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EXPANDING OUR KNOWLEDGE OF ANURANS IN THE COLOMBIAN ANDES: NEW RECORDS OF *PRISTIMANTIS BUCKLEYI* (BOULENGER, 1882) AND RANGE EXTENSIONS FOR *NICEFORONIA ADENOBRACHIA* (ARDILA-ROBAYO, RUIZ-CARRANZA, AND BARRERA-RODRÍGUEZ, 1996) AND *NICEFORONIA LATENS* (LYNCH, 1989)

APORTES AL CONOCIMIENTO DE LOS ANUROS EN LOS ANDES COLOMBIANOS: NUEVOS REGISTROS DE *PRISTIMANTIS BUCKLEYI* (BOULENGER, 1882) Y AMPLIACIÓN DEL RANGO DE DISTRIBUCIÓN DE *NICEFORONIA ADENOBRACHIA* (ARDILA-ROBAYO, RUIZ-CARRANZA, Y BARRERA-RODRÍGUEZ, 1996) Y *NICEFORONIA LATENS* (LYNCH, 1989)

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The diversity of anurans in Colombia is remarkable, with approximately 832 reported species, being Centrolenidae (~82 spp.), Dendrobatidae (~103 spp.), Hylidae (~156 spp.), and Craugastoridae (275 spp.), the most representative anuran families in the country (Frost, 2025; Acosta-Galvis, 2025). The Andes, with its diverse altitudinal zones and ecosystems, is recognized as one of the world's most biodiverse regions for amphibians (Hernández-Camacho et al., 1992; Myers et al., 2000; Armesto & Señaris, 2017; Hutter et al., 2017). Despite the Andes' significance as an amphibian hotspot, knowledge gaps persist, particularly regarding ecology, systematics, and geographic distribution of species within the genera *Pristimantis* and *Niceforonia*. These information gaps are due, in part, to the difficulties of species identification, the high degree of plasticity reported in these groups, cryptic diversity, and instability in their taxonomy (Guayasamín et al., 2015; Acosta-Galvis et al., 2018).

Addressing these gaps requires targeted sampling efforts to understand this group, particularly for geographic distribution, as delineating species ranges is essential for effective conservation (Syfert et al., 2014). In addition, these efforts will be reflected in the understanding of ecological attributes such as their use of microhabitats and prey-predator interactions, aspects that are poorly known in these species. This study presents new records of the Boqueron Robber Frog, *Niceforonia latens* (Lynch, 1989), and Buckley's Robber Frog, *Pristimantis buckleyi* (Boulenger, 1882), in the department of Quindío. Furthermore, we report the first records of *Niceforonia adenobrachia* (Ardila-Robayo, Ruiz-Carranza, and Barrera-Rodríguez, 1996) and *N. latens* in the department of Risaralda. We also document aspects of natural history unknown for the genus *Niceforonia*, particularly, defensive behaviors.

Between 2020 and 2025, we conducted opportunistic surveys in several microhabitats across four localities in the departments of Risaralda and Quindío, to document anuran diversity. These localities are characterized by typical high Andean forest features (sensu Holdridge, 1967) (Fig. 1). In Risaralda, two visits were conducted at Reserva Wild Campo Alegre (La Linda sector, Santa Rosa de Cabal: 4.86103° N, 75.50612° W, 2,926 m a.s.l.) (Fig. 1A), which is part of the Distrito de Conservación de Suelos Campo Alegre, a buffer zone of the Parque Nacional Natural

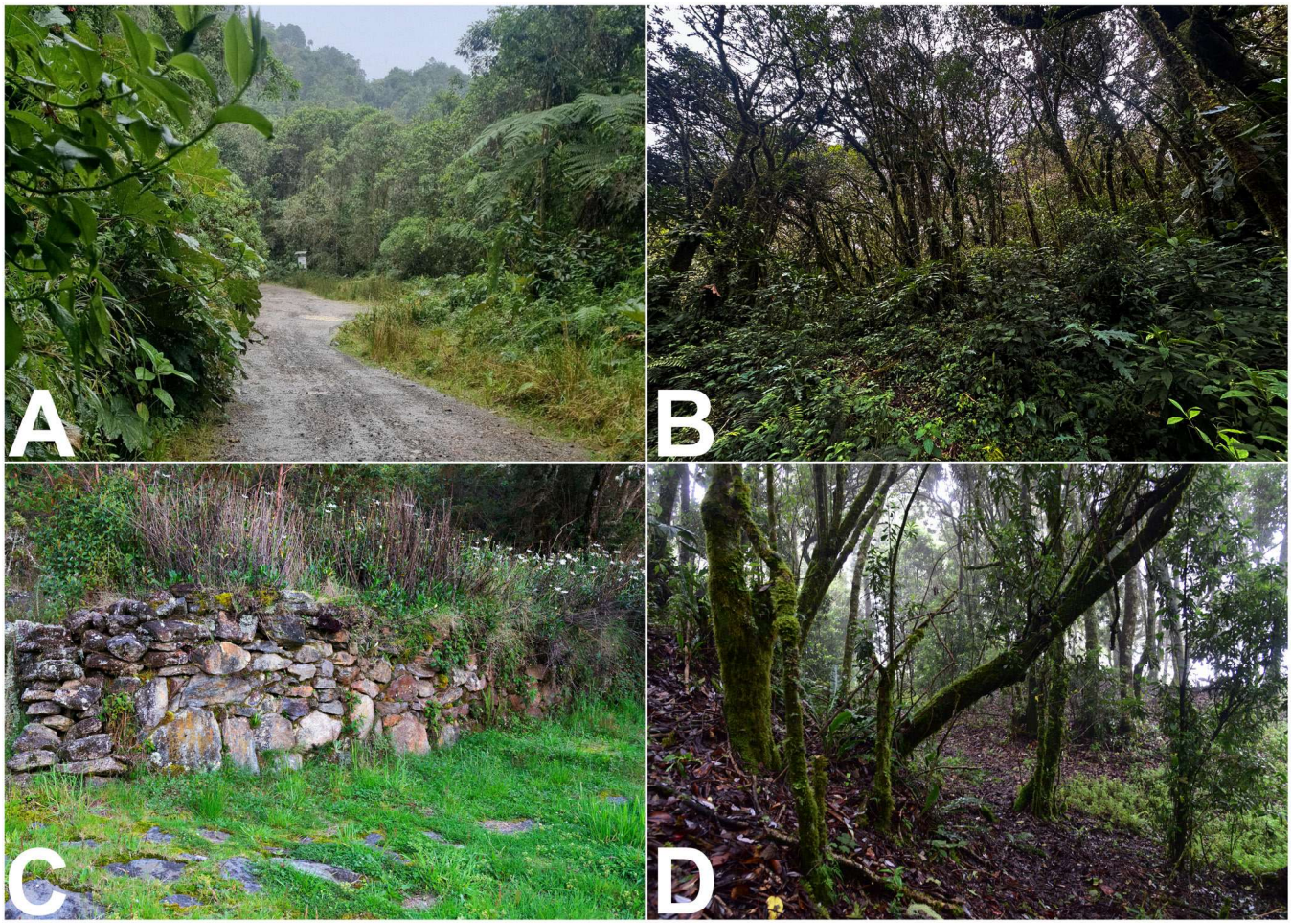

Figura 1. Ecosistemas muestreados en las cuatro localidades visitadas: A) Reserva Wild Project Campo Alegre, B) Reserva Natural El Jardín, C) Reserva El Mirador, y D) Reserva Natural La Sonadora. Fotos: A) Andrés Montes-Londoño, B) Cynthia Ávila-Rojas, C) Sergio Raul Cruz Suazo y D) Kevin J. López-Molina.

Figure 1. Sampled ecosystems in the four visited locations: A) Reserva Wild Project Campo Alegre, B) Reserva Natural El Jardín, C) Reserva El Mirador, and D) Reserva Natural La Sonadora. Photos: A) Andrés Montes-Londoño, B) Cynthia Ávila-Rojas, C) Sergio Raul Cruz Suazo, and D) Kevin J. López-Molina.

Los Nevados. In Quindío, one visit was conducted to each of the following localities: Reserva Natural El Jardín (Génova: 4.15069° N, 75.74274° W, 2,887 m a.s.l.) (Fig. 1B), Reserva El Mirador (Génova: 4.13981° N, 75.73573° W, 3,264 m a.s.l.) (Fig. 1C), and Reserva Natural La Sonadora (Calarcá: 4.43163° N, 75.61977° W, 3,100 m a.s.l.) (Fig. 1D).

Species identification was conducted in the field (no individuals were collected) and was based on species descriptions (Boulenger, 1882; Lynch, 1989; Ardila-Robayo et al., 1996) and relevant literature (e.g., Lynch, 1981; Ardila-Robayo et al., 2004; Rojas-Morales & Marín-Martínez, 2019). *Niceforonia adenobrachia* is distinguished from other species in the genus by its smooth dorsal skin with scattered tubercles; light to dark brown dorsal coloration, with a cream axillary and inguinal patch; tubercles on the upper eyelid; differentiated tympanum, but hidden under the skin; prominent tarsal tubercle, unwebbed digits; granular ventral skin; cream-colored ventral coloration with dark brown to black reticulations or vermiculations (Ardila-Robayo et al., 1996, 2004). The three individuals identified as *N. latens* exhibited the characteristics described by Lynch (1989): snout rounded in dorsal view; canthus rostralis rounded; smooth dorsal and ventral skin, except for the lower back which has scattered tubercles; dorsum brown, darker laterally; venter dark brown with pale flecks; yellow blotch in the groin (cream in *N. adenobrachia*) (Fig. 2A, C); tympanum concealed; dorsolateral folds incomplete; first finger longer than second; fingers lacking discs; ulnar fold present; no tarsal tubercles (present

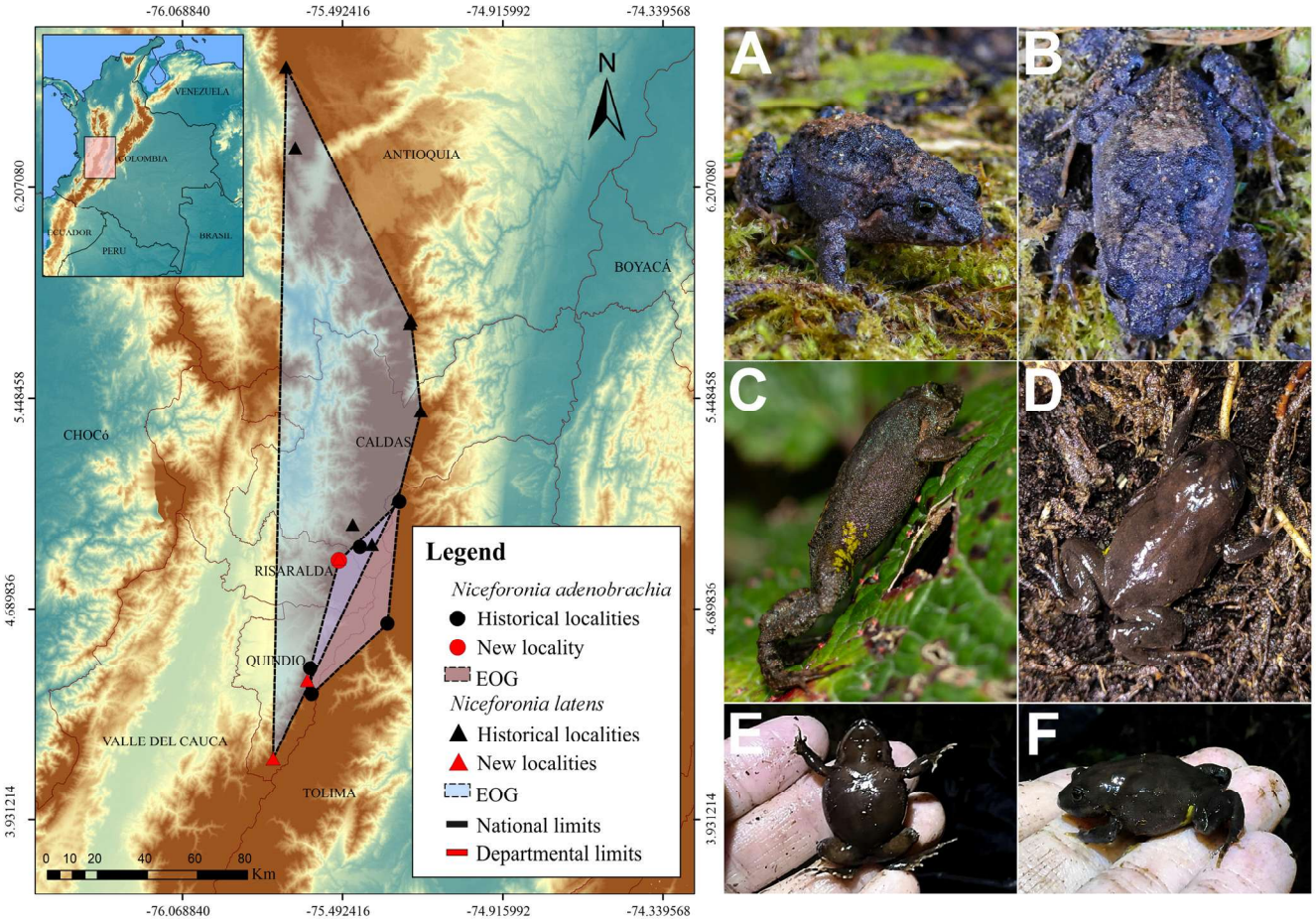

Figura 2. Mapa de distribución de *Niceforonia adenobrachia* y *N. latens*. A) Vista dorsolateral y B) dorsal de *N. adenobrachia* C) vista lateral y D) dorsal de *N. latens*; y E-F) individuo de *N. latens* inflando el cuerpo. Fotos: A-C) Andrés Montes-Londoño, D) Daniel Alejandro Londoño-Campo y E-F) Cynthia Ávila-Rojas.

Figure 2. Distribution map of *Niceforonia adenobrachia* and *N. latens*. A) Dorsolateral view and B) dorsal view of *N. adenobrachia;* C) lateral view and D) dorsal view of *N. latens;* and E-F) *N. latens* individual displaying body inflation. Photos: A-C) Andrés Montes-Londoño, D) Daniel Alejandro Londoño-Campo, and E-F) Cynthia Ávila-Rojas.

in *N. adenobrachia*); indefinite inner and outer tarsal folds; two metatarsal tubercles; toe tips with slightly expanded discs (Lynch, 1989; Rojas-Morales & Marín-Martínez, 2019). *Pristimantis buckleyi* can be distinguished from other *Pristimantis* species by its rounded snout, as long as the greatest orbital diameter; canthus rostralis distinct; distinct tympanic membrane and annulus; labial stripe white or cream; low dorsolateral folds; variable dorsal coloration: grayish to yellowish-brown, reddish, or black; skin of upper surfaces with small smooth warts; brown granular belly, with dark spots or marbling; fingers with broad, expanded discs on truncate pads; absence of tarsal, calcar, and ulnar tubercles; males lacking vocal sac (Boulenger, 1882; Lynch, 1981).

Additionally, we compiled geographic records for the three species from the Global Biodiversity Information Facility (GBIF, 2025a, b, c), using the filters 'Basis of record: preserved specimen' and 'Occurrence: including coordinates' to minimize taxonomic identification biases (Ríos-Muñoz & Espinosa-Martínez, 2019). These records were complemented with data from recent publications (Romero-García et al., 2015; Rojas-Morales & Marín-Martínez, 2019; Cuellar-Valencia et al., 2020). For *P. buckleyi*, only Colombian records were included given its broader distribution in Ecuador (Frost, 2025). To quantify the geographic distance between our records and those compiled, we used a tool in Google Earth Pro® that measures distance considering elevation profiles (i.e., not linear distances). For *N. adenobrachia* and *N. latens*, categorized as Endangered (EN) and Vulnerable

(VU), respectively (IUCN, 2017a, b), we calculated the Minimum Convex Polygon (MCP) to estimate their distribution ranges. MCPs were calculated using the Minimum Bounding Geometry algorithm in QGIS v. 3.34.13 (QGIS.org, 2025).

A total of one *N. adenobrachia*, three *N. latens*, and one *P. buckleyi* individual were recorded across the four localities. In the Reserva Wild Campo Alegre (Risaralda), one adult *N. adenobrachia* (8:03 h) and one adult *N. latens* (14:04 h) (Fig. 2A-D) were found under rocks less than five meters from the road (Fig. 1A). On the other hand, in the La Sonadora and El Jardín reserves (Quindío), two additional *N. latens* individuals were found under leaf litter, one during the day (13:12 h) and one at night (19:21 h) (Fig. 2). Notably, the individual found in El Jardín was buried 15 cm deep among roots (Fig. 2D) and displayed defensive behaviors such as body inflation when disturbed (Fig. 2E-F). In the Reserva El Mirador (Quindío), an adult *P. buckleyi* was observed perched on a rocky substrate by the roadside at 01:47 h (Fig. 3A-B). Additionally, several individuals were heard calling in a nearby flooded area with muddy substrate and low vegetation characteristic of the páramo transition.

A total of 112 geographic records were obtained for the three species. *Niceforonia adenobrachia* was represented by seven records from the departments of Caldas, Quindío, and Tolima, with a new record reported here for Risaralda (Fig. 2). This new record extends the species' known distribution by 10.3 km from the nearest locality (Vereda Playa Larga, Caldas: 4.90997° N, 75.43017° W) and by 35.9 km from the type locality (Herveo, Tolima: 5.07401° N, 75.28820° W). For *N. latens*, a total of eight records were obtained from the departments of Antioquia, Caldas, and Tolima, with three additional records from Quindío and Risaralda (Fig. 2). In particular, the record from El Jardín represents the southernmost known distribution for the species (Fig. 2). The records from El Jardín and the Reserva Wild Project are 86.6 km apart. These localities, in turn, are 250 km and 172

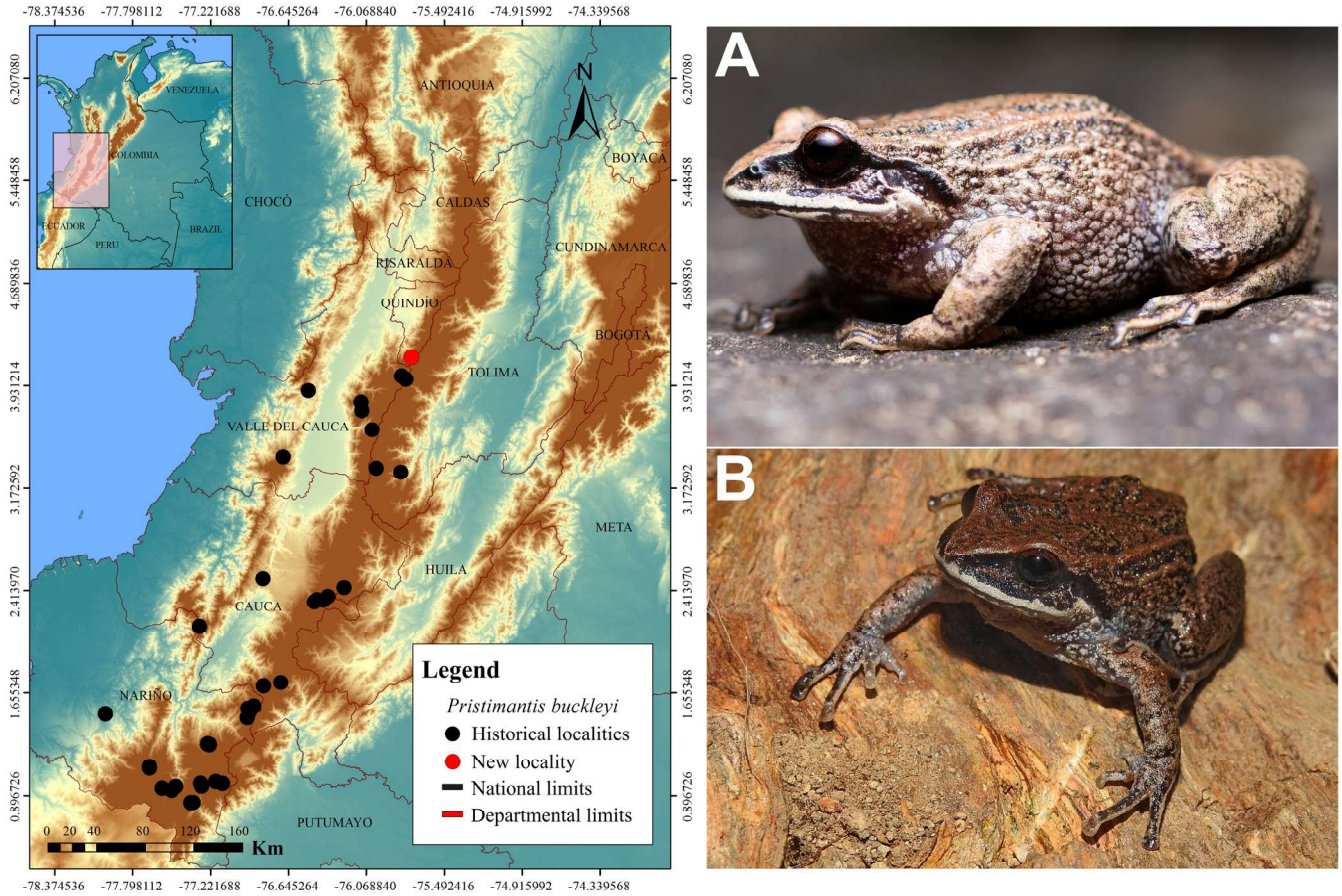

Figura 3. Mapa de distribución de *Pristimantis buckleyi* en Colombia. A) Vista lateral, B) vista dorsolateral. Fotos: A) Germán D. Gallego-Chica, and B) Sergio Raul Cruz Suazo.

Figure 3. Distribution map of *Pristimantis buckleyi* in Colombia. A) Lateral view, B) dorsolateral view. Photos: A) Germán D. Gallego-Chica, and B) Sergio Raul Cruz Suazo.

km, respectively, from the type locality (Serranía Las Baldías, Boquerón, Antioquia: 6.3495° N, 75.6624° W). MPCs indicated that the distribution ranges of *N. adenobrachia* and *N. latens* were 1258.46 km² and 8952.03 km², respectively (Fig. 2, 3). For *P. buckleyi*, 93 records were obtained from Cauca, Nariño, Tolima, and Valle del Cauca. This study presents a new record for Quindío (Fig. 3), 18.4 km from the nearest previously known locality in Sevilla, Valle del Cauca (4.0005° N, 75.80719° W).

These results not only provide the first records of the studied species in the departments of Quindío and Risaralda, but also expand the distribution ranges of two Colombian endemic species, *N. adenobrachia* and *N. latens*, and fill gaps in the distributions of *P. buckleyi* and *N. latens* in Quindío and Risaralda, respectively (Fig. 2, 3). In particular, *P. buckleyi* is distributed across the Colombian Central Massif, both slopes of the Cordillera Central, and the eastern slope of the Cordillera Occidental in the departments of Cauca, Nariño, Quindío, Tolima, and Valle del Cauca, at elevations between 1,900 and 3,700 m a.s.l. (Acosta-Galvis, 2023; Frost, 2025; this study). Our record confirms the species' presence in Quindío, as suggested by its distribution polygon (sensu IUCN, 2023).

For *N. adenobrachia*, which is distributed in the departments of Caldas, Quindío, Risaralda, and Tolima (Buitrago-González et al., 2016; Frost, 2025; Acosta-Galvis, 2025; this study), our records also extend its known altitudinal range from 2,926 (this study) to 3,872 m a.s.l. (sensu IUCN, 2017a). On the other hand, *N. latens* has been recorded in Antioquia, Caldas, Tolima, Risaralda, and Quindío, at elevations between 2,600 and 3,200 m a.s.l. (Rojas-Morales & Marín-Martínez, 2019; Acosta-Galvis, 2025; this study). The species' presence in Risaralda and Quindío has been debated. Acosta-Galvis (2000) previously reported *N. latens* in Quindío and Risaralda, and its distribution polygon (sensu IUCN, 2017b) suggests its presence in these departments. However, there is no associated information to support these records (i.e., locality, voucher, or photographs). Consequently, Gómez-Hoyos et al. (2017) did not include the species in their amphibian list for Quindío. In this context, our study provides the first formal records of *N. latens* for both departments.

Concerning distribution ranges, *N. adenobrachia* has an extent of occurrence of 2,213 km², while *N. latens* has an extent of occurrence of 6,764 km² (sensu IUCN, 2017a, b). Our new records expand these ranges to 1,258.46 km² and 8,952.03 km², respectively. However, according to IUCN (2012) criteria for the Endangered (EN) and Vulnerable (VU) categories, these expansions do not indicate potential changes in the conservation status of these species. It is also important to note that MCPs may include unsuitable habitats for the species, and further analyses are required to determine the actual Areas of Occupancy (AOO). In terms of conservation, all records were obtained in areas with varying degrees of environmental protection. However, those from the Reserva Wild Campo Alegre were located at the roadside (Fig. 1A), highlighting the need to assess potential impacts on population dynamics of both species. Although *N. latens*, *N. adenobrachia*, and *P. buckleyi* fall into different threat categories (IUCN, 2017a, b, 2023), they face similar anthropogenic pressures. *N. adenobrachia* and *N. latens* are categorized as EN and VU, respectively, due to habitat degradation as a consequence of deforestation, agricultural activities, livestock farming, and mining (IUCN, 2017a, b). Although *P. buckleyi* is categorized as Least Concern (LC) due to its wide distribution and tolerance of moderately disturbed habitats (e.g., crops), it is also exposed to similar threats (IUCN, 2023).

Additionally, our observations provide new data on the natural history of the species, documenting for the first time a defensive mechanism in *N. latens*, which is known as body inflation (Fig. 2E-F). This is the first record of this behavior within the genus *Niceforonia*. Body inflation has been reported in species of 30 anuran families (see Ferreira et al., 2019), and within Craugastoridae, it had been reported only for the genera *Pristimantis* and *Strabomantis* (Heatwole, 1962; Ferreira et al., 2019). This anti-predator strategy, which increases body size, is thought to reduce predation risks by deceiving predators, making ingestion or manipulation more difficult, or even intimidating potential predators (Toledo et al., 2011; Caro, 2014; Ferreira et al., 2019). Our findings highlight the need for further research on the distribution, ecology, and ethology of species with limited information, especially those threatened by habitat transformation. The implementation of long-term studies will allow us to understand their population dynamics and thus, design effective conservation strategies.

We report *Niceforonia latens* and *Pristimantis buckleyi* for the first time in the department of Quindío, as well as *N. latens* and *N. adenobrachia* in the department of Risaralda. These records extend the distribution ranges of the two *Niceforonia* species and fill gaps in the distribution of *P. buckleyi*. Additionally, our study enhances knowledge about the diversity and composition of amphibian communities in both departments, highlighting the importance of high-Andean ecosystems as biodiversity refuges. Further surveys of Colombian high-Andean forests, especially in underexplored areas such as the mountainous municipalities of the Quindío and the buffer zones of the Parque Nacional Natural Los Nevados in Risaralda, remain a priority. Furthermore, the documentation of body inflation in *N. latens* contributes to the

understanding of poorly studied natural history aspects of this genus, offering new perspectives for studying predator-prey interactions. Integrating ecological research with conservation strategies could ensure effective management of anuran diversity and the protection of their ecosystems.

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