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Nota

Confirmation of the presence of *Anolis gaigei* Ruthven, 1916 (Squamata, Anolidae) in Venezuela and new distribution records

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Abstract: After almost eight decades, *Anolis gaigei* was resurrected from the synonymy with *A. tropidogaster*. Until then, its geographic distribution was restricted to Panama and Colombia, with possible, but not confirmed, occurrence in Venezuela (presumed on the basis of some previous records of *A. tropidogaster*). In this note, we corroborate the taxonomic identity of the Venezuelan *A. tropidogaster*-like populations as *A. gaigei*, based on the inspection of key phenotypic diagnostic characters from museum specimens. In addition, we compile geographic records of *A. gaigei* for Venezuela, based on museum specimens, literature, photographic records, and anecdotal observations of uncollected specimens. Lastly, we present an updated distribution map and briefly discuss the geographic distribution of this species in Venezuela.

Keywords: Reptilia; Iguania; *Norops*; Neotropics; Maracaibo Lake Basin; Andes

Confirmación de la presencia de *Anolis gaigei* Ruthven, 1916 (Squamata, Anolidae) en Venezuela, con nuevos registros de distribución

Resumen: Luego de casi ocho décadas, *Anolis gaigei* fue resucitado de la sinonimia de *A. tropidogaster*. Desde entonces su distribución fue restringida a Panamá y Colombia, ya que su presencia en Venezuela (presumida con base en algunos registros previos de *A. tropidogaster*) quedó a la espera de confirmación. En esta nota corroboramos como *A. gaigei* la identidad taxonómica de las poblaciones venezolanas de los *Anolis* previamente referidos como *A. tropidogaster*, con base en la verificación de caracteres fenotípicos diagnósticos en especímenes de museo. Adicionalmente, compilamos los registros de *A. gaigei* para Venezuela a partir de especímenes de museo, literatura, registros fotográficos y observaciones anecdóticas de especímenes no colectados. Finalmente, presentamos un mapa actualizado de la distribución geográfica de la especie en Venezuela y discutimos brevemente sobre su distribución en el país.

Palabras clave: Reptilia; Iguania; *Norops*; Neotrópico; Cuenca del Lago de Maracaibo; Andes

Anolis gaigei was described by Ruthven in 1916, from twelve specimens collected in San Lorenzo, Sierra de Santa Marta, Colombia, at ca. 823 m a.s.l. (Ruthven 1916). This taxon was subsequently considered a junior synonym of *Anolis tropidogaster* Hallowell, 1856 (Barbour 1934, Peters and Donoso-Barros 1970), a species until then known from northern Colombia and Panama (Barbour 1934). *Anolis tropidogaster* was reported for the first time for Venezuela by Donoso-Barros (1968) based on an unspecified number of specimens from El Tokuko in the Sierra de Perijá, Zulia state. Later on, Vanzolini and Williams (1970) referred seven specimens from La Fría and San Félix in Táchira state (south of the Maracaibo Lake Basin), and Rojas-Runjaic *et al.* (2007) reported two additional localities for Venezuela, both in the western border of Zulia state. Rivas *et al.* (2012) listed *A. tropidogaster* for three Venezuelan bioregions:

Mountain Range of Perijá, Maracaibo Lake Basin, and Mountain Range of Mérida, without indicating precise locations. The reference of this species for the first two bioregions apparently was based on the records of Donoso-Barros (1968), Vanzolini and Williams (1970), and Rojas-Runjaic *et al.* (2007); however, its presence in the third bioregion (Mountain range of Mérida), as far as we know, is not based on any previously published locality record.

Khöler *et al.* (2012) revisited the systematics of *Anolis tropidogaster* based on an extensive geographic sampling and on integrated morphological (hemipenis, dewlap coloration, and pholidosis) and molecular evidence (partial sequences of the mitochondrial 16S rRNA gene). They discovered two morphotypes, which were recovered in their molecular phylogenetic inference as two reciprocally monophyletic and deeply divergent lineages. Based on those results, Khöler *et al.* (2012) redefined *Anolis tropidogaster* and resurrected *A. gagei* from its synonymy. Additionally, the geographic distribution of *A. tropidogaster* was re-delimited from eastern Panama to northwestern Colombia (excluding previous records from western Venezuela), and for *A. gagei* from western Panama to northeastern Colombia. The authors presumed that *A. gagei* was present in Venezuela, but no specimens were verified. Hence, they cautiously referred the single locality record of Donoso-Barros (1968) as a locality for *A. tropidogaster*-like specimens, pending verification.

More recently, Barrio-Amorós and Ortiz (2015) reviewed the specimens collected by Donoso-Barros at El Tokuko (MZUC 11197, 39348, and 40157; all juveniles and very dehydrated) and presented a photograph of an additional specimen in life, supposedly from Santa Cruz de Mora, Mérida state (Barrio-Amorós and Ortiz 2015: Fig. 5D). However, the specimen photographed corresponded to an adult female from La Orchila, in the northern foothill of Sierra de Perijá, Zulia state (F.J.M. Rojas-Runjaic, pers. obs.). Barrio-Amorós and Ortiz (2015) referred all of these specimens to *A. gagei*, but did not provide any information about diagnostic characters that allowed them to determine the species identity. Lastly, Esqueda *et al.* (2016) mentioned the occurrence of *Anolis* aff. *tropidogaster* from two nearby locations in the Río Limones basin, in the lacustrine foothill of Cordillera de Mérida (Mérida state), but these last records were included in the natural history comments of a paper about the systematics and distribution of a different lizard species, and had consequently gone unnoticed in the literature.

Anolis gagei, as currently defined, is characterized by the following character states: medium-sized body (SVL up to 52.5 mm); large and flat dorsal head scales (particularly those in the parietal region); outer postmental scales greatly enlarged relative to medial ones; strongly keeled mucronate imbricate ventral scales; mid-dorsal caudal scales distinctly enlarged and forming a regular series; males with enlarged postcloacal scales; males with a large dewlap, yellowish colored at the margins and centrally reddish-orange; small unilobed hemipenis; and tube-like axillary pocket absent (Khöler *et al.* 2012).

In order to determine if whether presumed Venezuelan records of *Anolis tropidogaster*-like specimens actually correspond to *A. gagei*, we verified the specimens reported by Rojas-Runjaic *et al.* (2007) and a number of additional specimens housed in the Venezuelan collections of the Museo de Historia Natural La Salle, Caracas (MHNLS), and Museo de Biología de la Universidad del Zulia, Maracaibo (MBLUZ). The taxonomic identity of the specimens was re-assessed through inspection of the

morphological diagnostic characters described by Khöler *et al.* (2012), except hemipenis morphology, which was not reviewed. In addition, we compiled all records of *Anolis tropidogaster*-like specimens housed in six Venezuelan collections (MHNLS, MBLUZ, Museo de la Estación Biológica de Rancho Grande, Maracay [EBRG], Museo de Biología de la Universidad Central de Venezuela, Caracas [MBUCV], Colección de Vertebrados de la Universidad de Los Andes, Mérida [CVULA], Colección de Anfibios y Reptiles de Laboratorio de Biogeografía, Universidad de Los Andes, Mérida [ULABG]), and Museum of Comparative Zoology (MCZ) Massachusetts, USA. Finally, we included some additional locality records based on uncollected specimens, observed or photographed by the authors during fieldwork.

We listed and mapped a total of 31 locality records for Venezuelan *Anolis tropidogaster*-like specimens (Figure 1; Table 1). From these, we examined directly or through photographs, a total of 42 specimens coming from 16 of these localities. All of them fitted the definition of *A. gagei*, namely: large dorsal head scales, greatly enlarged outer postmentals, strongly keeled ventrals, mid-dorsal caudal scales enlarged and

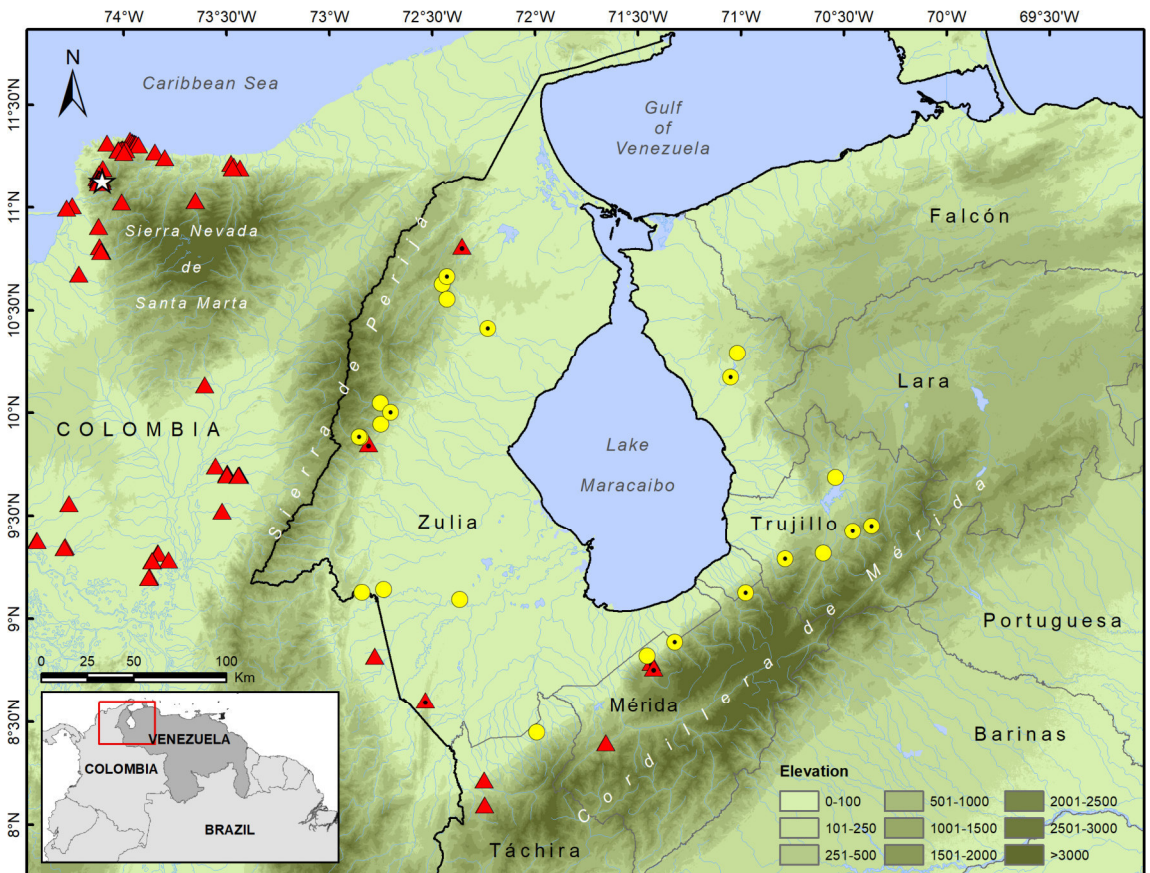


Figure 1. Map of northwestern Venezuela and northeastern Colombia showing the eastern portion of the geographic distribution of *Anolis gagei*. Red triangles: records from literature (those from Venezuela mostly referred to as *A. tropidogaster*). Yellow circles: new locality records. White star: type locality. Dotted symbols: locality records for which specimens were verified. Records for Colombia were obtained from GBIF (2023).

Table 1. List of geographic records of *Anolis gagei* from Venezuela. (*): locality for which all or some specimens were verified; (n): new locality record; **MHNLS**: Museo de Historia Natural La Salle, Caracas, Venezuela; **ULABG**: Colección de Anfibios y Reptiles de Laboratorio de Biogeografía, Universidad de Los Andes, Mérida, Venezuela; **CVULA**: Colección de Vertebrados de la Universidad de Los Andes, Mérida, Venezuela; **EBRG**: Museo de la Estación Biológica de Rancho Grande, Maracay, Venezuela; **MBLUZ**: Museo de Biología de la Universidad del Zulia, Maracaibo, Venezuela; **MBUCV**: Museo de Biología de la Universidad Central de Venezuela, Caracas, Venezuela; **MZUC**: Museo de Zoología de la Universidad de Concepción, Chile; **UMMZ**: University of Michigan, Museum of Zoology, Ann Arbor, USA; **MCZ**: Museum of Comparative Zoology, Cambridge, USA.

Locality	Geographic coordinates	Elevation (m a.s.l.)	Source
Mérida			
- Selva Guayacán, Río Limones basin, Obispo Ramos de Lora municipality (*)	8.790000°, -71.432500°	398	Esqueda <i>et al.</i> (2016); This study: ULABG 6585, 7327
- Cacaotal, Río Limones basin, 1.7 km from the junction with the road La Azulita-Guayabones, Andrés Bello municipality (*)	8.762778°, -71.422222°	790	Esqueda <i>et al.</i> (2016); This study: ULABG 6577
- Santa Cruz de Mora, Antonio Pinto Salinas municipality.	8.396973°, -71.653734°	700	Barrio-Amorós and Ortiz (2015): Anecdotal record (the Fig. 5D does not correspond to a specimen from that locality. See comments in this note)
- El Espejo, near Las Virtudes, Tulio Febres Cordero municipality (*) (n)	9.124720°, -70.973890°	600	This study: MHNLS 6928
- La Maricela sector, Panamerican highway, Carracciolo Parra Olmedo municipality (*) (n)	8.886861°, -71.319667°	270	This study: MHNLS 22638–22342 (Fig. 3a–b)
- Río Capaz (n)	8.820679°, -71.454740°	95	This study: MBUCV 3669
Táchira			
- La Fría, García de Hevia municipality	8.217899°, -72.245034°	140	Vanzolini and Williams (1970): UMMZ 55973, 55975, 55981, 55983, 55988
- San Felix, Ayacucho municipality	8.097279°, -72.242914°	490	Vanzolini and Williams (1970): UMMZ 55980, 55986
- Unidad Agropecuaria Los Andes, road La Fría-El Vigía (n)	8.448835°, -71.991166°	70	This study: MBUCV 3705
Trujillo			
- El Chuco, southwest of La Gira, Rafael Rangel municipality (*) (n)	9.288949°, -70.783227°	450	This study: Anecdotal record (E.E. Infante-Rivero, pers. obs., 2015)
- El Prado urbanization, Pampanito municipality (*) (n)	9.423407°, -70.453180°	470	This study: Anecdotal record (F.J.M. Rojas-Runjaic, pers. obs., 2003)
- Siquisay, Pampán municipality (*) (n)	9.450003°, -70.378333°	1287	This study: Uncollected specimen (Fig. 3c–d). Photographic record available at: https://www.inaturalist.org/observations/68439258
- Río Jirajara, about 2 km from the iron bridge (n)	9.686230°, -70.538238°	175	This study: MBLUZ R-160
- Near Valera city, Valera municipality (n)	9.315773°, -70.597075°	460	This study: CVULA 2701
Zulia			
- Misión de El Tokuko, Sierra de Perijá, Machiques de Perijá municipality (*)	9.849910°, -72.808470°	261	Donoso-Barros (1968) and Barrio-Amorós and Ortiz (2015): MZUC 11197, 39348, 40157; This study: MHNLS 10049, 10057, 10070, MBLUZ R-331, ULABG 1358–1362, 1379, 1381
- Fundo La Orchila, Sierra de Perijá, Mara municipality (*)	10.812222°, -72.353611°	230	Rojas-Runjaic <i>et al.</i> (2007): MBLUZ R-794, R-797; This study: MBLUZ R-787
- Hacienda El Mirador, km. 497 Machiques-Colón road, Jesús María Semprún municipality (*)	8.606108°, -72.530307°	136	Rojas-Runjaic <i>et al.</i> (2007): MBLUZ-R 803; This study: MBLUZ-R 827
- Caño Colorado, Sierra de Perijá, Jesús Enrique Lossada municipality (*) (n)	10.663080°, -72.425980°	240	This study: MHNLS 17657
- El Deseo farm, Sierra de Perijá, Machiques de Perijá municipality (*) (n)	10.000000°, -72.700000°	261	This study: MHNLS 18071, 18073–18074
- Upstream of the Kusare waterfall, in front of ipika, Sierra de Perijá, Machiques de Perijá municipality (*) (n)	9.878889°, -72.846111°	579	This study: MHNLS 18134–18137
- Inparques ranger station, Burro Negro recreational park, Lagunillas municipality (*) (n)	10.172804°, -71.048251°	77	This study: MHNLS 18148
- Ipika, Río Tukuko basin, Sierra de Perijá, Machiques de Perijá municipality (*) (n)	9.882152°, -72.852093°	534	This study: MHNLS 18562–18563
- On trees at bridge over Río Palmar, km 79 on road Maracaibo-El Rosario (*) (n)	10.411770°, -72.228261°	52	This study: MCZ R-133468–133470
- Río Bravo, Catatumbo municipality (n)	9.092500°, -72.364722°	23	This study: MBUCV 3646
- Kasmera, Sierra de Perijá (n)	9.943333°, -72.749167°	270	This study: MBUCV 8022
- Buenos Aires farm, 1 km from La Pista, Río de Oro, Perijá National Park, Jesús María Semprún municipality (n)	9.127448°, -72.840178°	39	This study: MBLUZ R-252
- Parcelamiento la Onza, Caño Lindo, 6 km from Río de Oro, Jesús María Semprún municipality (n)	9.140354°, -72.735203°	38	This study: MBLUZ R-257
- Near the banks of Río Palmar, Sierra de Perijá (n)	10.627405°, -72.448789°	660	This study: EBRG 2550
- Near the banks of Río Lajas, Sierra de Perijá (n)	10.553748°, -72.426999°	280	This study: EBRG 2561
- Coffee plantation southeast of Ayapaina, Sierra de Perijá, Machiques de Perijá municipality (n)	10.047558°, -72.749297°	887	This study: MBLUZ R-334
- Near Río Chiquito, Serranía de Ziruma (n)	10.291555°, -71.016186°	126	This study: MBLUZ R-850, R-856

arranged in regular series, enlarged postcloacal scales in males, large dewlap, yellowish-colored at the margins and reddish-orange at the center in males, and tube-like axillary pocket absent (see figures 2–3). Our qualitative morphological assessment objectively confirmed that Venezuelan *Anolis tropidogaster*-like populations correspond to *A. gaigei*. Although it was not possible to inspect the specimens reported by Donoso-Barros (1968), Vanzolini and Williams (1970), and Barrio-Amorós and Ortiz (2015), we corroborate *A. gaigei* as the identity of other specimens from the same general area (e.g., MHNLS 10049, 10057, 10070 from Misión del Tokuko, Zulia; MBLUZ-R 803, 827 from Cerro El Mirador, Zulia; and MHNLS 22638–22342 from

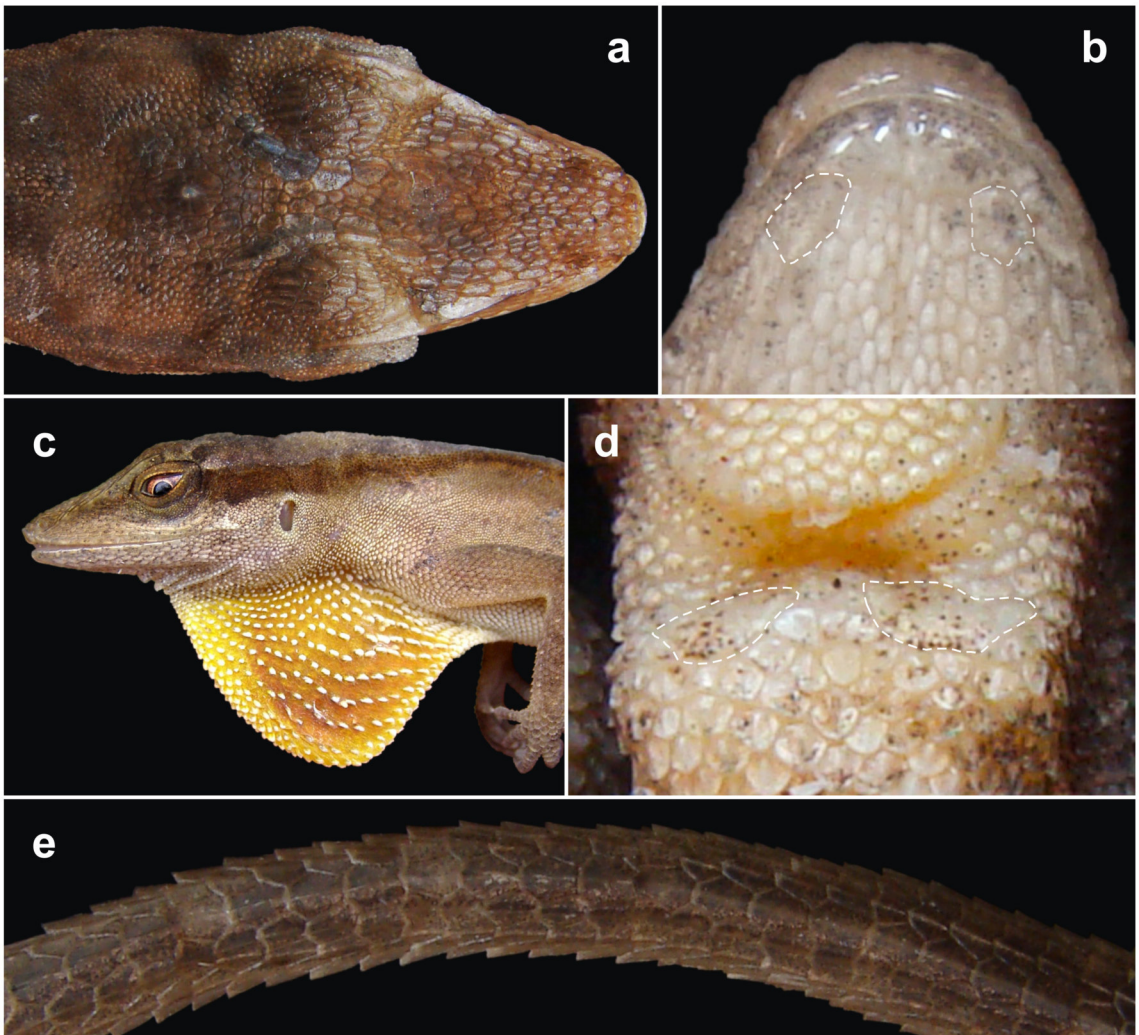


Figure 2. Some relevant diagnostic characters of *Anolis gaigei* noted in the Venezuelan specimens: **a.** Flat and keeled enlarged cephalic scales (MHNLS 18137); **b.** Outer postmental scales (highlighted by a dashed white line) greatly enlarged relative to medial ones (MHNLS 18136); **c.** Dewlap orange yellow with a darker orange central area; **d.** A pair of postcloacal scales (highlighted by a dashed white line) greatly enlarged in males (MHNLS 18136); **e.** Middorsal caudal scales distinctly enlarged and forming a regular series (MHNLS 18137). Photos: M.C. Castellanos-Montero (a–b, d–e) and E.E. Infante-Rivero (c)

La Maricela, Mérida). Hence, we assume that it is very likely that these specimens are conspecific.

Locality records suggest that *Anolis gagei* is apparently restricted, in Venezuela, to the Maracaibo Lake Basin, in the northwestern portion of the country, including the states of Zulia, Táchira, Mérida, and Trujillo. In this region, the species is distributed mainly along the eastern foothills of the Sierra de Perijá and in the western slopes of the Andean Cordillera de Mérida (Figure 1), inhabiting from semideciduous lowland forest to ombrophilous submontane/montane evergreen forests (Huber and Alarcón 1988), between 23 and 1,287 m a.s.l.



Figure 3. Photographic records of one of the five specimens (MHNLS 22368–22342) of *Anolis gagei* from La Maricela, Mérida state (a–b), and the uncollected specimen from Siquisay, Trujillo state (c–d). Photos: D. Quihua (a–b) and D. Rojas (c–d).

Khöler *et al.* (2012) state that *Anolis gagei* is extremely common in Panama, reaching high population densities at some locations. They also indicate that the species inhabits a variety of habitats, from semideciduous forests to bushy savannahs, and even in living fences bordering cattle pasture areas. Based on our field observations on some locations at the foothills of Sierra de Perijá and Cordillera de Mérida, we noted that *Anolis gagei* is primarily a silvicolous species, mainly found in forest environments associated with mountain creeks and rivulets. The species was common in some foothill localities (e.g., La Orchila and Ipika, in Zulia state, and La Maricela in Mérida state), with individuals active during the day, detected while running on the leaf litter on forest floor or among rocks on the margins of creeks, or while perched on branches of the lower strata of the riparian forest. Specimens were also frequently found sleeping on the upper surface of leaves or branches of bushes on the lower strata of riparian forests. Contrary to observations provided by Khöler *et al.* (2012), we detected no specimens of *Anolis gagei* in open areas (i.e., bushy savannahs and living fences bordering pasturelands) next to the riparian forests during fieldwork.

We noted that three of our locality records are somewhat unexpected, considering the general distribution pattern of the species in Venezuela. The first two locations correspond to the surroundings of the bridge over Río Palmar, in the road Maracaibo-El Rosario (52 m a.s.l.) and in Río Bravo (23 m a.s.l.). Both are located in lowland landscapes of the western part of Maracaibo plain (Zulia state), somewhat distant from foothill environments where the species appears to be more common. In view that both localities correspond to riparian forests associated with rivers that originated in the piedmont of Perijá, we presume that these riparian forests could have acted as corridors, eventually allowing the dispersal of *Anolis gagei* into some regions of the Maracaibo plain. It appears more plausible if we also consider that this species can thrive even in shrublands and open environments (Khöler *et al.* 2012). Nevertheless, further studies will be required in order to corroborate our hypothesis.

The third case correspond to the record from Siquisay, Trujillo state (western slope of Cordillera de Mérida), at 1,287 m a.s.l. This refers to the highest altitudinal record for the species, not only from Venezuela but for its entire geographic range (the upper limit of the elevational range reported by Khöler *et al.* 2012 was about 900 m a.s.l.). The second highest elevational record for the species (this study) is 887 m a.s.l. and correspond to a locality of ombrophilous submontane/montane evergreen forest on the eastern versant of Sierra de Perijá. The specimen from Siquisay (Figures 3c–d) was found in the periphery of a small town located in a mountainous landscape dominated by crops and pasturelands, with a few remnant forest patches, distant from local creeks and rivulets. In this region, deforestation has been historically intense, generating almost continuous open areas along the Andean valleys, from lowlands an up to these high elevations, apparently allowing the relatively recent colonization of this upland locality by some lizard species that typically inhabit lowlands, as *Cnemidophorus* aff. *lemniscatus* (Damaris Rojas, pers. obs.). We suspect that the presence of *Anolis gagei* at this locality could be consequence of a recent colonization facilitated by habitat modification, as apparently occurred at the same location with *C.* aff. *lemniscatus*. Alternatively, it could represent a natural (albeit atypical) upper limit on the altitudinal range of *Anolis gagei*. Further research will be required in order to objectively explain the occurrence of this species at this upland location.

Taking into account that the geographic distribution of *Anolis gaigei* appears to be continuous along the Andean foothills that circumscribes the Maracaibo Lake Basin, it is likely that the species occurs in similar suitable habitats of the western part of the states Lara and Falcón. The Lara-Falcón Mountain System has been poorly surveyed for herpetofauna, and we encourage herpetological inventories to be conducted in that region. This would, not only to improve our knowledge about the eastern limit of the distribution of *Anolis gaigei* but would also better characterize the poorly known local herpetofauna. Finally, by corroborating that the identity of the Venezuelan *Anolis tropidogaster*-like populations correspond to *A. gaigei*, and by significantly improving the knowledge on the geographic distribution of this species based on museum specimens, we demonstrate in this note how relevant are natural history collections in the urgent task of minimizing the Wallacean shortfall in our current scenario of climate change and accelerated biodiversity loss.

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