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New records of four reptile species (Lepidosauria, Squamata) from the province of Guayas, southwestern Ecuador

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Abstract

We report the southernmost record of *Rhinobothryum bovallii* (Andersson, 1916) and new records and notes on the geographic distribution of *Anolis lyra* Poe, Velasco, Miyata & Williams, 2009, *Corallus blombergi* (Rendahl & Vestergren, 1941), and *Spilotes megalolepis* Günther, 1865, provided from specimens collected in the Cerro de Hayas forest, province of Guayas, southwestern Ecuador.

Keywords

Anolis, biogeography, *Corallus,* Lepidosauromorpha, Neotropics, *Rhinobothryum, Spilotes*.

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Introduction

Neotropical forests support the greatest number of living species in the world (Brown 2014; Andresen et al. 2018). The tropical forest of western Ecuador is home to more than 190 species of reptiles, representing 39% of the reptile species richness in the country (Reyes-Puig et al. 2017; Torres-Carvajal et al. 2020). Although our knowledge of the diversity and natural history of reptiles in western Ecuador is limited, important herpetological discoveries have been made in recent years, such as new species and significant expansion of the geographic range extensions of previously recorded species (e.g. Jadin et al. 2009; Cisneros-Heredia et al. 2010; Ortega-Andrade et al. 2010; Passos et al. 2012; Torres-Carvajal et al. 2012, 2015; Ayala-Varela et al. 2014; Yánez-Muñoz et al. 2014, 2018; Cisneros-Heredia and Romero 2015; Pyron et al. 2015; Salazar-Valenzuela et al. 2015; Cruz-García 2017; Cruz et al. 2017; Arteaga et al. 2017, 2018; Reyes-Puig et al. 2019).

The province of Guayas is a geopolitical division in western Ecuador and supports the largest human

population in the country (INEC 2018). It is in the Tumbes–Chocó–Magdalena biodiversity hotspot and has a varied environment and geography, producing different ecosystems, including moist forests, dry forests, mangroves, and coastal marine areas (Mittermeier et al. 2004, 2011; MAE 2012). Habitat change and loss due to anthropogenic activities, such as unsustainable agricultural practices, urban expansion, illegal or unsustainable natural resources extraction, have impacted over two-thirds of the province. Native vegetation in Guayas covers approximately 37% of its area, and most forest fragments are unprotected, except for a few private reserves (Camacho et al. 2011; Larrea et al 2015).

Despite these serious conservation issues, forest fragments in Guayas still harbor a diverse, poorly known and threatened fauna. We present new records of *Anolis lyra* Poe, Velasco, Miyata & Williams, 2009, *Rhinobothryum bovallii* (Andersson, 1916), and *Spilotes megalolepis* Günther, 1865, and extend these three species' geographical ranges to the western lowlands in southern Ecuador. A new record of the little-known and threatened Blomberg's Tree Boa, *Corallus blombergi* (Rendahl & Vestergren, 1941), is also documented.

Methods

Herpetological surveys were carried out in the Cerro de Hayas Provincial Natural Recreation Area, which is in the foothills of the Molleturo–Mollepungo mountain range, Naranjal county, province of Guayas, Ecuador. Cerro de Hayas is a private reserve protecting 3.78 km^2 of semideciduous lowland forests in hilly landscapes with streams and waterfalls. The reserve is surrounded by agricultural areas. It is one of the few tropical humid forest relicts remaining in Guayas and is currently threatened by mining, logging, and illegal hunting.

Fieldwork was conducted between December 2015 and March 2016, and in November 2019. Following Gallina and López-González (2011), three 150 m visual transects were established and sampled during day (11h00–14h00) and night (19h30–23h00) by two researchers each. The transects were separated from each other by 500 m and sampled in a period of one hour each. Transects were located in forest patches and crossed water bodies (including small waterfalls), hunter trails, and forest gaps. Specimens were captured by hand, photographed, euthanized with an anesthetic solution of 2% roxicain, fixed in 10% formalin, and preserved in 70% alcohol.

Specimens are deposited in two zoological museums in Ecuador: Museo de Zoología, Universidad del Azuay (MZUA; Cuenca) and Museo de Zoología, Universidad San Francisco de Quito (ZSFQ; Quito). The geographic coordinates and elevation data were obtained with a GPS unit Garmin GPSMAP 62st. Updated distribution maps were created for each species using QGIS v3.4 (QGIS Development Team 2019). The previous records and their references are summarized in Table 1.

Measurements of snout–vent length (SVL) were taken with digital calipers and rounded to the nearest 0.1 mm for small specimens, and with a tape measure for longer specimens. We followed measurement protocols specific for each species (Henderson et al. 2001; Poe et al. 2009; Pazmiño-Otamendi 2019; Rodríguez-Guerra 2019). Maturity and sex were determined by eversion and exposure of sexual organs.

Results

The records of *Anolis lyra*, *Rhinobothryum bovallii*, and *Spilotes megalolepis* from Cerro de Hayas are the first in the province of Guayas and in the Cordillera de la Costa, an isolated mountain range running parallel to the Andes along the coast of Ecuador. They also fill gaps in the distributions of these species across western Ecuador. The distribution range of *R. bovallii* is extended to the south. The new record of *Corallus blombergi* from Cerro de Hayas is important because of the scarcity of information available for this threatened species.

Squamata, Sauria, Dactyloidae

***Anolis lyra* Poe, Velasco, Miyata & Williams 2009**
Figures 1a, 2a; Table 1

New records. ECUADOR • 1 adult female, SVL 76 mm; Guayas, Naranjal, Molleturo-Mollepungo mountain, Cerro de Hayas Provincial Natural Recreation; −02.7308, −079.6286; alt. 120 m; 13 March 2016; Keyko Cruz-García leg.; at night on tree leaves 3–4 m above ground level; MZUA.Re0387 • 1 adult female, SVL 64 mm; same data as above, except: MZUA.Re0388 • 1 adult female, SVL 62 mm; same data as above, except: in daytime on a tree trunk next to a stream while displaying to another individual 5 m above it; MZUA.Re0391.

Identification. *Anolis lyra* (Fig. 2a) is distinguished from other South American *Anolis* species by the combination of the following characters: dewlap blue-white in females and red in males, small and with a large black central mark; lyre-shaped occipital mark. It is distinguished from the similar *A. vittigerus* Cope, 1862, by having smaller dorsomedial scales; semicircular scales between supraorbitals (absent in *A. vittigerus*); = 4.1 scales between interparietal and supraorbital semicircles (= 2.4 in *A. vittigerus*); lateral stripes extending to axilla (to thigh in *A. vittigerus*); and a conspicuous lyre-shaped mark (absent or faint in *A. vittigerus*) (Poe et al. 2009).

Remarks. A fourth individual, which was not collected, was observed on a tree trunk during the day. *Anolis lyra* has been reported from the western slopes of the Cordillera Occidental from Colombia to extreme southwestern Ecuador (Poe et al. 2009; Yánez-Muñoz et al. 2014). Cerro de Hayas is 54 km north of the southernmost known record of *A. lyra* (Cascadas de Manuel, province of El Oro; Yánez-Muñoz et al. 2014) and 240 km south of

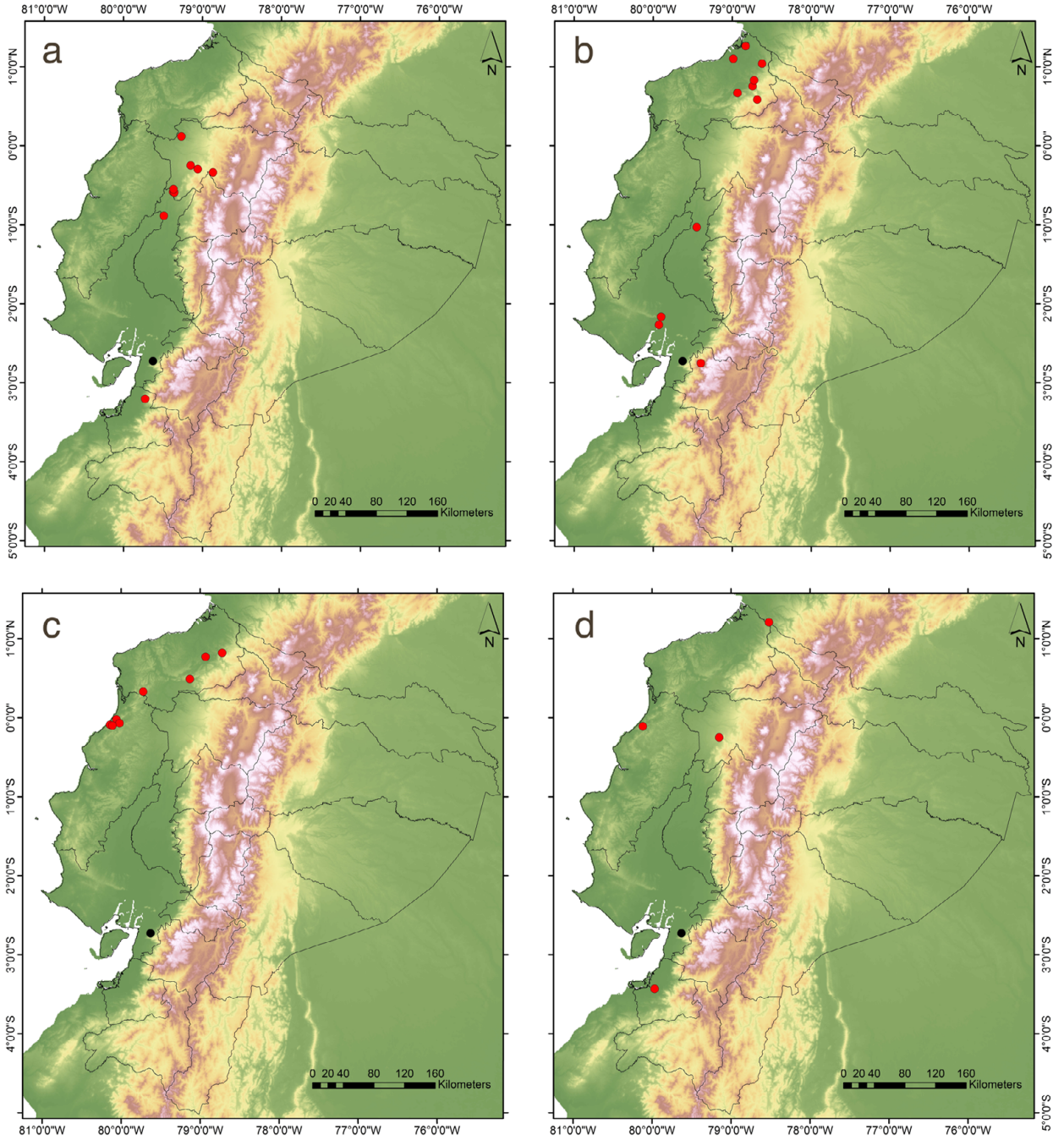

Figure 1. Geographic distribution of species in Ecuador. Red circles indicate the previously published records. Black circles indicate the new records. **a.** *Anolis lyra*. **b.** *Corallus blombergi*. **c.** *Rhinobothryum bovallii*. **d.** *Spilotes megalolepis*.

the nearest locality to the north (Río Palenque, province of Los Ríos; Poe et al. 2009).

Squamata, Serpentes, Boidae

***Corallus blombergi* (Rendahl & Vestergren, 1941)**
Figures 1b, 2b; Table 1

New record. ECUADOR • 1 subadult male, SVL 466 mm; Guayas, Naranjal, Molleturo-Mullepungo mountain, Cerro de Hayas Provincial Natural Recreation; −02.7316, −079.6319; alt: 138 m; 10 June 2016 at 22h32; Keyko Cruz-García leg.; at night moving 6 m above forest floor, among branches of a *Ficus citrifolia* tree, next to a stream; MZUA.Re0383.

Identification. *Corallus blombergi* (Fig. 2b) is distinguished from *Boa imperator* Daudin, 1803, the only other boid in its distribution range, by the following combination of characters: absence of nasals in contact; subcaudal scales 76–86 (47–69 in *B. imperator*); rows of dorsal scales 50–55 (56–79 in *B. imperator*); ventral scales 251–269 (225–253 in *B. imperator*); dorsum dusky red with round red spots with dark gray margins along the body, not contacting ventral scales (gray body with large spots in *B. imperator*); venter orange; eyes red; snout with thermoreceptive furrows in the corners of the lips (absent in *B. imperator*); anal plate divided (Henderson et al. 2001; Rodríguez-Guerra 2019).

Remarks. *Corallus blombergi* inhabits the Pacific

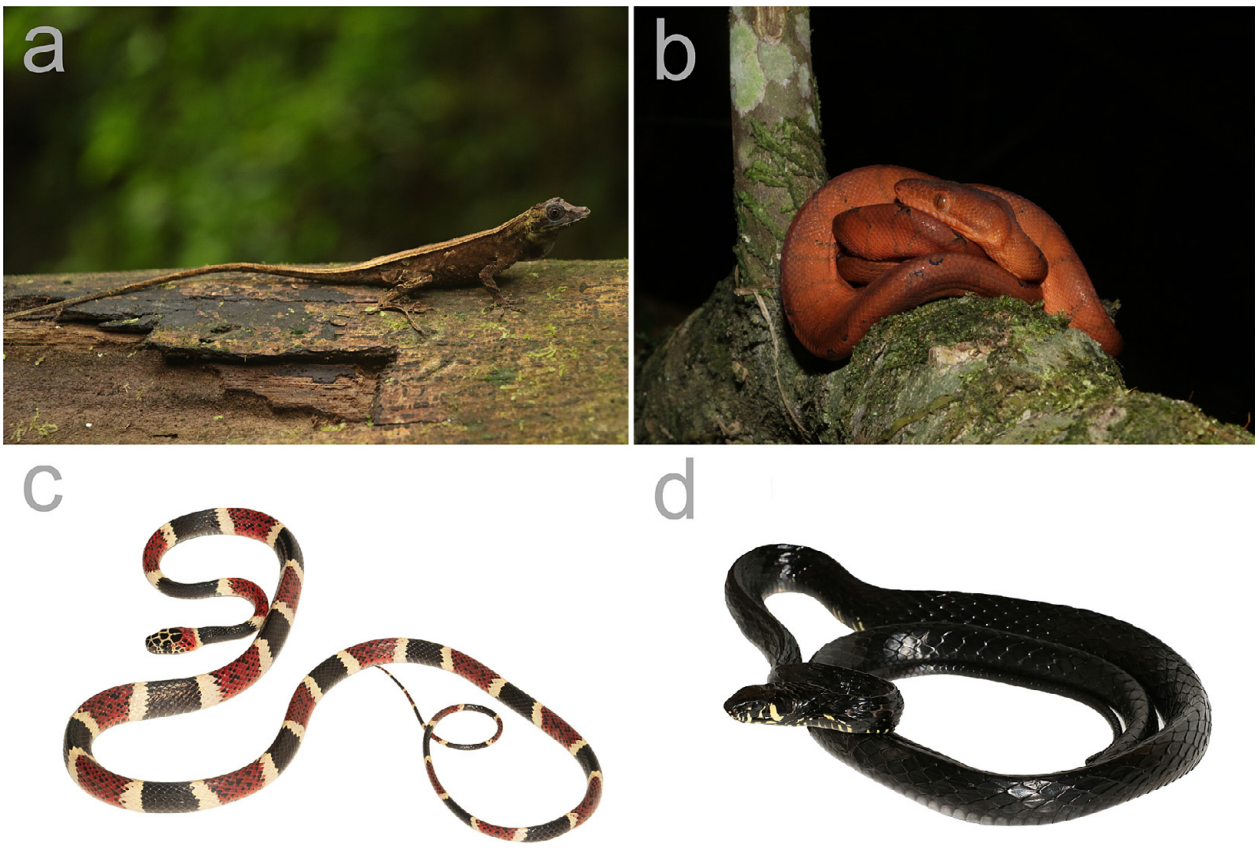

Figure 2. Specimens collected in Cerro de Hayas (Naranjal), Guayas, Ecuador. **a.** *Anolis lyra* ♂ adult (MZUA.Re0387). **b.** *Corallus blombergi* ♂ subadult (MZUA.Re0383). **c.** *Rhinobothryum bovallii* ♂ adult (ZSFQ 4081). **d.** adult *Spilotes megalolepis* ♂ (MZUA.Re0378).

lowlands from southwestern Colombia to central-western Ecuador (Pérez-Santos and Moreno 1991; Henderson 1997; Henderson et al. 2001; Valencia et al. 2008; Pinto-Erazo and Media-Rangel 2018). The species was previously known in Guayas, but we consider it important to report this record due to the limited information available for this species, which is classified as Endangered by the International Union for Conservation of Nature (IUCN) Red List of Threatened Species (Pérez-Santos and Moreno 1991; Henderson 1997; Henderson et al. 2001; Cisneros-Heredia 2016). Our record is 26 km west of the southernmost record of the species in Molleturo–Mollopungo Protected forest, province of Azuay.

Squamata, Serpentes, Colubridae

***Rhinobothryum bovallii* (Andersson, 1916)**
Figure 1c, 2c; Table 1

New record. ECUADOR • 1 adult male, SVL 1170 mm; Guayas, Naranjal, Molleturo-Mollepungo mountain, Cerro de Hayas Provincial Natural Recreation; −02.7308, −079.6286, alt. 110 m; 02 November 2019 at 20h25; Keyko Cruz-García leg.; at night moving on the ground next to a secondary road, near a creek; ZSFQ 4081.

Identification. *Rhinobothryum bovallii* (Fig. 2c) differs from similar snakes within its distribution range of distribution, such as *Dipsas gracilis* (Boulenger, 1902), and from its congener *R. lentiginosum* (Scopoli, 1875), by the combination of the following characters: upper scales of head black with white borders (head completely black or black scattered with reddish brown in *D. gracilis*); body pattern with black, white and large red bands, the red bands with scattered black scales (small red bands in *R. lentiginosum*); dorsal scales in 21 rows, smooth anteriorly but becoming keeled posteriorly (Peters 1960; Touzet and Cisneros-Heredia 1998; Harvey 2008; Pazmiño-Otamendi 2019).

Remarks. This species has been reported in Ecuador in the provinces of Esmeraldas, Manabí, Carchi and Imbabura (Pérez-Santos and Moreno 1991; Touzet and Cisneros-Heredia 1998; Ortega-Andrade et al. 2010; Arredondo et al. 2017; Pazmiño-Otamendi 2019). Our record is the southernmost record of *R. bovallii*, 294 km south of the nearest record of the species (Reserva Ecológica Jama-Coaque, province of Manabí; Lynch et al. 2016).

***Spilotes megalolepis* Günther, 1865**
Figures 1d, 2d; Table 1

New record. ECUADOR • 1 adult male, SVL 1813 mm; Guayas, Naranjal, Molleturo-Mollepungo mountain, Cerro de Hayas Provincial Natural Recreation; −02.7339, −079.6290; alt. 250 m; 23 February 2016 at 11h31; Keyko Cruz-García leg.; in daytime moving among the leaf litter, approximately 10 m above the waterfall plunge pool; MZUA.Re0378.

Table 1. List of historical localities in Ecuador of the reptile species reported in this work.

Species	Province	Locality	Latitude	Longitude	Elevation (m)	Museum number	References
Anolis lyra	Pichincha	Puerto Quito	00.117	−079.267	750	MCZ 164416, 165209, 165210, 171160	Poe et al. 2009
Anolis lyra	Santo Domingo de los Tsáchilas	Finca La Victoria	00.338	−078.868		MCZ 80954	Poe et al. 2009
Anolis lyra	Santo Domingo de los Tsáchilas	Sto. Domingo de los Tsachilas (City)	−00.250	−079.150		MCZ 164421, 164420, 124407	Poe et al. 2009
Anolis lyra	Santo Domingo de los Tsáchilas	Hotel Tinalandia	−00.296	−079.060		MCZ 152434, 145267, 145263	Poe et al. 2009
Anolis lyra	Los Ríos	Los Ríos	−00.585	−079.372		MCZ 146995	Poe et al. 2009
Anolis lyra	Los Ríos	Buena Fe	−00.888	−079.489		MCZ 146994	Poe et al. 2009
Anolis lyra	Los Ríos	Centro Científico Río Palenque	−00.550	−079.367	1179	MCZ 152433, 145867	Poe et al. 2009
Anolis lyra	El Oro	Cascadas de Manuel	−03.206	−079.726	197	DHMECN 10983	Yánez-Muñoz et al. 2014
Corallus blombergii	Azuay	Molleturo Mullopungo	−02.754	−079.397	256	UDA-AMARU 0019	Valencia et al. 2008.
Corallus blombergii	"Ecuador"	"Ecuador"				AMNH 61754	Henderson et al. 2001
Corallus blombergii	Los Ríos	Quevedo	−01.033	−079.450		USNM 204087	Henderson et al. 2001
Corallus blombergii	Esmeraldas	Norte de Borbón	01.260	−078.830		QCAZR6401	Rodríguez-Guerra 2019
Corallus blombergii	Esmeraldas	Cotacachi Cayapas	00.583	−078.683		QCAZR10713	Rodríguez-Guerra 2019
Corallus blombergii	Esmeraldas	Río Bravo	00.667	−078.933		FHG01074	Valencia et al. 2008.
Rhinobothryum bovallii	Esmeraldas	Río Bogotá	01.047	−078.837			Touzet and Cisneros-Heredia 1998
Rhinobothryum bovallii	Esmeraldas	Zapallo Grande	00.77	−078.93		QCAZR1595	Wallach et al. 2014; Pazmiño-Otamendi, 2019;
Rhinobothryum bovallii	Esmeraldas	Zona Baja de Reserva Ecológica Cotacachi Cayapas	00.82	−078.72		QCAZR10703	Wallach et al. 2014; Pazmiño-Otamendi 2019
Rhinobothryum bovallii	Esmeraldas	Reserva Tesoro Escondido	00.49	−079.13	675	QCAZR15012	Wallach et al. 2014; Pazmiño-Otamendi 2019
Rhinobothryum bovallii	Esmeraldas	Reserva Ecológica Mache-Chindul	00.33	−079.72	427	QCAZR16951	Wallach et al. 2014; Pazmiño-Otamendi 2019
Rhinobothryum bovallii	Manabí	Río Cuaque	−00.02	−080.06		QCAZR8962	Wallach et al. 2014; Pazmiño-Otamendi 2019
Rhinobothryum bovallii	Manabí	Reserva Ecológica Jama Coaque	−00.09	−080.14		QCAZR4652	Wallach et al. 2014; Pazmiño-Otamendi 2019
Rhinobothryum bovallii	Manabí	Reserva Ecológica Jama Coaque	−00.10	−080.11	392	QCAZR5889	Lynch et al. 2014; Wallach et al. 2014; Pazmiño-Otamendi 2019
Rhinobothryum bovallii	Manabí	A 15 km de Pedernales, en la vía a Jama	−00.07	−080.02	36	QCAZR5757	Wallach et al. 2014; Pazmiño-Otamendi 2019
Spilotes megalolepis	Esmeraldas	Río Mira	01.208	−078.519		EPN 001305	Orcés and Almendáriz 1989
Spilotes megalolepis	Santo Domingo de los Tsáchilas	Santo Domingo de los Colorados	−00.250	−079.150	500	EPN 001300	Orcés and Almendáriz 1989
Spilotes megalolepis	El Oro	Santa Rosa	−03.433	−079.967	100	EPN 001302	Orcés and Almendáriz 1989
Spilotes megalolepis	Manabí	Reserva Ecológica Jama Coaque	−00.109	−080.117	408	QCAZR11430	Guerra-Correa, E 2019.

Identification. We follow Orcés and Almendariz (1989) in considering *S. megalolepis* (Fig. 2d) as a valid taxon. The specimen reported herein differs from similar snakes within its estimated range of distribution, such as *Clelia equatoriana* (Amaral, 1924), by having a metallic black body (brownish black in *C. equatoriana*); body robust and laterally compressed (not laterally compressed in *C. equatoriana*); head well-differentiated from neck, with yellow marks on supra and infralabials; and tail moderately long, 24–27% of total length (medium or short in *C. equatoriana*). The melanistic color differs from other *Spilotes* species, such as *S. pullatus* (Linnaeus, 1758), by its darker coloration, with small yellow markings anteriorly, absent on the posterior third of the body. Since very little pholidosis data are available for the species, we report herein the scale counts of MZUA.Re0378: postocular 1; supralabials 8, fourth and fifth in contact with the eye; infralabials 8; dorsal scales large, except paraventral rows; and dorsal scales at midbody in 14 rows.

Remarks. Another individual was observed in a paddock area, foraging in the undergrowth, but was not collected. Both individuals were near secondary trails used by tourists. *Spilotes megalolepis* is a little known species, currently reported on the western lowlands of Ecuador, in the provinces of Esmeraldas, Imbabura, Pichincha, Santo Domingo de los Tsáchilas, and El Oro (Boulenger 1898; Orcés and Almendáriz 1989; Yánez-Muñoz et al. 2009; Ortega-Andrade et al. 2010; Guerra-Correa 2019). Cerro de Hayas is 99 km north of the southernmost known record of the species (Santa Rosa, province of El Oro), and 220 km south of the nearest locality to the north (Río Palenque, province of Los Ríos) (Guerra-Correa 2019).

Discussion

Eighty-four species of reptiles have been previously reported in the province of Guayas (Almendáriz and Carr 1992; Cornejo 2015; Cruz et al. 2017; Torres-Carvajal et al. 2019). Records presented herein reinforce the

probability that there are still several unreported species of reptiles in Guayas, remaining in small relicts of native vegetation.

We add three additional reptile species to the list of the province of Guayas, including one specimen of *Corallus blombergi,* categorized as Endangered by IUCN (Cisneros-Heredia 2016). The conservation status of *Anolis lyra* and *Spilotes megalolepis* have not been evaluated. *Rhinobothryum bovallii* has been categorized as Least Concern (Arredondo et al. 2017) because of its large range, but it is necessary to study threats that may affect local populations. These records show the importance of improving our understanding on the distribution patterns of poorly known species. Recently, *C. blombergi* and *R. bovallii* were recorded from Colombia (Pinto-Erazo and Media-Rangel 2018) and Nicaragua (Martínez-Fonseca et al. 2019), respectively.

All four species reported in this study were found in a small private protected area, with small remnants of native riparian vegetation along streams and waterfalls, showing the importance of in-situ private initiatives for the conservation of ecosystems that are highly threatened by anthropogenic activities.

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Authors' Contributions

KCG collected and prepared specimens, took photos, wrote and revised the manuscript; DFCH identified specimens, wrote and revised the manuscript; JCS prepared and identified specimens, wrote and revised the manuscript, prepared the maps; LA wrote and revised the manuscript, prepared figures and table. All authors approved the final version of the manuscript.

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