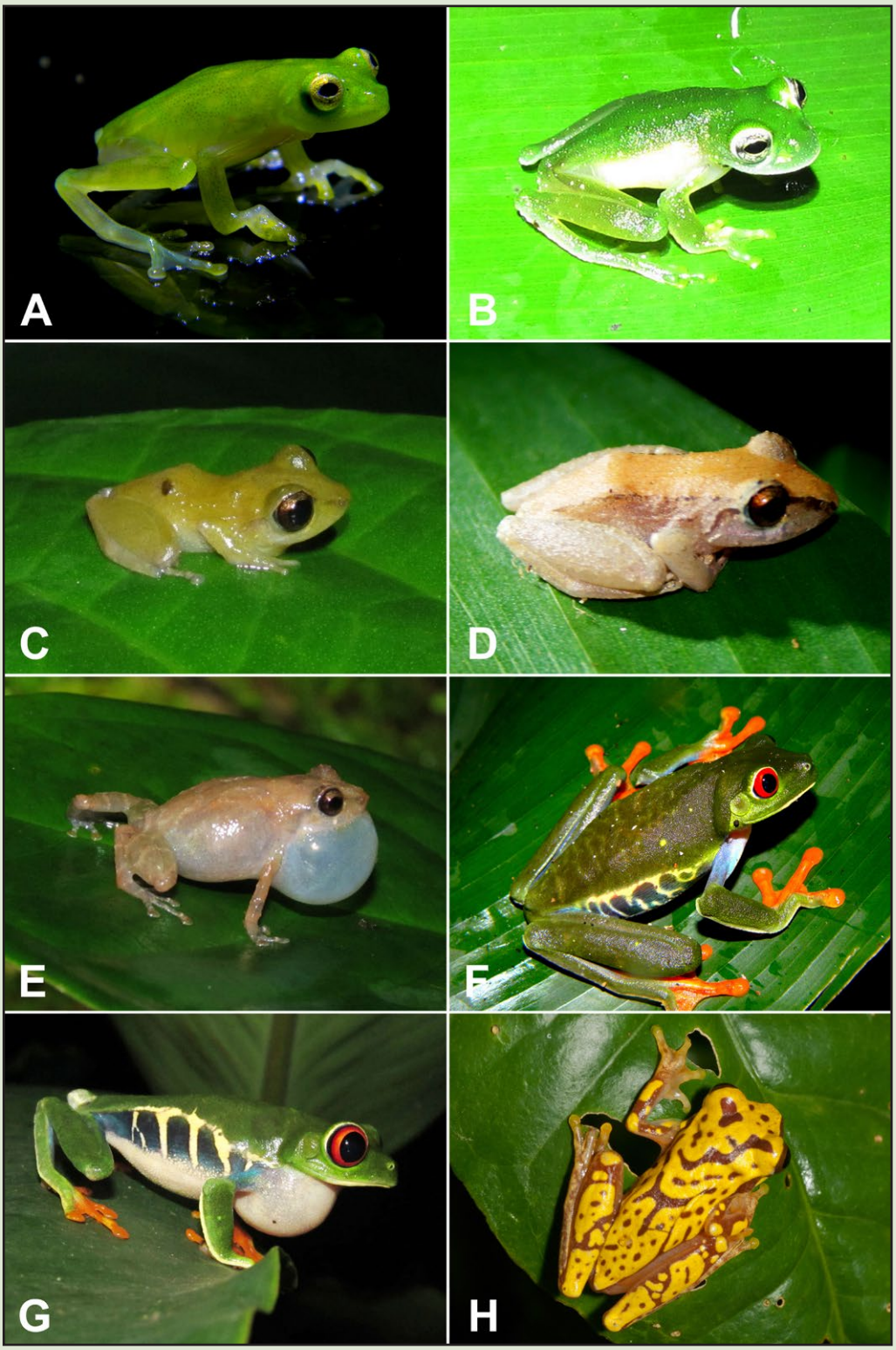

Fig. 3. (A) *Hyalinobatrachium fleischmanni* from the department of Chontales; (B) *Teratohyla pulverata* from the department of Boaco; (C and D) *Pristimantis ridens* from the department of Chontales; (E) *Diasporus diastema* from the department of Chontales; (F) *Agalychnis callidryas* from the department of Carazo; (G) *A. callidryas* from the department of Chontales; and (H) *Dendropsophus ebraccatus* from the department of Atlántico Sur.

Scinax boulengeri (Cope, 1887). BOACO: Camoapa, Finca Santa Elena (12.53579°N, 85.35665°W, WGS84); elev. 530 m; 17 September 2009. Javier Sunyer and Lenin A. Obando. We obtained one frog (MHUL 165) at night, calling from a leaf ca. 1 m above a permanent stream. The specimen represents the northwesternmost record in Nicaragua, as well as and new departmental record with the closest localities in the departments of Atlántico Sur and Chontales (Noble, 1918; Gaige et al., 1937; Duellman, 1970; Villa, 1972; Köhler, 2001). RIVAS: Reserva Silvestre Privada El Abuelo (11.11216 °N, 85.26927°W, WGS84); elev. 39 m; 28 October 2012. José G. Martínez-Fonseca, Luis Gutiérrez-López, and Milton Salazar-Saavedra. We found one individual (UTA-8212; Fig. 4E) at night, on a bush ca. 90 cm above the ground in a disturbed patch of forest close to Lago de Nicaragua. This voucher represents the westernmost locality in the country for the species and a new departmental record, with the closest locality in the department of Río San Juan (Noble, 1918; Villa, 1972).

Scinax staufferi (Cope, 1865). LEÓN: El Jicaral, San Juan de Dios, Lost Canyon Nature Reserve (12.70403°N, 86.41782°W, WGS84); elev. 142 m; 28 May 2007. Javier Sunyer and Lenin A. Obando. We encountered three specimens (SMF 87287–88, 98685, Fig. 4F) at night, calling from herbaceous vegetation that emerged from a seasonal pond adjacent to a permanent stream. They represent a new departmental record, with the closest localities in the departments of Chinandega, Estelí, and Managua (Mayorga, 1967; Köhler, 2001).

Smilisca phaeota (Cope, 1862). BOACO: Camoapa, Finca Santa Elena (12.53579°N, 85.35665°W, WGS84); elev. 530 m; 16 September 2009. Javier Sunyer and Lenin A. Obando. MHUL 166. We happened upon three frogs calling in a chorus at night while floating in a small artificial pool; they represent a new departmental record, with the closest localities in the departments of Chontales and Matagalpa (Villa, 1972; Köhler, 2001).

Smilisca sordida (Peters, 1863). MATAGALPA: Reserva Natural Cerro Musún, Palán, Bilampí (13.02572°N, 85.23908°W, WGS84); elev. 458 m; 16 July 2006. Javier Sunyer, Lenin A. Obando, and Darwin E. Manzanarez. We found a single frog (SMF 86777) at night in the back of a ranch, on vegetation growing in a flooded pasture with scattered bushes nearby. It represents a new departmental record, with the closest localities in the departments of Atlántico Sur and Jinotega (Duellman, 1970; Travers et al., 2011).

Tlalocohyla loquax (Gaige and Stuart, 1934). ATLÁNTICO NORTE: Wisconsin (14.51403°N, 84.18591°W, WGS84); elev. 76 m; 19 June 2010. Javier Sunyer, Kirsten E. Nicholson, Jenny A. Gubler, John G. Phillips, and Lenin A. Obando. We captured one specimen (MHUL 167) at night, on a bush above a seasonal roadside pond. It represents the northeasternmost record in Nicaragua, and new departmental record with the closest localities in the departments of Jinotega, Matagalpa, Boaco, and Atlántico Sur, where its distribution is restricted to the Corn Islands (Duellman, 1970; Köhler, 2001).

Trachycephalus typhonius (Linnaeus, 1758). CARAZO: Reserva Silvestre Privada Finca Concepción de María (11.86064°N, 86.20946°W, WGS84); elev. 132 m; 24 May 2012. Milton Salazar-Saavedra. We found one individual (UTADC-8213; Fig. 4G) in a coffee plantation, perched on a palm leaf at night. This voucher represents a new departmental record, with the closest localities in the departments of Granada and Managua (Villa, 1972; Köhler, 2001). LEÓN: Reserva Natural Complejo Volcánico Momotombo (12.46240°N, 86.55661°W, WGS84); elev. 108 m; 15 October 2010. José G. Martínez-Fonseca and Milton Salazar-Saavedra. We encountered a single individual (UTADC-8214; Fig. 4H) at night, ca. 1.3 m above the ground on a small tree. It represents a new departmental record, with the closest localities in the departments of Chinandega and Managua (Duellman, 1970; Villa, 1972; Köhler, 2001). RÍO SAN JUAN: Refugio de Vida Silvestre Los Guatuzos, Río Frío, Estación Fundeverde (11.07694°N, 84.74881°W, WGS84); elev. 45 m; 4 June 2006. Javier Sunyer, Darwin E. Manzanarez, Andreas Hertz, and Sebastian Lotzkat. We secured one specimen (SMF 87944) at night, on herbaceous vegetation in swampy area along Senda Peter. RÍO SAN JUAN: Refugio de Vida Silvestre Los Guatuzos, Río Frío, Estación Fundeverde (11.07869°N, 84.75145°W, WGS84); elev. 37 m; 28 April 2010. José G. Martínez-Fonseca and Luis Gutiérrez-López. We observed one frog (UTADC-8215; Fig. 5A) at night while it was raining, perched on the wall of a house located near a seasonal pond. RÍO SAN JUAN: Refugio de Vida Silvestre Los Guatuzos, Papaturro (11.02278°N, 85.05139°W; WGS84); elev. 40 m; 20 July 2007. Javier Sunyer, Iris Garbayo, and Armando Gómez. We collected

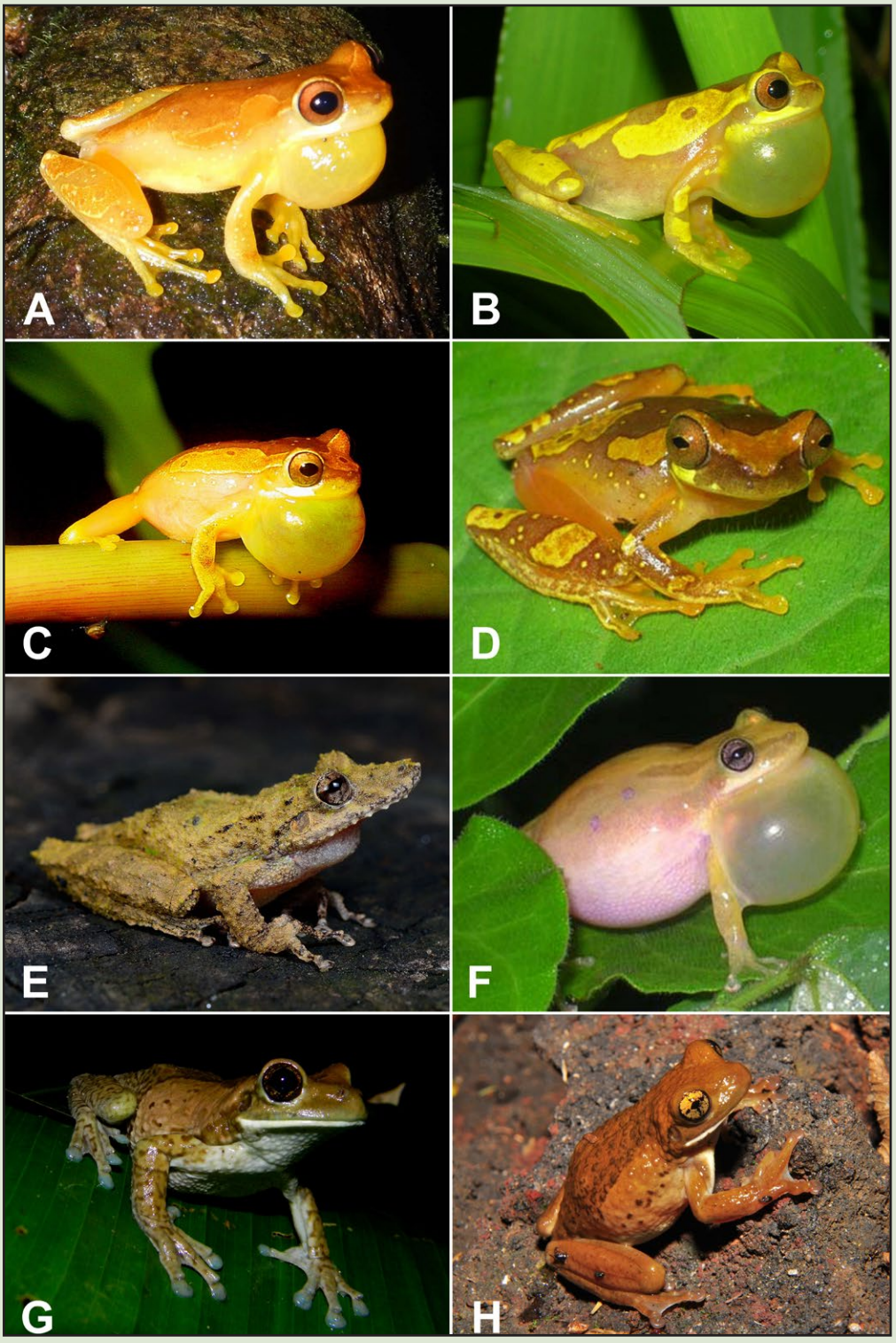

Fig. 4. (A) *Dendropsophus ebraccatus* from the department of Atlántico Sur; (B) *D. ebraccatus* from the department of Boaco; and (C) *D. ebraccatus* from the department of Chontales; (D) *D. ebraccatus* from the department of Jinotega; (E) *Scinax boulengeri* from the department of Rivas; (F) *Scinax staufferi* from the department of León; (G) *Trachycephalus typhonius* from the department of Carazo; and (H) *T. typhonius* from the department of León.

four specimens (SMF 87942–43, 98732–33; Fig. 5B) at night in the town of Papaturro, perched on small trees above a swampy area adjacent to Río Papaturro. They represent a new departmental record, with the closest locality in adjacent Costa Rica (Duellman, 1970). RIVAS: Morgan's Rock (11.32692°N, 85.91389°W, WGS84); elev. 37 m; 10 September 2006. Javier Sunyer, Lenin A. Obando, and Darwin E. Manzanarez. SMF 87941, 98731. We found two frogs (SMF 87941, 98731) at night while it was raining. We encountered SMF 87941 on the ground next to a small seasonal pond, and SMF 98731 calling from the branch of a nearby tree at ca. 12 m above the ground. RIVAS: Finca de Escameca Grande (11.18284°N, 85.78684°W, WGS84); elev. 28 m; 13 December 2011. José G. Martínez-Fonseca and Marlon Chávez. We found one individual (UTADC-8216; Fig. 5C) at night on a small tree at ca. 4.5 m above the ground and ca. 5 m away from a seasonal stream, which was dry at the time. This voucher represents a new departmental record, with the closest localities in the departments of Río San Juan (see above) and Granada (Köhler, 2001).

Family Leptodactylidae

Engystomops pustulosus (Cope, 1864). GRANADA: Reserva Natural Volcán Mombacho (11.83831°N, 85.99277°W, WGS84); elev. 739 m; 19 May 2010. Javier Sunyer, Kirsten E. Nicholson, Jenny A. Gubler, John G. Phillips, and Lenin A. Obando. MHUL 168. We found five of these anurans calling at night while floating in artificial pools used for harvesting coffee. They represent a new departmental record, with the closest localities in the departments of Carazo, Managua, and Rivas (Mayorga, 1967; Köhler, 2001).

Leptodactylus fragilis (Brocchi, 1877). ATLÁNTICO SUR: Laguna de Perlas, Kahkabila (12.40339°N, 83.72230°W, WGS84); elev. 5 m; 25 July 2012. Javier Sunyer and Diana M. Galindo-Uribe. We discovered one frog (MHUL 169) on the ground at night, near a large permanent pond in the town of Kahkabila. This specimen represents a new departmental record, with the closest localities in the departments of Atlántico Norte, Boaco (see below), Chontales, and Río San Juan (Köhler, 2001; Heyer et al., 2006; Sunyer et al., 2009). BOACO: Camoapa, Finca Santa Elena (12.53579°N, 85.35665°W, WGS84); elev. 530 m; 17 September 2009. Javier Sunyer and Lenin A. Obando. We encountered a single frog (MHUL 170) at night, calling from a small hole in the ground in a cattle field. It represents a new departmental record, with the closest localities in the departments of Granada and Chontales (Köhler, 2001; Heyer et al., 2006).

Leptodactylus savagei Heyer, 2005. CHONTALES: Santo Domingo, Reserva Silvestre Privada Las Brumas (12.28°N, 85.09°W, WGS84); elev. 562 m; 22 July 2012. Javier Sunyer and Diana M. Galindo-Uribe. We came across one individual (UTADC-8217; Fig. 5D) of this large leptodactylid at night, on the ground in a disturbed patch of forest. It represents a new departmental record, with the closest localities in the departments of Boaco and Atlántico Sur (Noble, 1918; Gaige et al., 1937; Brattstrom and Howell, 1954; Villa, 1972; Köhler, 2001; Heyer, 2005). RIVAS: Reserva Silvestre Privada El Abuelo (11.11216 °N, 85.26927°W, WGS84); elev. 39 m; 30 August 2011. José G. Martínez-Fonseca and Luis Gutiérrez-López. UTADC-8218; Fig. 5E. We found five individuals at 2210 h in holes in the ground on the shore of Lago de Nicaragua, close to a small permanent stream. They represent the westernmost record for this species in Nicaragua and a new departmental record, with the closest locality in the department of Río San Juan (Villa, 1972; Köhler, 2001; Sunyer et al., 2009).

Family Microhylidae

Hypopachus pictiventris (Cope, 1886). ATLÁNTICO SUR: Aguazarca (11.42720°N, 84.23068°W, WGS84); elev. 97 m; 16 April 2014. José G. Martínez-Fonseca, Luis Gutiérrez-López, and Lenin A. Obando. We observed one frog (UTADC-8218; Fig. 5F) at 1940 h, in leaf litter in a small patch of forest surrounded by cattle fields. Although this frog does not constitute a new record for the department nor a range extension, it closes a wide gap in the distribution of this rare species in southern Nicaragua and represents the third known locality for the country (Köhler, 2001).

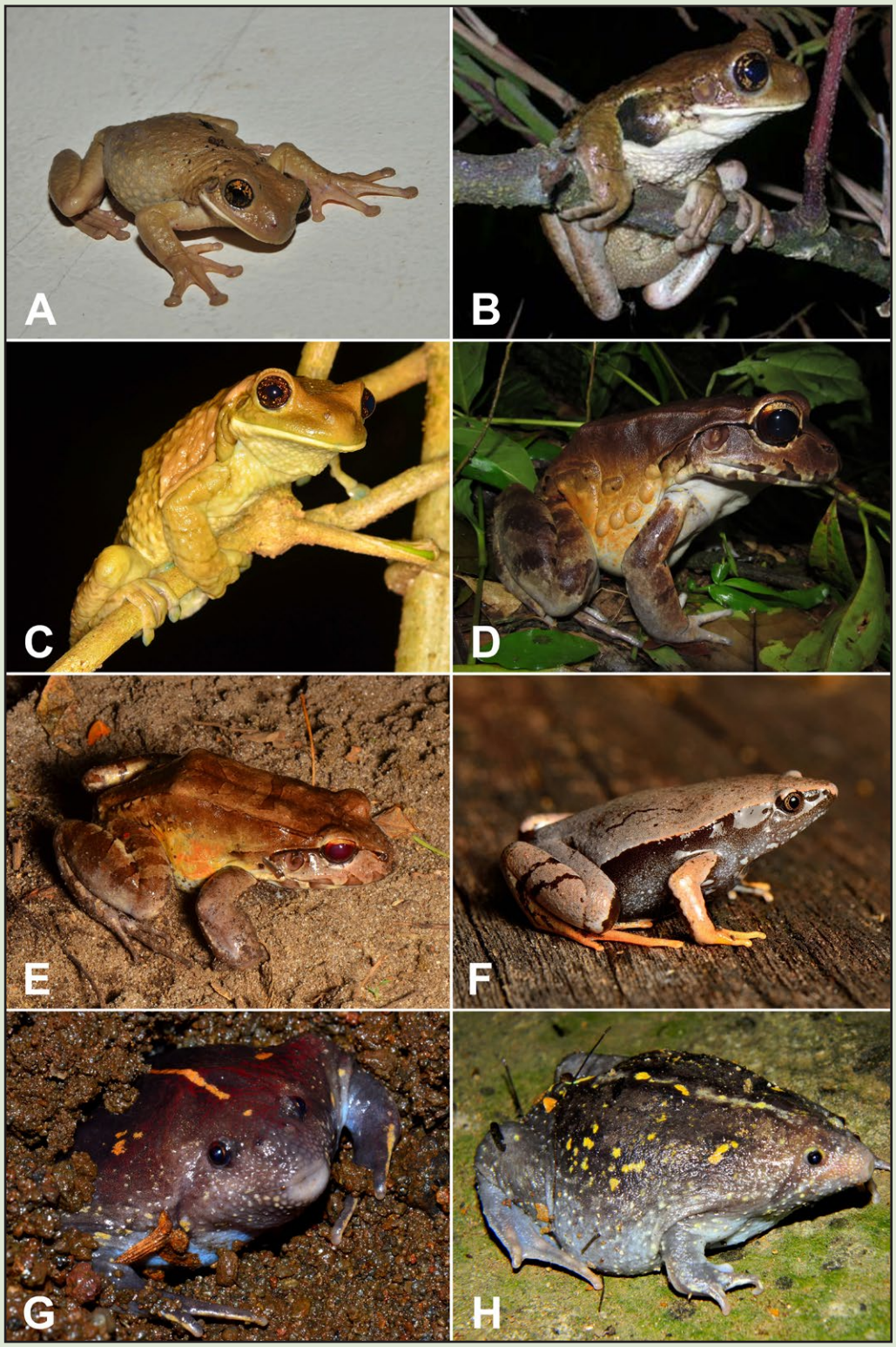

Fig. 5. (A and B) *Trachycephalus typhonius* from the department of Río San Juan; (C) *T. typhonius* from the department of Rivas; (D) *Leptodactylus savagei* from the department of Chontales; (E) *L. savagei* from the department of Rivas; (F); *Hypopachus pictiventris* from the department of Atlántico Sur; (G) *Rhinophrynus dorsalis* from the department of Chinandega; and (H) *R. dorsalis* from the department of Granada.

Hypopachus variolosus (Cope, 1866). RIVAS: Morgan's Rock (11.32692°N, 85.91389°W, WGS84); elev. 37 m; 11 September 2006. Javier Sunyer, Lenin A. Obando, and Darwin E. Manzanarez. We found two of these microhylids (SMF 88076, 98540) calling at night during heavy rains, while floating in small seasonal ponds. They represent a new departmental record, with the closest localities in the departments of Carazo and Granada (Villa, 1972; Nelson, 1974).

Family Rhinophrynidae

Rhinophrynus dorsalis Duméril and Bibron, 1841. CHINANDEGA: Chinandega, Barrio El Rosario (12.62550°N, 87.13926°W, WGS84); elev. 61 m; 30 August 2014. Milton Salazar-Saavedra. We observed one frog (UTADC 8221; Fig. 5G) in the backyard of a house around midnight, during heavy rain. It represents a new departmental record, with the closest locality in the department of León (Villa, 1984; Sunyer and Köhler, 2007). GRANADA: Southern slope of Volcán Mombacho (11.77114°N, 85.95770°W, WGS84); elev. 62 m; 7 February 2012. José G. Martínez-Fonseca and Milton Salazar-Saavedra. UTADC-8220; Fig. 5H. We saw five individuals at night in a pond surrounded by palm forest. They represent a new departmental record, with the closest locality in the department of León (Villa, 1984; Sunyer and Köhler, 2007).

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140 years after William M. Gabb's climb to Cerro Pico Blanco

On 4 February 1873, the American geologist William M. Gabb arrived in Puntarenas, Costa Rica, commissioned by the Keith brothers and the Costa Rican president, Tomás Guardia. He remained in Costa Rica until August of 1874, and returned to the United States where he died on 30 May 1878 at the age of 39. We will not provide a more extensive biography on W. M. Gabb, since other authors have written extensively about his life (Dall, 1909) and contributions to herpetology (Savage, 1970), geology and cartography (Denyer and Soto, 1999; Denyer and Lücke, 2007), and ethnic and socio-political studies in Costa Rica (Gabb, 1978). Instead, the purpose of this note is to analyze the route William M. Gabb traveled on his expedition to Cerro Pico Blanco, because of its importance in the study of the Costa Rican herpetofauna.

During his 19 months in Costa Rica, Gabb primarily was engaged in studying the Talamanca region (Gabb, 1894). As part of his research he was required to climb Cerro Pico Blanco, currently known as Cerro Kamuk. Whether he actually went to Kamuk or another peak has been debated (see below). During this trip, Gabb collected specimens of 20 species of amphibians and reptiles (Cope, 1875), of which 15 were described as new species (Cope, 1875; Savage, 1970). To this day, 12 specimens from Gabb's collection are maintained as holotypes (Frost, 2014; Table 1). Due the great scientific value of Gabb's collections, it is important to clarify the actual collecting localities from where the specimens came. Identifying the type locality of a species is an essential consideration when attempting to visit the site to collect new specimens to replace lost material, or to obtain tissues for molecular studies. Thus, the goals of this contribution are as follows: (1) to clarify which peak Gabb actually climbed during his trip to Cerro Pico Blanco in Costa Rica, (2) to suggest the possible ascent route he followed, and (3) to suggest the possible type localities for the majority of the specimens he collected.

Table 1. Species described with specimens Gabb collected. The elevations are according to the sites suggested on Fig. 3.

Species	Locality
Amphibia	
Craugastor gulosus	Near an unnamed hill close to the Río Lari canyon, elev. 1,830 m
Craugastor megacephalus	Near an unnamed hill close to the Río Lari canyon, elev. 1,830 m
Craugastor melanostictus	Near another unnamed hill at the headwaters of the Río Lari, elev. 2,135 m
Craugastor podiciferus	Between Cerro Pat and the headwaters of the Río Lari, elev. 1,520–2,135 m
Diasporus hylaeformis	Near another unnamed hill at the headwaters of the Río Lari, elev. 2,135 m
Incilius fastidiosus	Around the small village of Ourut, elev. 760 m
Incilius epioticus	Near Cerro Pat, elev. 1,520 m
Isthmohyla pictipes	Between Cerro Pat and the headwaters of the Río Lari, elev. 1,520–2,135 m
Pristimantis cerasinus	Slope of Cerro Kamuk, elev. possibly 760–1,520 m
Reptilia	
Anolis pachypus	Slope of Cerro Kamuk, elev. possibly 760–1,520 m
Ninia psephota	Between Cerro Pat and the headwaters of the Río Lari, elev. 1,520–2,135 m
Mesaspis monticola	Summit of Cerro Kamuk, elev. ca. 3,500 m

Among the documents Gabb generated during his stay in Costa Rica was a report on the geology of the country (Gabb, 1874). This report, however, remained unpublished until it was transcribed in 2007 (Gabb, 2007). In this report, Gabb wrote that he reached the summit of Cerro Pico Blanco or Kamuk on 13 June 1874, after 12 days of the hardest work in his life. He reported an elevation of 11,877.8 feet (3,620 m), close to the 3,549 m in elevation calculated for Kamuk by the Instituto Geográfico Nacional of Costa Rica (IGN). Nonetheless, in a map Gabb produced from his studies on Costa Rica (Petermann 1877, Fig. 1) an elevation of 9,652 feet (2,942 m) is assigned to Cerro Pico Blanco. This confusion grew when Enrique Pittier translated Gabb's reports (Gabb, 1894), since Pittier attributed an elevation of 9,652 feet to Cerro Pico Blanco. This discrepancy in the reported elevations led some researchers to conclude that William Gabb ascended Cerro Utyum and not Cerro Kamuk (Carballo, 1960; Gutiérrez, 1960; Savage, 1970), a conclusion largely motivated by the similarity of elevations in the 1894 translation of Gabb's report and that of the Cerro Utyum (3,060 m). We believe, however, that this interpretation from the 1960s and 70s is the result of the difficulty in accessing Gabb's unpublished 1874 manuscript. The inaccessibility of the original copy at the U.S. Geological Survey obligated researchers to consult only Pittier's translation (Gabb, 1894) in referring to Gabb's work. Denyer and Lücke (2007) suggested that Gabb actually climbed Cerro Kamuk, based on the similarity of the hydrography and position of the mountains between Gabb's map (Petermann, 1877, Fig. 1) and recent ones. These authors, however, did not discuss the issues raised by other researchers (Carballo, 1969; Gutiérrez, 1960; Savage, 1970). Hence, Gabb's zoological contributions from Cerro Pico Blanco still are attributed to Cerro Utyum (Frost, 2014).

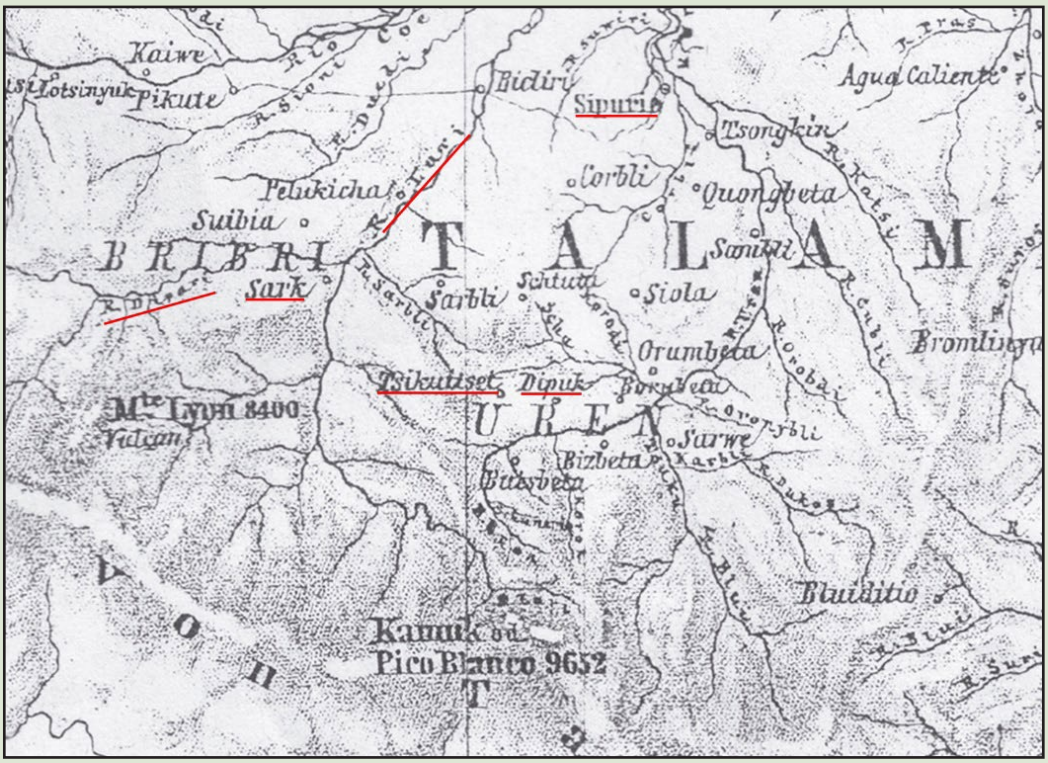

Fig. 1. A portion of Gabb's map showing the region between Sipurio and Cerro Kamuk. Compare sites underlined in red with those in Fig. 3. Reproduced from Petermann (1877).

We performed a comprehensive analysis of Gabb's original manuscript (1874), his map (Petermann, 1877), Pittier's translation (Gabb, 1894), Savage's interpretation (1974), Denyer and Lücke's analysis (2007), and our personal surveys at the summits of Kamuk and Utyum. Based on our re-evaluation of these sources, we conclude that Gabb indeed climbed Cerro Kamuk, as he reported. This conclusion is based on several lines of reasoning. First, when Gabb sent the specimens he collected to the Smithsonian Institution, he attributed an elevation of at least 11,800 feet to Cerro Pico Blanco (Cope 1875), which is very close to the actual elevation of Cerro Kamuk. Also,

in some of Gabb's other documents (Gabb, 1894; Petermann, 1877), he consistently miscalculated the elevation of several peaks, other than Cerro Kamuk. For example, the well-known Volcán Barva was reported at an elevation of 2,827 m in Gabb (1894), but it was reduced to 2,652 m in his map (Petermann, 1877); indeed, it would be difficult to believe that Gabb misidentified Volcán Barva for another peak. Thirdly, Gabb (1874) reported that the Lari and Uren rivers originate on Cerro Pico Blanco; both are known to originate at Cerro Kamuk, and it is difficult to imagine that Gabb could have reported this accurately if he actually had reached the summit of another peak. For example, if he in fact had climbed Cerro Utyum his descriptions of the Lari and Coen rivers would have been the most detailed, but the Río Coen is poorly described in his map (Petermann, 1877). Finally, a detailed description of the summit of Cerro Pico Blanco in the original 1874 report is not included in the translation of Pittier (Gabb, 1894). Gabb described the difficult access to the summit, with large cliffs and vegetation similar to that in American deserts. This description differs greatly from the summit of Cerro Utyum, where we currently conduct studies. An extensive peat bog is present on Cerro Utyum, and the summit is accessed easily from the treeline (Fig. 2a). The description, however, closely matches that of Cerro Kamuk (G. Chaves, pers. observ.), in which the slopes are very steep and it is difficult to reach the summit, the vegetation is limited, and cliffs dominate the landscape (Fig. 2b).

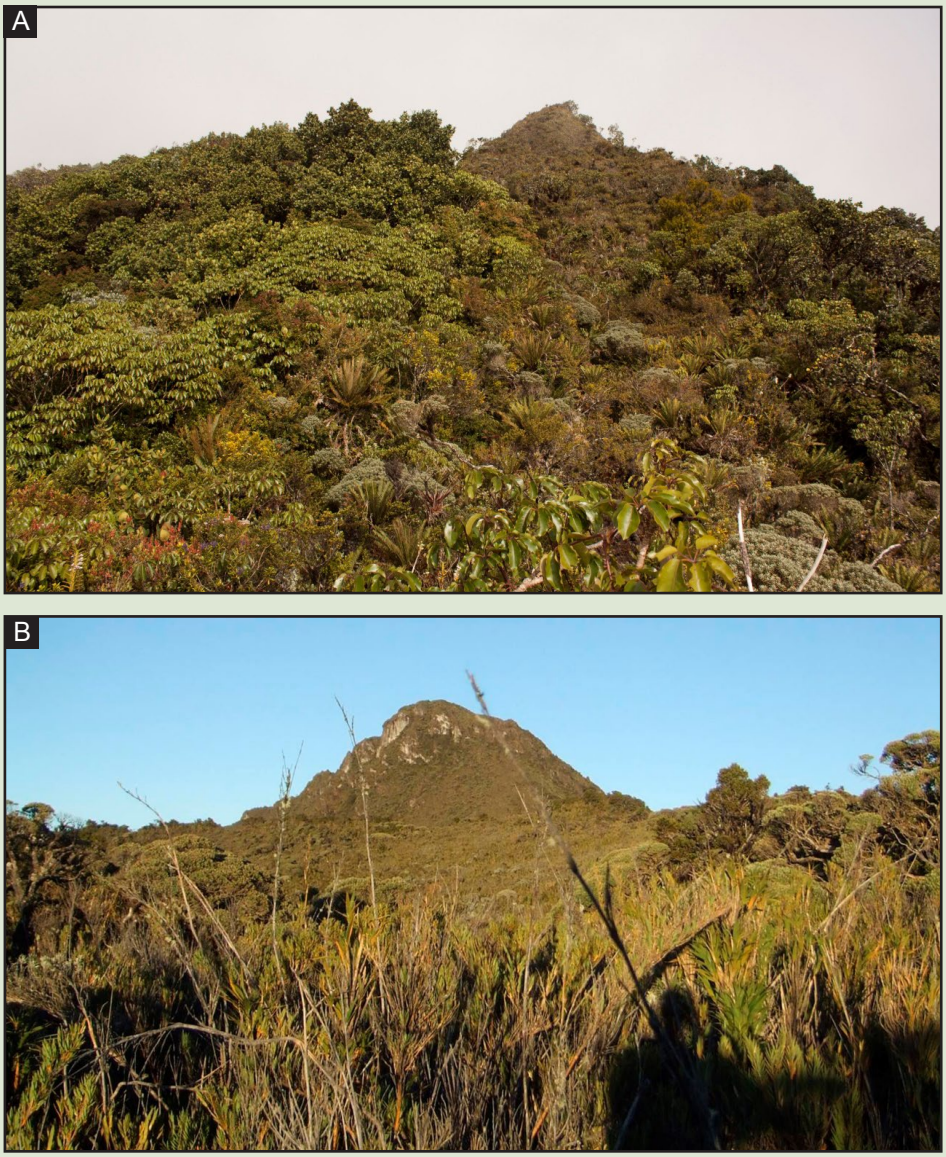

Fig. 2 Summits of (A) Cerro Utyum and (B) Cerro Kamuk in southwestern Costa Rica. © (A) E. Arias, (B) Luis G. Artavia

We analyzed Gabb's map (Petermann, 1877, Fig. 1) to determine the possible route he followed while ascending Cerro Kamuk. We inferred that the more accurate Gabb's description of a landmark, the better he was able to inspect it, and therefore, the closer his route took him to it. Gabb (1874) indicated that he ascended between the Lari and Uren rivers. According to Denyer and Lücke (2007), Gabb's map (Petermann, 1877) adheres closely to current knowledge of the hydrography of the Talamanca region; they especially noted the excellent fit of the Río Lari with the IGN's current maps (Fig. 1). A noteworthy consideration, however, is that the section of the Río Uren between Sipurio (9.5360°N, -82.9513°W, WGS84, elev. 60 m) and Dipuk (see below) is different than in the current maps (Figs. 1 and 3). Given this detail, we suggest that Gabb did not use the river line of the Uren to reach Dipuk, but rather walked along the Lari. We propose (see Fig. 3) that he started in the town of Sipurio, walked to the small village of Sarke or Alto Lari (9.4345°N, -83.0466°W, elev. 400 m) following the Río Lari, then walked to Cerro Pat (9.3957°N, -83.0231°W, elev. 1,500 m). At an elevation of about 2,000 m, he climbed to Cerro Kamuk following a ridge that divides the Uren and Lari rivers. When Gabb's map (Petermann, 1877) is superimposed on IGN's current map, the locations Gabb called Isikoilset and Dipuk correspond to Cerro Pat and the small village of Guachalaba (9.3730°N, -82.9987°W, elev. 900 m), respectively (Figs. 1 and 3). Gabb likely visited Dipuk on a separate trip taken before climbing Cerro Kamuk, since he indicated that he crossed the Río Uren and continued southeastward until reaching Panama. We infer that this visit to Dipuk was part of an earlier trip, because the journey to Panama would have been very difficult to complete following the strenuous trip to Kamuk. Notably, the trail between Sipurio and Guachalaba

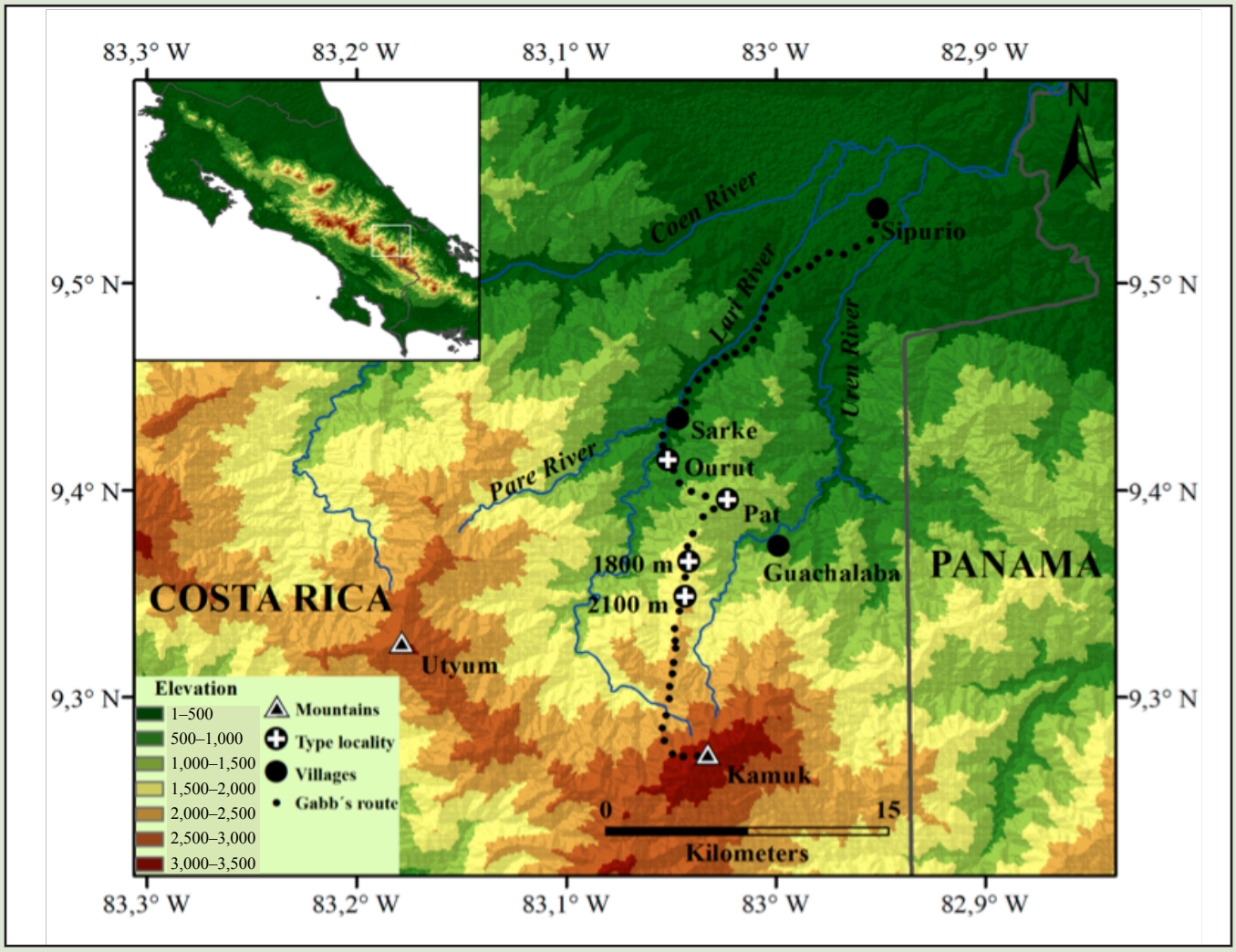

Fig. 3 Map of the Costa Rica–Panama border region showing the route we suggest Gabb followed.

is an old indigenous route recognized on IGN maps from 1968. Finally, Gabb (1874) noted that he climbed to Pico Blanco by the narrow ridge dividing the Lari and Uren, a crest that runs from Cerro Pat to Cerro Kamuk.

Based on the proposed route, we suggest some localities as potential collection sites (Table 1, Fig. 3). The specimens collected by Gabb on his trip to Cerro Kamuk are restricted to four sites, at 760, 1,520, 1,830 and 2,135 m in elevation (Cope, 1875). We suggest the following four areas are an approximation of Gabb's original sites (Table 1, Fig. 3): the site at 760 m is around the small village of Ourut (9.4149°N, -83.0514°W, elev. 700 m); the 1,520 m site is near the Cerro Pat; the 1,830 m site is near an unnamed hill close to the Río Lari canyon (9.3657°N, -83.0415°W, elev. 1,800 m); and the 2,135 m site is near another unnamed hill at the headwaters of the Río Lari (9.3488°N, -83.0434°W, elev. 2,100 m).

Clarifying the route followed by Gabb on his trip to Cerro Kamuk allows us to understand the fieldwork of a pioneer collector of Costa Rica's herpetofauna. On 13 June 2014 we celebrated the 140th anniversary of William Gabb's climb to Cerro Pico Blanco. This feat fills us with admiration, but also imposes the task of replicating his expedition, particularly since the comforts and technologies of the present facilitate fieldwork.

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